SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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FRIDAY, JULY 5, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ACADEMIC FREEDOM[1]

MY subject is academic freedom, a difficult subject, not as yet very well understood in this country, but likely to be of increasing interest and importance throughout the coming century. I have divided my essay into three parts: the first dealing with academic freedom for teachers; the second with academic freedom for students; and the third with university administration as a type of free government in general.

ACADEMIC FREEDOM FOR TEACHERS

In a democracy, and in the political and social organizations to which democracy takes kindly, there are some new difficulties in regard to academic freedom for teachers. The principal new difficulty is the pressure in a democracy of a concentrated multitudinous public opinion. The great majority of the people in a given community may hold passionately to some dogma in religion, some economic doctrine, or some political or social opinion or practise, and may resent strongly the expression by a public teacher of religious, economic, political, or social views unlike those held by the majority. In parts of our country at this moment liberty of thought and speech on certain topics is, to say the least, imperfect for men who do not coincide with the prevailing opinions and sentiments of the community in which they dwell. Even in colleges and universities in those parts a teacher holding unpopular opinions could,

[1] Address before the Cornell Phi Beta Kappa.

until very recently, hardly escape the alternative of silence or banishment. The teaching of history in schools and colleges is watched with great suspicion by different parties in church and state, lest some unwelcome lessons of present application be drawn from the history of the past. Professors of economics are not even supposed to be free in some American communities which have held for generations with great unanimity the doctrine of protection. The endowed institutions are by no means exempt from this strong pressure of public opinion; for they are sensitive to threats that the stream of gifts on which they depend will be cut off. This multitudinous tyrannical opinion is even more formidable to one who offends it than the despotic will of a single tyrant or small group of tyrants. It affects the imagination more, because it seems omnipresent, merciless, and irresponsible; and therefore resistance to it requires a rare kind of moral courage. For this difficulty there is no remedy except the liberalizing of the common people, or at least of the educated class. To be sure, there is another mode of preventing free teaching on dangerous subjects, which is quite as effective as persecution and much quieter, namely, the omission of all teaching on those subjects, and the elimination of reading matter bearing on them. Thus the supreme subject of theology has been banished from the state universities, and from many of the endowed universities; and in some parts of the country the suppression of Bible-reading and prayer at the opening exercises of the schools, in deference to Roman Catholic objections, has resulted in the children's getting no direct ethical instruction whatsoever. A comical illustration of this control by omission is the recent suggestion that Shakespeare's "Merchant of Venice" ought not to be read in any school where there are Jewish children, because it contains an unamiable and inaccurate representation of the character of a Jewish money lender.

A long tenure of office for teachers is wellnigh indispensable, if a just academic freedom is to be secured for them. In the absence of laws providing for it, this long tenure, after suitable periods of probation, is only to be secured in this country through the voluntary, habitual action of school committees and boards of trustees. In this respect, great improvements have been made all over the country through the reforms in the structure or composition of the committees which govern the free schools and of the boards of trustees for institutions of higher education; but much still remains to be done. So long as school committees insist on annual elections of all teachers, and boards of trustees of colleges and universities claim the right to dismiss at pleasure all the officers of the institutions in their charge, there will be no security for the teachers' proper freedom. We have, however, learned what the proper tenure for a teacher is. Teachers in every grade of public instruction from the lowest to the highest, when once their capacity and character have been demonstrated, should hold their offices without express limitation of time, and should be subject to removal only for inadequate performance of duty or for misconduct publicly proved. To procure this tenure for teachers, wherever it does not now obtain, should be the special care of all persons who believe that education is the prime interest of the commonwealth, and that teachers should enjoy perfect liberty within the limits of courtesy and of a "decent respect for the opinions of mankind."

In the institutions of higher education the board of trustees is the body on whose discretion, good feeling, and experience the securing of academic freedom now depends.

There are boards which leave nothing to be desired in these respects; but there are also numerous boards that have everything to learn with regard to academic freedom. These barbarous boards exercise an arbitrary power of dismissal. They exclude from the teachings of the university unpopular or dangerous subjects. In some states they even treat professors' positions as common political spoils; and all too frequently, both in state and endowed institutions, they fail to treat the members of the teaching staff with that high consideration to which their functions entitle them. In the newer parts of our country, it has of course been impossible to find at short notice men really prepared to discharge the difficult duties of educational trusteeship; and it will take generations yet to bring these communities in this respect up to the level of the older states and cities which have had for generations abundant excellent material for such boards of trustees.

In the institutions of higher education there is usually found an organized body of the permanent teachers called a faculty. This body exercises customary powers delegated to it by the board of trustees; and its determinations are ordinarily made by a majority vote after more or less discussion. It deals with questions of general policy affecting both teachers and students, and its votes may sometimes limit the freedom of its own members. Such restrictions, however, as proceed from a faculty are not likely to be really oppressive on individuals; for every voter in a faculty is likely to remember that he himself may hereafter be unpleasantly affected by the same kind of majority vote which he is thinking of taking part in against a resisting colleague.

As a rule, the faculty of a college, professional school, or university is the real source of educational policy and progress,—so much so, that the vitality of any institution may best be measured by the activity and esprit de corps of its faculty. Is the faculty alert, progressive, and public-spirited, the institution will be active and increasingly serviceable; is the faculty sluggish, uninterested, and without cohesion, the institution will probably be dull or even retrograde. If a faculty chooses, it can really limit academic freedom; but it is not likely to do so, because its members will not deny to others the freedom they desire for themselves, unless, indeed, on rare occasions, and for short periods. A faculty is much more likely to limit unduly the academic freedom of students than of teachers; and yet, even in this field, it is harder and harder for a lively and enterprising faculty, representing any adequate variety of university subjects, to restrict the just freedom of students.

Interference with the academic freedom of an individual professor is in these days more likely to come from his colleagues in the same department than from the faculty as a whole. Of course in those institutions which maintain only a single teacher for each subject, there is no competition among teachers of the same subject, and no departmental organization which may become formidable to the individual teacher; but many of our colleges and universities have now got beyond that elementary stage, and have considerable groups of teachers working on one subject, as, for instance, the classics, the modern languages, the mathematics, history, government, economics, philosophy, the physical sciences and the biological sciences. These groups of teachers, whatever called—divisions, departments, or schools—have lately acquired in some American universities very real powers, and among these powers is partial control over the teaching of the individual teachers within each group. The senior professor of the group sometimes has a formidable amount of restrictive power. This danger to liberty is diminished in some institutions by disregarding seniority in selecting the chairmen of departments or divisions, and making frequent changes of chairmen in those departments which have many members. The points at which danger to freedom exists are: first, the assignment of subjects to the younger members of the department; secondly, the direct access of advanced students to all members of the department; and thirdly, the exchange of subjects year by year among the various members, old and young. At any one of these points it is easy for a department to become despotic, particularly if there be one dominant personage in it. The exercise of power by a division, department, or school should therefore be carefully watched by the president, the dean of the faculty, or some committee of the faculty; so that the just liberty of all members of the department may not be invaded.

The prodigious stream of benefactions to institutions of education in the United States, which has now been flowing in increasing volume ever since the Civil War, has brought upon the endowed institutions a new risk in regard to academic freedom. So far as state institutions are also in a measure endowed, as is the case with the University of California, the same new risk is incurred by them. The risk is all the greater because the living benefactor plays in these days a part even more important than that of the dead benefactor. Ought the opinions and wishes of a living benefactor to influence the teaching in the institution which he endows? In general, the answer must be in the negative; because teaching which is not believed to be free is well-nigh worthless. It inevitably loses its intended effect on those who listen to it. It has no effect even on those who agree with, or are pleased with, its general tenor. Nevertheless, benefactors have certain rights in this respect. They may fairly claim that their benefactions entitle their opinions and sentiments to be treated with consideration and respect, and not with contumely or scorn, in the institutions they have endowed, or by the professors whom their gifts support. If their benefactions are for general uses and not for the support of any specific courses of instruction, they may fairly claim that subjects likely to be taught in a manner repulsive to them should be omitted altogether, unless some serious public obligation requires the institution to include them. The mere lapse of time will probably free an endowed institution from embarrassments of this nature, not chiefly because the living benefactor will die, but because the burning questions change so frequently with the rapid progress of society. Thus, the choice between Calvinism and Channingism was a burning question seventy years ago, but now few people take keen interest in it. In like manner, a few years ago academic freedom was seriously impaired during the discussion about the relations of gold and silver to a stable currency; but now all heat has gone out of that controversy. For two generations protection and free trade have been hot subjects; but in a few years they will be stone cold, because the practise miscalled protection will have become inapplicable to American industrial conditions, and, indeed, manifestly injurious to both manufactures and commerce. Any slight interference with academic freedom which time will certainly cure may be endured with equanimity for a season, in consideration of great counter-balancing advantages.

There is another university authority who can, if he choose, put limits to academic freedom for a time—the president.

The president of moderately long service has probably been concerned with the selection and actual appointment of a large majority of the teaching staff in his institution. He has also probably had to do with the step-by-step promotion of nearly everybody connected with the institution. For these reasons his wishes may have undue weight with the individual professor who desires to make changes in his subjects or methods of instruction. Some presidents are, therefore, careful how they bring any restrictive pressure to bear on teachers; but others are careless in this respect, or deliberately attempt to control the nature or quality of the instruction given by individual teachers, particularly in what they regard as critical or dangerous subjects. In American institutions few presidents possess dangerous constitutional or charter powers in this respect, and none should exercise such powers. A president may of course remonstrate with a professor who seems to him to be exceeding the just limits of academic freedom, and he may properly give distinct advice when consulted beforehand by any member of his staff on a question relating to academic freedom; but he should never attempt to impose his judgment or his will on a teacher.

The real liberty of a teacher to teach as he wishes to may be closely limited by the customs or habitual usages of the institution with which he is connected, even more than by the direct action of the constituted authorities. Every earnest and progressive teacher desires to be freed, as much as possible, from routine details which admit of little variety, and have ceased to be instructive or otherwise beneficial to himself. If his habitual duties involve much work of this character, his own rate of progress in knowledge and efficiency will be checked, and his enthusiasm may be chilled as the years go on. Routine is an enemy to progress, and to real mental liberty. Again, in every teacher's life there is apt to be a large element of year-by-year repetition. Year after year he reads the same authors with his classes, or he deals with the same subjects in his laboratory teaching, and even with the same materials for illustrating his subjects. He may be held to an unreasonable degree of repetition by the faculty, by his department, or by two or three colleagues who refuse to exchange with him. As years go on, it is easier for him to follow a routine, or to use again his manuscript notes grown yellow and brittle with age, than to change his habits, or to venture into comparatively new fields. Routine and repetition have done their work. They have limited his freedom, and therefore his growth. In all teaching, at whatever grades, there must be elements of routine and repetition, but excess of these indispensable elements is to be guarded against in every possible way, both by the teacher himself and by the authorities to whom he is responsible; for the teacher's efficiency depends primarily on the maintenance of his vitality and enthusiasm.

The prudent teacher in school, college, or university will keep a sharp lookout on two other risks to which American teachers are exposed; they will beware of doing too much teaching and of undertaking too much administrative work. The teacher for life absolutely needs to reserve time and strength for continuous acquisition and development on his own part. He must not be always giving out information and influence. He must have time to absorb, to feed his own growing powers, and to rekindle his own enthusiasms at the great lamps of literature and science. The university teacher ought to keep time and strength to contribute a little to the advancement of his own subject. This he can not do if teaching or administration, or both, take up all his time or all his energy. He should therefore aim at regulating his academic life in such a way that these higher purposes may be fulfilled; and this good end in each individual case should be furthered by every academic authority and influence. These are some of the subtler elements in a well-composed academic freedom.

Professors and other teachers, who should be always teaching or making researches, need to be relatively free from pecuniary cares; so that their minds may run on their work. To this end they should have fixed salaries, and retiring allowances; so that they may adjust their scale of living to their earnings, and not have to think about making money, or to feel anxiety about disability or old age. This detachment from ordinary pecuniary or livelihood anxieties is an important element in their mental freedom, and for the right kind of person a strong inducement to the profession. The teacher ought always to be a person disposed to idealism and altruism; and he should have abandoned once for all the thought of measuring his success by the size of his income.

In the best managed universities, colleges, and school systems a teacher is always free to accept promotion in another institution or school system, although in most cases he may properly consider himself bound to finish, where he is, an academic year begun. It is inconvenient for the institution which the promoted teacher leaves to lose him; but in the long run institutions which are liberal and cordial in such dealings will have a better staff than they would have if they tried to hold their successful teachers to long contracts against the will and to the disadvantage of those teachers. This feature of academic freedom has far-reaching good effects on the profession and the nation, as appears conspicuously in the educational history of Germany, and the present condition of the leading educational institutions in the United States.

Finally, academic freedom for teachers is properly subject to certain limitations which may best be described as those of courtesy and honor. They resemble the limitations which the manners of a gentleman or a lady impose on personal freedom in social intercourse. The teacher in a school, or the professor in a college or university, may properly abstain from saying or doing many things which he would be free to say or do if it were not for his official position. He may properly feel that his words and acts must inevitably have an effect on the reputation and influence of the institution with which he is connected. This sentiment undoubtedly qualifies or limits the freedom he would otherwise exercise and enjoy. Many a professor in this country has felt acutely that he was not entirely free to publish in journals or books just what he thought on controversial subjects, if he put in connection with his signature his official title as professor. Doubtless some difficult cases of this sort arise in which the reputation of an institution is unfavorably affected temporarily by the publications, or public speeches of one or more of its officers; but no satisfactory defense against this kind of injury has yet been invented, since the suppression of such publications does infinitely more harm to the general cause of education than it can do good to the institution concerned. Most learned societies declare in some conspicuous place within their customary publications that the society is in no way responsible for the opinions or conclusions of the individual contributors; but it is hardly practicable, even if it were desirable, for a university, college, theological seminary or school of technology to put a like declaration on all the publications made by their officers. The only satisfactory defense of the institutions against the risks under consideration is to be found in the considerateness and courtesy of the teachers concerned, and in their sense of obligation to the institutions with which they are connected, and of the added weight which their official position gives to their personal opinions.

When I was first president of Harvard College I got a lesson on this subject from one of the most respected of the Harvard professors of that day. He had recently made to the American Academy of Arts and Sciences a communication which dealt in a novel way with one particular aspect of the financial credit of the United States; and this communication had been warmly attacked by several of his fellows in the Academy, including some influential Boston business men. He was in the act, however, of issuing a manual for schools and colleges, in which he had incorporated the questionable doctrine, and on the title page of this book he had put under his name his professorial title in Harvard University. As the time approached for publishing the volume—the plates of which he owned—his mind misgave him with regard to the propriety of proclaiming this unusual and controverted doctrine in his capacity as professor in Harvard University, and he therefore asked me, as President, what the president and fellows of Harvard College would think on that point. I was obliged to tell him that the president and fellows would prefer to have that doctrine omitted from the book, unless, indeed, he were willing to omit from the title page his own official title as a Harvard professor. The result was that the troublesome chapter was omitted; but the professor lost all interest in his entire manual, and insisted on selling the plates to his publisher, and foregoing his royalty on the sales of the book. The incident taught me that the best defense of an institution against abuses of academic freedom was to be found in the sense of duty and honor which obtains among its officers.

FREEDOM FOR STUDENTS

The college student coming from a good secondary school has probably had some small amount of choice among the subjects provided at his school towards admission to college. He may arrive at his college with more Latin and Greek and less modern languages, or the reverse. He may offer himself in several sciences or in not more than one. His choice in this respect may have been closely limited, and yet not without serious effects on his subsequent career. When he reaches his college, normally at eighteen or nineteen years of age, he ought to find at once a great enlargement of his freedom of choice among studies. This is for the student the first element in a just academic freedom. By close attention to his own individual problem, and to his own antecedents, and with a little assistance from an expert in the list of courses and the schedule of hours, he will have no difficulty in finding the courses most suitable for himself. In the freest elective system there are plain fences marking out the feasible tracks. These fences are in most cases the natural and inevitable sequences of the courses offered in the several subjects of instruction. A few may be arbitrary and artificial, such restrictions being probably the results of inadequate resources in the college itself, or of some policy inconsistent with its general regime of liberty. The choice of studies made in any individual case may be very wisely modified, or fundamentally changed, by the student's choice of teachers. This choice among teachers is a very valuable element in academic freedom for the student. The newcomer at a college may not possess the information needed to enable him to exercise this freedom; but during the first half-year or quarter of residence most students can acquire sufficient information about the different teachers of the subjects which interest them to enable them to exercise discreetly this freedom of choice among teachers. Having found his best teacher, the student ought to find himself free to follow him for several years. Unfortunately faculties are more likely to interfere with this particular liberty than with any other, as for instance by enacting that philosophy, or economics, or political science shall not be accessible to any student before the sophomore year.

Under a broad elective system in the arts and sciences the students will always make many choices of single courses which interest them, or look to them profitable; but there will also be a great variety of voluntary groupings of courses, and the liberty to make an appropriate grouping is a very important part of academic freedom for the student. Such groupings are often determined by the student's foreknowledge of his professional career, or if this knowledge is lacking, by his own selection of kindred subjects, all of which commend themselves to his taste or his judgment. This liberty to make groupings, each one for himself, is another important element in a just academic freedom. Almost all students who decide on their profession early in their college course make groupings which will further them in their professional career, and in their preparation therefor, and for the student there is no safer principle of selection among appropriate college subjects. A student who lacks this clear guidance may most safely depend for guidance in the choice of his studies on the tastes and capacities of which he is conscious. Among the multitude of culture courses which a large college offers, the safest selection for the individual student is that of courses in which he has the capacity to achieve something considerable. Interest in a subject is an indication of fitness for its study, or, in other words, a student is much more likely to succeed in a subject which interests him strongly than in a subject which does not. Achievement and gain in power are the true rewards of persistent exertion, and the best spurs to further effort. The college student ought to be free to specialize early in his course, or not to specialize at all; to make his education turn on languages, mathematics, history, science or philosophy—for example—or on any mixture of these great subjects.

The college student may reasonably expect to find himself free from attempts to impose opinions on him. These attempts may be made by his teachers, or by intimate comrades, or by groups of companions and friends, or by mass meetings. He has a right in these days to be free from the imposition of opinions, whether attempted by elders or associates, by one individual or a multitude. He has also a right to be free from all inducements to cant, hypocrisy, or conformity. On this account, voluntary attendance at all religious exercises is a valuable element in academic freedom. No student ought to be able to suppose that he will gain anything towards high rank as a scholar, or social standing, or popularity among his fellows by any religious observance or affiliation whatsoever. A mercenary or profit-seeking spirit in religious practices is very injurious to young people, and is peculiarly repulsive in them.

The student who needs pecuniary aid in college, or desires employment in which he can partly earn his livelihood, ought to find an absolutely free competition for such assistance on merit only, without regard to any opinions or practices of his. It is highly desirable that college students should be free from care for their livelihood during the whole period of education, accepting support from their parents or other loving friends. To give this support is the precious privilege of parents, to accept it the precious privilege of children. Nevertheless, it is one of the best results of democracy that young men of capacity and character find it possible to obtain a prolonged education for the professions or for business, although they are obliged to support themselves wholly or in part during the long period of strenuous study. Endowments, the bounty of the state, or the facilities for obtaining appropriate employment which colleges now provide, procure this freedom for thousands of young Americans every year. The young men thus aided to attain a larger and freer career should invariably feel bound in after life to pass on and amplify the privilege they enjoyed.

Finally, the student ought to find himself free to determine the method of his daily life with no more restrictions than the habits and customs of civilized society necessarily impose. His problem will be to regulate his own life wisely by self-control in liberty. Up to his entrance to college his mode of life has probably been regulated for him by home rules, or school rules; and he has been almost constantly under the observation of parents or teachers, or both. Now, at college, he should be free. He will probably make some mistakes, at first, about eating and drinking, sleeping, taking exercise, arranging his hours for work and for play, and using his time; but his mistakes will not be fatal or beyond remedy, and he will form habits based on his own observation and experience and his own volitions. These are the habits that prove trustworthy in adult life. As in the outer world, so in the comparatively sheltered college world, freedom is dangerous for the infirm of purpose and destructive for the vicious; but it is the only atmosphere in which the well-disposed and resolute can develop their strength. Under any college regime, whether liberal or authoritative, a very valuable though dangerous part of the student's freedom is his freedom to choose his comrades, or habitual associates. That choice will show in every individual case whether the young man possesses moral principle and firmness of character or not. If the choice is good, he will be safe in liberty; if the choice is bad, he will be unsafe under any regime. The student ought to choose his own comrades deliberately, and after some study of the accessible variety of associates. To be forced to accept an unknown group of permanent associates within three weeks of entering college is an unfortunate limitation of academic freedom.

I have thus far spoken as if academic freedom were one thing for teachers and another thing for students; and, indeed, the aspects and results of that freedom for the mature men whose life work is study and teaching, and for the youth who are only beginners in the intellectual life, are somewhat different. Nevertheless, in a college or university there is a perfect solidarity of interests between teachers and taught in respect to freedom. A teacher who is not supposed to be free never commands the respect or personal loyalty of competent students, and students who are driven to a teacher are never welcome, and can neither impart nor imbibe enthusiasm.

The real success of a college or university teacher in the long run depends on his training up a few sincere and devoted disciples. To this process, freedom on both sides is essential. The student must be free to choose the same teacher for several years, and the teacher to hold the same student. There must be a voluntary cooperation of tastes, capacities, and wills for years. As a rule, enduring influence is won only by a teacher who thus brings up a few congenial, cooperative disciples capable of carrying on and developing their master's work. The duration of the master's influence depends on the capacity of his disciples to go beyond him, and develop his ideas under new conditions; and for this development they in their turn will need a genuine freedom for themselves, and for their students. Such is the rapid progress of science, letters and art in these days that the old ideas can only live as they are transmuted into the new; but for the just development of the new out of the old freedom is indispensable. All truth-seeking needs freedom, and in a university teachers and taught ought to be constantly seeking truth together. Even partial truth makes free, and every sincere searcher for the next glimpse of truth beyond the present limits of knowledge needs not only a perfect candor in his own soul, but freedom from all artificial external restraints on the flights of his intelligence and goodwill.

UNIVERSITY GOVERNMENT IS A TYPE

The government of a good college or university in the United States, which is free from denominational or political control, foretells the type of the best ultimate forms of human government. It is a government in which there is no use of force. There is some police inspection, and a constant watchfulness against disease, fire, noise, and similar evils, but no prison, no physical punishment, the least possible interference with the personal conduct of the governed, and a generous amount of goodwill between all members of the community. The citizens, or constituency, of this government are selected persons as regards intelligence, goodwill, and cooperative purpose. Exile from the community is the sole penalty for misconduct, inefficiency, or unworthiness. The government is not arbitrary, and yet it possesses large elements of discretion. It habitually acts under rules and usages, yet it is progressive; it does not permit a perverse individual to injure the main body, but its dealings with the individual are always in the direction of reformation, education, and recovery from downfall, and exile is never resorted to until many efforts at recovery and reformation have failed. Vengeance on the sinner, and the satisfaction of justice by punishment, are absolutely excluded from its discipline, as in the first place unworthy of any intelligent ruler or governor, and also as completely ineffective towards either individual or community improvement. There are no elective bodies analogous to Senate and House of Representatives, and yet there are legislative bodies and an executive. Long tenure, and life office play a great part in university organization, and as a rule there is no jealousy or distrust of long service executives, provided they are considerate and fair. On the contrary, in universities the governed generally exhibit a decided preference for an experienced executive of proved capacity, and a dislike for changes in executive departments.

The principle of authority is very little applied in good university government. Respect is paid to age, if it remains vital, and to experience, especially to intensive experience; but mere seniority counts for very little, and an administrator's influence is supported chiefly on his persuasiveness, or power of discerning a good reason for a proposed action, and then stating it convincingly.

In the government of the American universities, sentiments have a large place, as indeed they should have in all government. Among these sentiments are a strong love for the site and surroundings of the university—an affectionate memory of the fields and hills, the streams or lakes within sight of which years of rapid intellectual and spiritual growth were passed; downright affection for teachers who greatly stimulated the intellectual life of their students; and among the members of the university staff itself, admiration and affection for certain colleagues whose traits of character, wit, or charming personal idiosyncrasies especially commend them to their brethren. Occasionally a college administrator who is also a preacher from pulpit or platform wins for the time being an extraordinary influence over large numbers of young men by the purity and force of his character, and the high spirit of his instruction and exhortation. These sentiments, like all the higher loves, grow up in a freedom which knows no admixture of fear, compulsion, or domination. They are all noble, refined, and inspiring sentiments. To develop them in the highest degree is one of the chief objects of academic freedom.

A university should be entirely free from the highly restrictive bonds described in the words, caste, class, race, sect, and party. In its best form it already is so. These formidable restrictions on individual liberty should play no part in its organization or its discipline. The world has had quite enough of these ancient means of dividing mankind into antagonistic sections. Every university should exert a strong unifying influence in these respects.

I have said that the university form of government is a prophecy. It really foretells the ultimate form of all good government among men—a government based on cooperative intelligence, almost universal goodwill, and noble loves. Its leaders are of a new sort which deserves study.

A modern university, being a voluntary cooperative association of highly individualistic persons for teaching and for advancing knowledge, is thoroughly democratic in spirit, and everywhere its objects are to train productive mental power in the young, to store each power in a select group from the next older generation, and to apply this stored power to the advancement of knowledge. This peculiar kind of democratic association needs leaders or managers; but the work of a university is so different from ordinary governmental and industrial work, that we are not surprised to find that the university leader or manager is a different kind of a leader from that common in governments and industries. It is an interesting question, therefore, what sort of leadership a university needs; what contribution to academic freedom the right sort of university leader makes; and what sort of freedom he needs for himself.

University administration is usually, and in chief part, administration by a selected expert who has had opportunity to prove his capacity. He ought also to be an advanced student in some field of knowledge—historical, economic, linguistic, scientific or artistic, it matters not which—and a student who has learned by experience what research or scholarly productiveness is and implies. Like the captain of industry, or the political ruler, he must have skill, capacity, and knowledge; must be inventive and constructive in his thinking; and must welcome care and responsibility. His inducements to laborious and responsible service are, however, different from those which are effective with other sorts of leader. A high salary, or the prospect of luxury for himself and his family, will not tempt him. These inducements will not draw the right kind of man into university administration any more than into teaching or research. He cannot be induced to do his best work by offering him any money prize, and he will manifest no desire whatever for arbitrary power over masses of human beings, or for what is ordinarily called fame or glory. The effective inducements will be the prospect of eminent usefulness, public consideration, the provision of all real facilities for his work, enough relief from pecuniary cares to leave his mind free for invention and forelooking, long tenure, and income enough to secure healthy recreations. He will not wish to receive a salary so high as to distinguish him widely from his colleagues the professors, except so far as the proper discharge of his functions involves him in expenditures from which they are exempt. He will want to work with a group of associates whose pecuniary recompense and prospects are not very unlike his own.

This educational expert will set a high value on freedom for himself. He will hope that trustees, faculties, alumni, and the supporting public, will permit him to carry out his own plans and provisions, or those which he espouses. He will hope that the responsibility he carries will entitle him to a certain deference for his judgments from his colleagues and the academic bodies. In short, a just academic freedom for the head of a university is more important than for any other person or group of persons connected with the university, for the reason that in education, as in every other function of democratic government, and every branch of the national industries, the problem how to create and develop real leadership is the most serious problem which confronts democratic society.

In all fields, democracy needs to develop leaders of high inventive capacity, strong initiative, and genius for cooperative government, who will put forth their utmost powers, not for pecuniary reward, or for the love of domination, but for the joy of achievement and the continuous, mounting satisfaction of rendering good service. This is just the kind of leader that democracy ought to produce for highly organized industries and for public service. The military commander is necessarily an autocrat; the hereditary ruler may be either a despot or a figurehead. The present type of industrial captain is too often governed by motives, and pursues ends, which are neither altruistic nor idealistic. None of these types is good for the democratic leader of the future, whether he is to serve in some great industry, in government, or in a university. At this moment the university administrator makes the best use now made of the powers of individualism on one hand, and of collectivism on the other, and understands better than any other leader in the world that in order to have successful cooperative action on the part of thousands of human beings, special emphasis must be laid on brotherhood in that admirable trinity—freedom, equality and brotherhood.

The American university gives an effective demonstration of the good results of the voluntary association in common work of many independent and unlike individuals possessing the maximum of goodwill; and academic freedom is, therefore, a good type of the considerate, humane freedom which will ultimately become universal.

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SCIENTIFIC BOOKS

RECENT LITERATURE ON ECHINODERMS

There has been a marked increase in the attention given to the echinoderms, since the opening of the twentieth century, and during the last year especially, the contributions to our knowledge of the group have been numerous. Among these there are three which, for widely different reasons, particularly deserve attention.

Fisher's "Starfishes of the Hawaiian Islands"[1] is the first extended contribution

[1] "The Starfishes of the Hawaiian Islands," by Walter K. Fisher, acting instructor in zoology, Leland Stanford Junior University. Extracted

from a newcomer in the field, but it is easily the most important publication on starfishes which has appeared in America, at least since Alexander Agassiz's "North American Starfishes." Although Dr. Fisher is chiefly concerned with a systematic account of the Hawaiian Asteroidea, particularly those collected by the *Albatross* in 1902, many important morphological points are discussed and the geographical distribution of the species is given careful consideration. The introduction states that the *Albatross* collection consists of about 1,650 specimens, representing 60 species, of which the author considers 52 are new to science. This surprisingly large percentage of novelties is not so remarkable, however, when the situation of the Hawaiian group is considered, and it is remembered that, previous to this report, only eleven species (and at least two of these erroneously) were recorded from the islands. The classification used is a compromise between the two fundamentally different systems of Perrier and Sladen, with due reference to the work of Verrill, but unfortunately Fisher does not explain what principles have governed him in his choices, and we are left in the dark as to what characters he considers of the greatest importance in determining relationships. He apparently gives considerable weight to the absence, or presence and form, of paxillæ, superambulacral plates and pedicellariæ, all of which, while of value in classification, reveal notable diversities in nearly related forms. On the whole, however, there can be little question that Fisher has shown excellent judgment and his classification is probably as satisfactory as can be devised in the present state of our knowledge. The nomenclature used is admirable, for, following the sensible lead of Bell and Verrill, adherence is given to the International Code, and the pre-Linnæan names, resurrected or maintained by Sladen in his great *Challenger* monograph, are rejected. While this course results in the alteration of some familiar names (such as the change of *Cribrella* to *Henricia* and *Palmipes* to *Anseropoda*), there can be no doubt that it is a long step towards a stable nomenclature for starfishes. Following the introduction, ten pages are given to a synopsis of the Hawaiian Asteroid fauna and a discussion of its relationships. The most interesting points here brought out are that, although starfishes were taken at 126 stations, the *Albatross* collection consists almost entirely of sublittoral and continental forms, only three or four species having been taken in less than 20 fathoms and fewer than ten in more than 500 fathoms; that only one species previously recorded from the islands was taken; that the Hawaiian starfishes are distinctly Indo-Pacific in their relationships rather than American, notwithstanding that the ocean currents passing the islands are west-bound; that these west-bound currents have only brought five species of starfish to the islands; and that seven or eight Hawaiian species find their nearest relatives in the Atlantic Ocean or Caribbean Sea. The following 116 pages are taken up with the account of the Hawaiian starfish fauna, and open with an artificial key to the nineteen families recognized as occurring in the area under consideration. This key is clear and well arranged, and while obviously artificial in a few particulars (as such keys are of necessity bound to be), it will doubtless prove more useful than any similar key hitherto published. It is probable, however, that further investigation will reduce the number of families recognized by Fisher, for they are certainly of very unequal value as at present arranged. Such families as Mithrodiidæ and Heliasteridæ are certainly much less satisfactory than Astropectinidæ and Linckiidæ. Following the key, the families are taken up in their natural sequence, the synonymy being followed by an artificial key to the genera, and each genus, when containing more than a single form, is introduced by a key to the species. These keys are admirable in matter and form and make up in a measure for the absence of any diagnoses of families and genera (except those which are new). The descriptions of the new genera and species, and the remarks on

from U. S. Fish Commission Bulletin for 1903, Part III., pp. 987–1130, pls. I.–XLIX. Issued June 30, 1906. Washington: Government Printing Office, 1906.

previously known forms, and on nomenclature, leave nothing to be desired. The volume ends with two pages of glossary, two of bibliography, eight of explanation of plates, forty-nine plates, and a good index of three pages. The plates are of more than usual excellence, thirty-six being photographs (many enlarged), light figures on a black background, while the remainder are drawings of morphological details, chiefly by Dr. Fisher himself. The Bureau of Fisheries and Dr. Fisher are both to be congratulated on the appearance and the contents of this report, which will rank hereafter, in importance to students of the Asteroidea, with the classic works of Perrier and Sladen.

The report of the Echini of the *Valdivia* collections[2] is a great contribution to the taxonomy of the Echinoidea, from one of the most eminent of living Echinologists, and is the most elaborate work which he has yet produced. Among other reasons, it is notable for the attempt made to show details of structure, particularly the pedicellariæ, by means of microphotography. It is a quarto volume of 228 (63–290) pages, dealing with nearly one hundred different Echini, of which 71 were collected by the *Valdivia* at 62 stations. Of these, 23 were new to science at the time they were taken, but only three or four are described here for the first time, as preliminary reports on the collection were published in the Zoologischer Anzeiger in 1901 and 1905. Döderlein's work is, however, far more than a mere systematic account of the Echini of the *Valdivia,* for the first part of the volume consists of a discussion of the new system and principles of classification proposed by Mortensen, in which the pedicellariæ play such an important part. After a brief introduction and some remarks in regard to his methods of illustration, Döderlein proceeds to a short review of the recent works of Mortensen, de Meijere and A. Agassiz, following this with a dozen pages of discussion of the pedicellariæ and their value for purposes of classification, in which the writer reveals his sympathy with Mortensen's methods, although not oblivious to the difficulties which they involve. Several pages are given to remarks on the interrelationships of the different groups of Echini, and then comes an outline of the classification of the recent Echinoidea, as Döderlein would have it. This classification leaves out of account the evidence of paleontology and lays particular stress on the pedicellariæ. It divides the Echinoidea into two subclasses, *Cidariformia,* with the single family Cidaridæ, and *Diadematiformia,* with two orders, Regularia and Irregularia. The Regularia includes two suborders with a single family each and two with five families each. The Irregularia consists of two suborders, Clypeastroidea with four families and Spatangoidea with six families. It is hardly probable that this classification will be widely accepted, for it is difficult to believe that the Spatangoids are more nearly related to the Diadematidæ and Echinothuridæ, than are the Cidaroids, and surely the mere position of the anal opening is not of greater morphological significance than the presence or absence of the complicated "Aristotle's lantern," as the position assigned the Clypeastroids forces one to believe Döderlein assumes. Following the outline of the proposed classification, 183 pages are given to a discussion of the seventeen families represented in the *Valdivia* collection, with full descriptions, models of their kind, of all new species, important accounts of many little-known forms, and elaborate descriptions of the pedicellariæ of all species, not yet so treated by Mortensen. Special attention is given the Cidaridæ the genera proposed by Mortensen are discussed in detail and a new grouping of the species into ten genera, with five subgenera, is suggested. This is the least satisfactory section of the report, owing to needless and confusing changes in long-established names and to a curious lack of consistency, due apparently to

[2] "Die Echinoiden der deutschen Tiefsee-Expedition." Von Dr. Ludwig Döderlein. Mit 42 Tafeln und 46 Abbildungen im Text. Abdruck aus Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia*, 1898–1899. Im Auftrage des Reichsamtes des Innern herausgegeben von Carl Chun, Professor der Zoologie in Leipzig, Leiter der Expedition. Fünfter Band. Verlag von Gustav Fisher in Jena, 1906.

the "personal equation" in the attempt to apply Mortensen's pedicellarian principles. It seems to the present reviewer that distinctions between genera are impracticably fine when degrees of difference in a single microscopical character are their only basis. Döderlein's argument is badly hampered by the fact that his own figures contradict his words. Thus it is said several times in the text that the globiferous pedicellariæ of *Stereocidaris* lack an unpaired end-tooth, but not less than a dozen of the figures given on plates XXXVI. and XXXVII., illustrating the pedicellariæ of Stereocidaris, show such an end-tooth and in some cases it is very conspicuous. The volume closes with a brief review of the geographical distribution of the *Valdivia* Echini; a list of the stations at which Echini were collected, with location, depth, bottom temperature, species taken and number of specimens of each; a bibliography; a register of genera and species, arranged alphabetically (virtually an index); and a table of contents. The list of stations shows that the most interesting hauls were at Station 103, off South Africa, in 277 fathoms, where nine species were taken, and at Station 199 in "Nias-Sudkanal," in 261 fathoms, where six species occurred. Special reference should be made to the illustrations in this report, which are very numerous, but of very unequal merit. All are photographic in origin, save only a few outlines of pedicellariæ. Excepting these few outlines, the text-figures are mostly mere "shadow-pictures," and while some are useful, the great majority are of little value. Of the plates, two (IX. and XI.) are heliotypes and are very good, while the remainder are phototypes on cream-tinted paper and are often very poor. The trouble in many cases is obviously due to the object having been out of focus when photographed, and some important figures are ruined by this inexcusable blunder. Where bare tests are shown, they were seldom carefully cleaned, and the figures are correspondingly unsatisfactory. The numerous microphotographs of pedicellariæ are useful and many are excellent, but a large proportion are aggravatingly indistinct on important points. On the whole, it must be admitted that this report, because of the undue importance given the pedicellariæ for systematic purposes and the many unsatisfactory figures, is somewhat of a disappointment, and does not compare favorably with the previous work of its eminent author.

The first volume of the "Cambridge Natural History"[3] contains six chapters devoted to the Echinoderms, the work of the well-known embryologist, E. W. MacBride. After a brief introduction, the classification to be used is outlined and then the starfishes are taken up, the familiar *Asterias rubens* being used as the type upon which the account of the anatomy is based. This account is very well written, the discussion of the so-called "blood-system" being particularly interesting, though it is quite possible the last word is not yet said on those perplexing structures. Following the anatomical portion are several pages of morphological details where those features in which other starfishes differ from *Asterias* are discussed. The not infrequent defects of these pages are due either to the excusable necessity for brevity, as in the paragraph on "Asexual Reproduction," where statements open to question are made without qualification and much interesting matter is ignored, or to the less excusable lack of acquaintance with a large variety of forms. To this latter cause must be referred the statement that "the families Heliasteridæ and Brisingidæ are characterized by possessing numerous (19–25) arms"; this is an unfortunate half-truth, as the Heliasteridæ have 21–44 arms, while the Brisingidæ have only 8–18. A similar blunder occurs in the paragraph on "spines," where the Echinasteridæ are said to have short, blunt spines, "very numerous and thick set." This statement applies only to the genus *Henricia* and its immediate allies, while the other genera have widely spaced, often very sharp, spines, and in *Acanthaster* (to

[3] "The Cambridge Natural History," Vol. I. * * * Echinodermata. By E. W. MacBride, M.A., F.R.S., formerly fellow of St. John's College, Cambridge; professor of zoology in McGill University, Montreal. London: Macmillan and Co., Limited; New York: The Macmillan Company. 1906. Chapters XVI.–XXI., pp. 427–623, figs. 185–296.

which no reference is here made) are found the longest and most remarkable spines occurring in the whole class. The section on the "Classification of Asteroidea" is thoroughly unsatisfactory and it is particularly annoying that an Englishman should show such a lack of appreciation of Sladen's great work, which despite its defects is certainly the most carefully reasoned and well-grounded classification of starfishes yet published. One is almost inclined to believe that MacBride has never read Sladen's philosophical discussion of the principles of classification in the Asteroidea. The present reviewer dissents emphatically from the principles proposed by MacBride, that "the best method of classification is to take as our basis the different methods in which the demands of the environment have been met," and that "the great differentiating factor in their development must have been the means they adopt to shelter themselves from their enemies";—"One of their chief dangers" "must be regarded as" "assaults by other animals, especially parasites, on their soft and delicate skins." According to these principles, the influence of environment is far more important than heredity, and classification should be based, not on the deep-seated, slowly modified characters, but on superficial externals which are easily modified by changes in the manner of life. It is clear to any one familiar with the great variety of form and external features exhibited by starfishes that "the demands of the environment" have been met in widely different ways by closely related forms, while the converse of this may or may not be true. Moreover, starfishes have comparatively few enemies, after their larval life is past, and certainly are not especially liable to parasites as MacBride assumes. The great majority of species are found more or less exposed on the bottom or, at the most, concealed beneath rocks, and there is not the slightest evidence that the danger from parasites has played the least part in the evolution of the group. In view of his principles, it is not strange that MacBride adopts the classification of Perrier, of which no previous English or American writer has approved, and divides the Asteroidea into five orders, each of which is taken up in turn with its constituent families. The latter are, as a rule, treated very briefly, but the more important are made the subject of many interesting and well-written notes. The chapter closes with a short account of the fossil Asteroidea. The following three chapters deal with the Ophiurans, Echini and Holothurians, respectively, each class being treated in practically the same way as are the Asteroids. The account of the morphology of each class is well-written and very clear, with few mistakes or important omissions. It is to be regretted that the terminology used in connection with the pedicellariæ of the Echini is not that which is now almost universally used by echinologists. Much attention is given the physiological aspects of the structures discussed, and some unconfirmed observations on habits and functions, made by other workers, are accepted apparently without question, even though somewhat improbable. As the classification of the Ophiurans is still very imperfectly worked out, MacBride has done well in following Bell's arrangement, but it is remarkable that the very peculiar genus *Astrophiura,* described by Sladen, is nowhere mentioned, although its obvious resemblance to an Asteroid makes it of great importance in this connection. The classification given for the Echini is apparently original and has much to commend it, particularly its simplicity and the clear-cut groups. Unfortunately it omits the fossil forms (which are, however, discussed in a separate section) and for this and other reasons, it needs some modifications. The classification of the Holothurians is also original, very much so in fact, and it is safe to say will not be adopted by any student of the group, recognizing, as it does, six orders, of which only one contains more than a single family. MacBride gives little heed to either the work or the judgment of Ludwig, the nestor of Echinoderm morphology, and by his use of "Aspidochirota" and his failure to mention the Synallactinæ, he reveals either ignorance or lack of appreciation of recent work on the Holothurians. The chapter on the Pelmatozoa is, at least from a zoologist's point of view, very satisfactory, and the writer's inclination to the classification of Wachsmuth and Springer for the fossil forms will be generally approved in America. The closing chapter, dealing with the development and phylogeny of the Echinoderms, is very interesting and is almost wholly free from the self-confident assertiveness which mars some of the preceding pages. While the conclusions which are reached as to the steps in the evolution of the type, and as to the interrelationships of the classes, need not always be approved in detail, it must be admitted that the author has made out a good case. The relationship of the Echini and Holothurians is well emphasized, as is the more obvious one between Asteroids and Ophiurans, but the evidence supporting the derivation of Echini from Asteroids is weak and it is difficult to believe that we are at this point on the true line of descent. It seems clear that MacBride has been somewhat unduly influenced by his familiarity with the development of *Asterina gibbosa,* and it is quite probable that his continued researches into the development of species of the other classes will ultimately lead him to somewhat different views from those he now holds. A word as to the illustrations is in order. About one third are original, the remainder being taken from such reliable authorities as Ludwig, Loven, Sladen, Wyville-Thomson, *et al.* Scarcely one is from a photograph, even such forms as *Asterias* and *Astropecten* being represented by drawings. While the diagrammatic sketches showing structure are always clear, and the original ones are particularly good, photographs of *Asterias, Ophiothrix, Echinus, Echinarachnius, Holothuria,* etc., would have been a great improvement on the rather crude sketches given. There are one or two mistakes made in identifications: thus the "Schizaster" figured on page 556 is certainly not *Schizaster,* but appears to be *Brissopsis,* while the *Salenia* figured on page 538 is not *varispina,* but *hastigera,* though this latter mistake is Wyville-Thomson's and not MacBride's. In conclusion, this review may be summed up as follows: the morphological, physiological and embryological portions of the text are excellent, though occasionally marred by an unnecessary dogmatism; the geological references are somewhat less satisfactory; while the ecological and systematic portions, and nearly all the illustrations of entire animals, range from mediocre to poor.

HUBERT LYMAN CLARK

The Principles and Practice of Surveying. By BREED and HOSMER. New York, Wiley and Son.

Of all the subjects taught in engineering schools, surveying, so-called, is one of the least satisfactory, both to the professor responsible for the instruction, and to the outside engineers who later test the value of the instruction in the light of the practical ability realized by those taught. This is doubtless due to two causes; first, on account of the large number of students and the small amount of time given to the subject, there is opportunity for giving to the individual little more than a bare insight into the methods of handling transit and level; and second, the use of those instruments in construction work involves very little of the time-honored methods indicated in the text-books for surveying farm areas and making differential profiles.

That the present methods are unsatisfactory is indicated in no clearer way than by the number of text-books on the subject, each school trying apparently to solve the problem of securing better results by the use of a new text-book which varies from that of some other school in the details of description of instruments or directions for field work.

The volume under review is the result of the experience of two instructors in the Massachusetts Institute of Technology, and embodies their ideas of what should be presented to the student who is taking up the subject of surveying for the first time. It is carefully and logically arranged for this purpose, giving descriptions in detail, emphasizing directions of what is, and what is not, proper procedure, and listing under each instrument and method, "common sources of error" and "common mistakes."

The book itself of 433 pages is divided into four parts, the first 94 pages being devoted to the description and uses of instruments, the next 224 pages to methods of field work, the next 58 pages to computation, and the remaining 57 pages to mapping and draughting; an arrangement admirably adapted to a clear presentation of the subject. The detail of these four sections is well worked out. For example, in part I., a series of diagrams shows all the types of transit verniers; the Berger top attachment is used to show the theory and operation of the solar compass; the measurement of angles by repetition is explained and the value insisted on; and the tape rod for reading elevations direct, is explained and commended. In part II., the usual methods of land surveying are explained, and many details are given which show the practical experience of the authors. The chapter on Topographical Surveying is particularly satisfactory. The chapter on Mining Surveying is written by Blamey Stevens, M.Sc., of Ellamar, Alaska, and the field and office methods of underground work are carefully explained. In the chapter on leveling, the advantage in accuracy of double rodded lines is carefully pointed out and in the chapter on city work, the simpler methods of running out and recording curves are shown. A brief description of methods of triangulation is also given. In part III., emphasis is laid on the accuracy of computations, on the significance of the number of digits employed and on the proper forms for computation. Models are given in details for land area determinations and for earth volume determinations and these form the chief part of this section. In part IV. are given many hints referring particularly to surveying draughting, such as the use of water colors for ready-made inks, the checks on field work made possible by a critical study of the plot, and methods of finishing and filing drawings.

The usual tables complete the volume, which is probably as satisfactory a text-book under present methods of technical school instruction in surveying as can be written.

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SCIENTIFIC JOURNALS AND ARTICLES

Bird-Lore for May–June opens with "A Sketch of the Thrushes of North America," by Jonathan Dwight, illustrated by a colored plate and maps of distribution. B. S. Bowdish furnishes an account of "The Rose-breasted Grosbeak"; and Emma E. Drew tells of "Some Bird Acquaintances," made while confined to an invalid chair on the veranda of an Adirondack cottage. A list of 140 species observed from such a restricted point of observation shows what may be done right at home. The Educational Leaflet, by Mabel Osgood Wright is devoted to "The Baltimore Oriole" and the section devoted to "The Audubon Societies" shows that, thanks to these same societies, laws for the protection of birds are gradually being enacted throughout the United States.

The Bulletin of the Charleston Museum for May is mainly devoted to a "Synopsis of the Bird Records of the Natural History Society for the year 1906."

The preparation of an index to the first twenty-five volumes of the *Astrophysical Journal* is now under consideration. If sufficient support is secured, the index will be issued during the autumn of 1907, at a price of $1.50 or $2.00.

SOCIETIES AND ACADEMIES

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION

The last regular meeting of the session of 1906–07 was held at the Chemists' Club, 108 West 55th Street, on June 7.

The following papers were presented:

F. D. Dodge: "Methyl Salicylate, Natural and Synthetic."

K. George Falk: "Ignition Temperatures of Mixtures containing Carbon Monoxide" and "Autoxidation of Organic Compounds: Review."

C. M. Joyce,
Secretary

DISCUSSION AND CORRESPONDENCE

A NECESSARY AMENDMENT IN THE APPLICATION OF THE LAW OF PRIORITY IN ZOOLOGICAL NOMENCLATURE

The keystone of all nomenclature of species and genera is the rigid and exceptionless application of the law of priority; without it no uniformity could be attained. There is practically complete agreement on this point among all who have had considerable experience in the definition of genera and species, that is, among those who best understand the difficulties of reaching ultimate agreement.

Now the International Code of Zoological Nomenclature has adopted the following:

> Art. 25. The valid name of a genus or species can be only that name under which it was first designated on the condition:
>
> (*a*) That this name was published and accompanied by an indication, or a definition, or a description; and
>
> (*b*) That the author has applied the principles of binary nomenclature.

It is clear that the ruling of clause (*a*) allows too much laxity and is too indefinite. The amendment that has probably occurred to others, and that I would urge as most necessary, is the change of clause (*a*) to read as follows:

> That this name was published accompanied by a published recognizable description or by a published recognizable drawing.

Publication is to be understood as meaning expression in print; and "recognizable," a description or drawing sufficiently accurate and detailed for distinguishing the species or genus named from any other species or genus known at the time when the name was applied. A few considerations among many may be mentioned to justify this amendment.

In the first place, as the code rules at present it is only necessary for a systematist to publish a name in accordance with the other rules of binary nomenclature, and to give an "indication," indicating, *e. g.*, a particular type specimen in a particular collection; he is really not obliged to give any description whatsoever, or he may give an indifferent or even an inaccurate description provided he makes this indication. In time this loophole will lead to the utmost confusion; it would be impossible to get any idea of a newly named species without resource to the type specimen. This is the main reason for eliminating from the clause in question the vague and meaningless word "indication" —vague and meaningless unless it signifies the indication of a particular specimen. Surely it is not the spirit of scientific nomenclature to point to a specimen as an idea!

In the second place, it is becoming more and more necessary that the name should be accompanied by a recognizable description or drawing. There are many of the most modern systematists, as well as large numbers of the earlier ones, whose diagnoses are worthless for purposes of positive identification. These diagnoses either do not mention the important characteristics, or do not describe them fully or accurately enough, or else do not draw comparisons with the closely allied forms. If there is one thing we want to get out of the description of a new species, it is the item of how it differs from the known forms of the same group. Such descriptions are a positive hindrance to systematic progress, they may even arrest it entirely. They are scientifically valueless, they vilify the journals containing them. Under the present code one must have resource to the type specimen. Suppose then I am monographing a particular group, and find in the literature some papers in which the descriptions are practically meaningless; then I must ask for the loan of the specimens; but they may be in a museum the rules of which forbid the loaning of types; then I must in person visit that museum to find perhaps that the specimens have been mutilated beyond recall or have even been lost. Or should I wish to undertake the revision of the species of a comprehensive genus, say *Epeira* or *Bulimulus*, then I should have to undertake a *Weltreise*, for which my finances would probably be inadequate, and visit practically every museum in the world. Then everyone knows how type specimens suffer from handling, how perishable the average dried or alcoholic specimen is. The mere statement that a type specimen exists in such a collection is not the spread of a scientific knowledge. Suppose a man should undertake a review of the present status of the problems of evolution; would we not expect that he would at least describe the various theories? Would it not be ridiculous for the reviewer to give simply a list of books and papers, and indicate in what libraries these are to be found? Science can make no advance when nothing but names are given, or only unrecognizable descriptions, with the indication where specimens are to be found. The retention of a type specimen is always desirable for future reference, but the publication of a good description is the *sine qua non* of scientific advance.

Those who take the pains to furnish adequate descriptions, and who draw comparisons with the previously known species, will always be regarded as the original describers whether the rules of nomenclature give them credit or not.

The suggestion of demanding a recognizable description is, of course, open to the objection that it is difficult to decide what constitutes a recognizable diagnosis. The decision must be made separately for each particular case. All would concur in the fairness of the principle to consider the adequateness of the description at the time when it was made. A description would be recognizable if at the time it was published it served to demarcate the species from all the other then known species of the genus, or the genus from all the other then known genera of the family. Questions of this kind can generally be decided by any monographic reviser of a group.

As the case stands at present there is all incentive for hasty and insufficient diagnoses, at least our codes do not prevent them. We have either to hunt up the type specimen, to spend fruitless hours to try to read some meaning into a description, or to try by the unsafe method of elimination to determine what species an author intended. As the A. O. U. Code of 1886 put it, "Zoological nomenclature is a means, not an end, of zoological science"; it ought to make the path clear and not maintain obstacles. Too much of a premium is placed upon age, there is too strong a tendency to resurrect the oldest name and try to fit to some particular species, whether it was accompanied by a good diagnosis or not. So long as this continues so long will the names in use be unstable.

Personally, I never have and never will regard a name as tenable unless it is based on a recognizable description or drawing, and that whether type specimens are preserved or not. There are many who share this view, and in this connection attention may be drawn to the very cogent recent arguments of Looss.[1] We are all in sympathy with the endeavors of the International Committee, most of us realize the difficulty of the questions it has to decide, and we are ready to relinquish personal views in order to reach uniformity. But there will never be uniformity of opinion in regard to the matter of allowing a name to be based simply upon an "indication." New names are multiplying in a geometrical ratio, some of them newly coined and others raked out of the ash heap of describers who deserve oblivion; few genera have been thoroughly revised; if mere "indications" and inadequate descriptions continue to be permitted the task of revision will before long be hopeless. Then there will be need for far more radical reform than the one here suggested. Now while our rules are still plastic let us insist on the absolute necessity of adequate diagnoses of genera and species. Thus insecurity may be abolished, each describer be given his just due and no more, and science as well as nomenclature be benefited.

One recommendation the committee might embody in the code to clarify future systematic work, though, of course, it could not be applied to the work of the past. That is, that when structural characteristics enter into a diagnosis they should be represented so far as possible by drawings rather than by words. A drawing is immediately clear, few descriptions are. Above all it is often very difficult to build a conception of a structure from a brief Latin description since the Latin is too poor in adjectives for our present needs. Describers are too intent upon their own convenience, give too little attention to the con-

[1] *Zoologischer Anzeiger*, 1907, Nr. 19.

venience of those who have to read their descriptions. This recommendation will be of great aid in identifying species and genera and will help towards that end when men will see there is honor in furnishing good diagnoses, but no hônor in simply naming species.

Thos. H. Montgomery, Jr.
The University of Texas,
June 4, 1907

ANOTHER WORD ON THE VULTUR CASE

My brief allusion to Dr. Allen's inconsistency in his latest elimination of *Vultur* seems to have been clear to all with whom I have discussed the question except Dr. Allen, who fails entirely to see my point.

It seems necessary, therefore, to restate the matter. The case is as follows:

Sarcorhamphus 1806.
  gryphus.
  papa = type of Gypagus 1816.
  auricularis = type of Torgos 1828.
Cathartes 1811.
  papa = type of Gypagus 1816.
  aura.
Gypagus 1816.
  papa.
  gryphus = type of Gryphus 1854.

Dr. Allen says that while *gryphus* is the type of *Sarcorhamphus* it was not the type in 1806 and only became so in 1828 by the removal of the other species. Therefore, he claims that in eliminating *Vultur* we have no right to remove *gryphus* at 1806 and can only remove it at the date at which *it became* the type of *Sarcorhamphus*.

This is absolutely contradictory to his own practise in all other cases, nor can I find a precedent in the "current usage" of other eliminators. For instance, *papa* is the type of *Gypagus* 1816, but it was not the type in 1816, and only became such in 1854; and yet Dr. Allen in all his eliminations removes *papa* at 1816, which any one can see is the date of establishment of the genus, not the date at which *papa* became its type. To be consistent *gryphus* must, of course, be removed at 1806, as I stated previously. Dr. Allen's recent note in which he repeats that *papa* must be removed at the date at which its genus was established, while *gryphus* must be removed at the date it became the type of its genus, only emphasizes his inconsistency—an inconsistency which is too self-evident to require the employment of any "imagination."

Witmer Stone
Academy of Natural Sciences
of Philadelphia,
May 24, 1907

SPECIAL ARTICLES

RELATION BETWEEN BIRTH RATES AND DEATH RATES

A short notice appeared on page 641 of Science, 1907, of a paper read by C. E. Woodruff before the American Association for the Advancement of Science, on the relation between birth rates and death rates, etc.

In this connection, it may be of interest to note that a mathematical expression can be obtained for the relation between the birth rate per head b and the death rate per head d, for the case where the general conditions in the community are constant, and the influence of emigration and immigration is negligible.

Comparison with some figures taken from actual observation shows that these at times approach very nearly the relation deduced on the assumptions indicated above.

I give here the development of the formula, and some figures obtained by calculation by its aid, together with the observed values, for comparison.

Let $c(a)$ be such a coefficient that out of the total number N_t of individuals in the community at time t, the number whose age lies between the values a and $(a+da)$ is given by $N_tc(a)da$.

Now the $N_tc(a)da$ individuals whose age at time t lies between the values a and $(a+da)$, are the survivors of the individuals born in time da at time $(t-a)$.

If we denote by $B_{(t-a)}$ the total birth rate at time $(t-a)$, and by $p(a)$ the probability at its birth, that any individual will reach age a, then the number of the above-mentioned survivors is evidently $B_{(t-a)}p(a)da$.

Hence:

$$N_tc(a)\,da = B_{(t-a)}p(a)\,da$$

$$c(a)=\frac{B_{(t-a)}}{N_t}p(a)$$

Now if general conditions in the community are constant, $c(a)$ will tend to assume a fixed form. A little reflection shows that then both N and B will increase in geometric progression with time,[1] at the same rate $r=(b-d)$. We may, therefore, write:

$$B_{(t-a)}=B_t e^{-ra}$$

$$c(a)=\frac{B_t}{N_t}e^{-ra}p(a)$$

$$=be^{-ra}p(a) \qquad (1)$$

Now from the nature of the coefficient $c(a)$ it follows that

$$\int_0^\infty c(a)\,da=1$$

Substituting this in (1) we have:

$$\frac{1}{b}=\int_0^\infty e^{-ra}p(a)\,da \qquad (2)$$

Equation (1) then gives the fixed age-distribution, while equation (2) (which may be expanded into a series if desired), gives the relation between b, the birth rate per head, and r, the rate of natural increase per head, and hence between b and d, since $r=b-d$.

Applying these formulæ to material furnished by the Reports of the Registrar-General of Births, etc., in England and Wales, the following results were obtained:

ENGLAND AND WALES 1871–80 (MEAN)

		Observed[2]	Calculated
Birth-rate per head	b	.03546	.0352
Death-rate per head	d	.02139	.0211
Excess	$(b-d)=r$	.01407	(.0141)

$p(a)$ from Supplement to 45th Ann. Rep. Reg. Gen. Births, etc., England and Wales, pp. vii and viii, assuming ratio:

$$\frac{\text{male births}}{\text{female births}}=1.04.$$

[1] Compare M. Block, "Traité théorique et pratique de statistique," 1886, p. 209.

[2] Mean b and d from 46th Ann. Rep. Reg. Gen. Births, etc., England and Wales, p. xxxi.

Age Scale.—1,000 individuals, in age-groups of 5 and 10 years

$a_1 a_2$	$1000\int_{a_1}^{a_2}c(a)da$	
0 – 5	136	138
5 – 10	120	116
10 – 15	107	106
15 – 20	97	97
20 – 25	89	87
25 – 35	147	148
35 – 45	113	116
45 – 55	86	87
55 – 65	59	59
65 – 75	33	33
75 – ∞	13	13

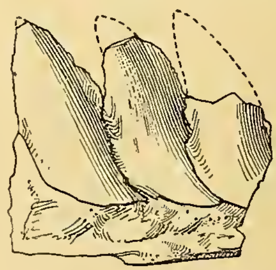
It will be seen that in the above example the values calculated for the age-scale and especially for b and d, show a good agreement with the observed values.[3]

The above development admits of further extension. But this, as well as further numerical tests, must be reserved for a future occasion. In view of the recent note of the work by Major Woodruff, it appeared desirable to the writer to publish this preliminary note.

Alfred J. Lotka

A NEW GENUS AND SPECIES OF FOSSIL SHARK RELATED TO EDESTUS LEIDY

The specimen which serves as the type of the new genus and species, *Lissoprion ferrieri*, was secured in what are regarded as Permo-Carboniferous deposits near Montpelier, Bear



Lake County, Idaho. It was collected by Mr. W. F. Ferrier, of the town mentioned. The specific name is given in his honor. The

[3] The calculation is based on the observed value of $r=.0141$, as indicated by the brackets.

specimen was transmitted to me by Mr. Fred Boughton Weeks, of the U. S. Geological Survey.

Three segments are represented in the specimen, as shown in the drawing. As in *Edestus,* there are enameled crowns of teeth supported on a shaft of vasodentine. Two of the crowns are practically complete, the third lacks a considerable portion. Much of the shaft is splintered off, so that its form and dimensions can not be determined.

Evidently our fossil does not belong to the genus *Edestus,* for not only are the bases of the teeth fused so that no traces of the constituents appear in the shaft, but the crowns themselves are fused to more than one half their height. The crowns differ from those of all the known species of *Edestus* in being devoid of all serrations. The crowns of *E. giganteus* are of nearly the same form and are so closely placed that their edges overlap, but they are not fused.

Karpinsky in 1899 described a remarkable genus, *Helicoprion,* related to *Edestus,* in which a series of about 150 teeth form a spiral of 3½ whorls. From the Idaho specimen it is impossible to determine the extent of the whole series or how much it curved during life. However, it certainly was not a species of *Helicoprion;* for the crowns of the latter are serrated, narrow, elongated, bent forward at a moderate angle, and prolonged so as to reach beneath the second crown forward and nearly to the base of the shaft. In *Lissoprion ferrieri* the crowns are broader, much shorter, more abruptly turned forward, and prolonged only to the middle of the next crown and far from the base of the shaft.

Another genus, *Campyloprion,* was proposed by Dr. C. R. Eastman, in 1902, which had for its type *C. annectans* Eastman and included *Edestus davisii* H. Woodward and *E. lecontei* Dean. The species were believed to have had a bent but not volute shaft and fewer teeth than *Helicoprion;* while they differed from *Edestus* in having crowns of different form and bases thoroughly fused.

In 1903 Dr. Eastman appears to have concluded that his species *annectans* belonged really to *Helicoprion* and he therefore substituted, as type of *Campyloprion, Edestus lecontei.* This substitution is not permissible, according to the rules of nomenclature. If *annectans* is really a species of *Helicoprion, Campyloprion* becomes a synonym of the former; and *Edestus lecontei* and *E. davisii* require a new generic name.

Lissiprion ferrieri differs from *Edestus lecontei* in various respects. The crowns of the teeth of the latter are narrower, higher, the divisions between the bases are seen to descend to near the base of the shaft and the slope of the axis of the tooth is rather forward than backward. It does not appear probable that the two species belong to the same genus.

Whether or not there was a longitudinal median channel along the under side of the shaft of *Lissoprion,* as in *Helicoprion,* can not be determined from our specimen.

The anterior end of the specimen is broken at right angles with the axis of the shaft and from it we can learn something of the internal structure. A figure of this would be practically identical with that presented by Karpinsky of the shaft and crown of his *Helicoprion.* The central portion of the section is occupied by a triangular core of spongy vasodentine. Near the base of this triangle are seen the longitudinal canal of the shaft and a smaller canal alongside of it. At the top of the triangle is the canal which leads into the broken crown. The triangle has its base near the lower border of the specimen, and it is probable that this border is very close to the roof of a longitudinal channel. On each side of the mass of spongy vasodentine are the denser layers of vascular and tubular dentine and, outside of all, the enamel of the crown.

The structure above described shows that the bases of the teeth, originally distinct, have become fused so completely that the boundaries between them no longer appear even in the microscopic structure.

The following diagnosis of the genus *Lissoprion* may be given:

Symphysial dentition, a series of fused teeth of unknown number, with broad, high, and laterally compressed crowns, without serration, the crowns fused for the greater part of their height, the lower portion of each suddenly contracted, shortened and turned forward, and lacking much of reaching the base of the shaft. Bases of all the teeth indistinguishably fused into a shaft which was probably more or less curved. Median longitudinal channel at the base of the shaft probably, but not certainly, present.

DIMENSIONS OF L. FERRIERI

	Mm.
Greatest extent of the crown of hinder tooth ..	44
Greatest anteroposterior breadth of same crown	17
Thickness of base of same crown	13

The figure of the specimen is two thirds the natural size. Oliver P. Hay

COON MOUNTAIN CRATER

Considerable interest has been manifested during the past year or two concerning the origin of a remarkable crater-like depression located on the summit of a slight elevation known as Coon Mountain or Coon Butte. It may be found on the plateau region of northern Arizona, but slightly removed from a locality of recent extreme volcanic activity where over a hundred volcanic cones may be seen, many of which still possess well-defined craters. Interest in this phenomenon has been revived as the result of the adoption and elaboration on the part of a few writers of the local common talk of the inhabitants of the immediate neighborhood of the mountain. Here it is religiously believed that an immense meteor nearly one half mile in diameter buried itself in the earth, forming a deep cavity with an upturned edge or rim very much as when a bullet is allowed to fall into soft mud. Some of the reasons cited for this belief are: (1) The circular shape of the depression, (2) the large amount of meteoric iron fragments[1] (over ten tons) which has been collected in the immediate vicinity, and, (3) the entire absence of all kinds of volcanic ejectamenta, or even heated or metamorphosed material, within the area covered by a radius of several miles.

During the summer of 1906 the writer, while studying the crater cones and lava flows of the San Francisco Mountain district, incidentally made a visit to this interesting locality and this report is the result of the impressions received at that time.

[1] Known as the Cañon Diablo meteorites.

An admirable description of the elevation has recently been presented to the public through the publications of D. M. Barringer and B. C. Tilghman,[2] as well as the results of the investigations which they made by means of shafts and borings in the bottom of the crater in search of the great meteorite. It is sufficient here to call attention to only a few of the most important facts. The crater is about 3,500 feet in diameter and nearly 600 feet deep. The elevation on which it is located is about 150 feet above the surrounding planes and from a distance presents the appearance of a narrow circular wall with a very jagged summit. The rocks in the immediate vicinity and also forming the walls of the crater, are made up of layers of sandstone of greatly varying composition. The cementing material is calcareous matter which in some places is present in sufficient quantities to classify the rock as a silicious limestone. The whole formation is known as the Aubrey limestone (and sandstone).

The strata is upturned, forming the rim of the crater exactly as one would expect if it had been lifted by some force from below. It has been frequently faulted and displacements of a few feet can readily be seen in several places on the walls of the crater. The most remarkable feature to be observed, however, is the complete absence of any evidence of vulcanism. No lava is found and not the slightest metamorphism of any kind has taken place in the sediments. Further, there is no evidence of solfataric action, or changes of any kind except mechanical erosion, having taken place after the cavity was formed. The nearest lava fields are located nearly fifteen miles distant. These are in the vicinity of San Francisco mountain and are associated with a remarkable crater cone known as Sunset Peak, an elevation made up of fine ash, lapilli, and lava blocks. In the lava blocks are frequently found masses of

[2] "Coon Mountain and its Crater," by D. M. Barringer, and "Coon Butte, Arizona," by B. C. Tilghman, *Proc. Acad. Nat. Sc. of Phil.*, December, 1905.

sandstone mostly changed to quartzite which have become included during the penetration of the sedimentaries by the molten magma. In the minds of the uninitiated this crater cone must have been produced by quite different agencies than were at work on Coon Mountain, whereas probably the difference lies in the degree and not the kind of action. It would seem quite probable that, on the border of a region of such extreme volcanic activity as has given rise to the most lofty mountains in Arizona, there might have been an explosion lacking the energy necessary to bring the igneous mass or even fragments of it to the surface. Further, the recession of the magma, accompanied by whatever portions of the strata had become metamorphosed by contact, would account for the precipitous walls of the crater as well as the absence of fused material. The explosion may have been of rather an incipient nature, throwing comparatively little of the material outside of the crater, although, considering the nature of the material, soft sandstone, whatever blocks had been thrown out could easily have become disintegrated and simply added to the mesa soil already made up of the same material. On the southern slope of the crater there are found quite a number of sandstone blocks. Whether these were actually thrown out of the crater or simply broke off from the crumpled rim and rolled down the slope can not be determined.

It would seem, then, that the phenomenon exhibited here can be satisfactorily explained as having been produced by an explosion followed by an entire lack of volcanic activity, as first explained by G. K. Gilbert, of the United States Geological Survey. The meteorites found here probably had nothing to do with the formation of the depression. The earth either encountered a meteoric swarm or, what is more likely, a large meteor fell to pieces on striking the earth's atmosphere. The latter hypothesis is considered more probable, for the reason that one would expect a swarm to have had the fragments spread out to a greater extent than is evidenced by the rather confined area in which they are found. It is to be concluded, then, that these two striking phenomena are simply coincidences and should not be interpreted as cause and effect.

The endeavor to explain the origin of the crater by some other than volcanic agencies has led some writers to suggest that it may have been produced by solution. According to this hypothesis the depression was caused by the falling in of the top layers of strata forming the roof of a nearly circular cavity which was a portion of an underground water way. This is supposed to have been the cause of the existence of the peculiar circular depression located near Camp Verde known as Montezuma's Well. Water still exists here and the fact that it never becomes stagnant or brackish is well known. This hypothesis can not be applied to Coon Mountain, however, for the reason that it leaves unexplained the most noticeable feature of the phenomenon, namely, the upturned strata which forms the rim. This could have been produced only by means of forces working from below.

F. N. Guild

University of Arizona,
January 22, 1907

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

MONTHLY WEATHER REVIEW

The articles of most general interest in Nos. 1 and 2, Vol. XXXV., 1907, of the *Monthly Weather Review* are as follows:

"Is not Honesty the wisest Policy?" is the title of a brief note by Professor Cleveland Abbe, in which it is pointed out that the officials and observers of the Weather Bureau are often urged by interested persons not to report tornadoes, or frosts, or droughts, or other meteorological phenomena, because of the injury which may be done by such announcements to local business enterprises and land booms. Professor Abbe rightly puts strong emphasis on the fact that it is a wrong "to mutilate or suppress the record of an observation of a phenomenon of nature" as it is "also wrong to make a bad use of the record."

"The Adirondack Rainfall Summit," by R.

E. Horton. An analysis of the rainfall over the Adirondack plateau, based on the records of twenty-five stations, reduced to the uniform period 1901–5. A map with 1,000-foot contours, the principal watershed lines and isohyetals is given, as is a profile along lat. 43°30′ N., extending eastward from Lake Ontario on a line running a few miles south of North Lake. There is evident a rapid increase of rainfall with altitude on the southwest slope; then a rapid decrease as the altitude increases proceeding northeast. The maximum rainfall is shown enclosed by the isohyetal line of 55 inches.

"The Climate of Kansas," a copy of the stenographic report of a hearing before the Committee on Agriculture of the House of Representatives on January 8, 1907, at which the Chief of the Weather Bureau testified, together with a supplementary note prepared by Professor Moore in order to counteract certain erroneous statements which found their way into the papers in regard to his testimony. The purpose of the testimony and of the supplementary statement is to show that there has been no permanent change in the climate of the central portion of the Great Plains since Weather Bureau records have been kept.

"The Climate of Yukon Territory," by R. F. Stupart, director of the Meteorological Service of Canada. A study of all available records.

"Problems in Meteorology," by C. F. von Herrmann and Professor Cleveland Abbe; continuation of a paper begun in the December, 1906, number of the *Review*.

"The Growth of Fog in Unsaturated Air," by Frank W. Proctor.

"Notes of a Meteorologist in Europe," by Professor A. J. Cox, who has recently visited the chief meteorological centers of Europe.

"Meteorological Work at Camp Wellman, Dane's Island, Spitzbergen," gives the results of meteorological observations made by H. B. Hersey, of the U. S. Weather Bureau, who accompanied the Wellman expedition as meteorological observer. The period covered is June 26 to August 31, 1906.

"A Climatic Sketch of Tacoma, Wash.," by E. B. Gittings, Jr. "The object of this sketch is to present in popular form as complete a description of the climate of this station as is possible without the introduction of extensive tabular compilations of data."

"Snow Rollers at Canton, N. Y.," by M. L. Fuller. An illustrated account of some well-developed snow rollers formed on February 19, 1907.

"Long-Range Seasonal Forecasts for South Africa," by Professor Abbe; a review of recent investigations by Mr. D. E. Hutchins, conservator of forests for South Africa. Sunspots have nothing to do with the variations of rainfall, but Mr. Hutchins has shown that there are certain correlations between the rainfall on the east and on the west, so that when one goes up the other goes down.

"Panama Rainfall," by Professor E. B. Garriott; a general description of the rainfall conditions and amounts, which brings clearly to view the controls, average amounts and the relation to the canal construction.

"Fog on the Newfoundland Banks," by C. T. Brodrick; a bibliographic study of these important fogs, and of the different methods of charting them.

We are glad to note the publication of an excellent index to Vol. XXXIV (1906) of the *Monthly Weather Review*. We have, on previous occasions, called attention to the fact that the index of the *Review* has in the past been very unsatisfactory.

BUCHAN

To the names of von Bezold, Paulsen and Russell, whose work for meteorology has recently been brought to a close by death, we must now add the name of Buchan. Alexander Buchan (1829–1907) began his real activities in meteorology in 1860, when called to Edinburgh to be secretary of the Scottish Meteorological Society, in which position he did most effective work of a pioneer kind in organizing, collecting and publishing meteorological observations. He published his "Handy Book of Meteorology" in 1867 (second edition, 1868), and his "Introductory Text Book of Meteorology" in 1871. Buchan was the first to trace the path of a "low" across the Atlantic, and to chart the mean pressure of the atmosphere and the prevailing winds of the globe. His best-known work is probably that in connection with the meteorological discussions of the *Challenger* expedition. He was more recently associated with Dr. A. J. Herbertson in the preparation of the splendid "Atlas of Meteorology." He was from the beginning actively interested in Ben Nevis Observatory, and published several discussions of Ben Nevis meteorology. Buchan was a member of the Meteorological Council (1887); an honorary LL.D. of Glasgow; F.R.S. of London and Edinburgh; the first recipient of the Symons Medal of the Royal Meteorological Society; an honorary member of numerous foreign scientific societies. Dr. W. N. Shaw (*Nature*, May 23) well says: "It is not too much to say that the work of Buchan's life has contributed largely to justify the claim of meteorology to be regarded as a separate scientific subject, entitled to separate academic recognition."

R. DeC. Ward

THE RUSSELL SAGE INSTITUTE OF PATHOLOGY

Mrs. Russell Sage has given the sum of $300,000 to found what will be known as the Russell Sage Institute of Pathology as an adjunct to the City Hospital on Blackwell's Island. The securities for that amount have been delivered to the Russell Sage Foundation, and the gift has been formally accepted by the Medical Board of the City Hospital.

Resolutions were adopted by the board thanking Mrs. Sage for this magnificent gift, and expressing appreciation for the honor conferred upon the hospital, "realizing that this has been the first occasion upon which a municipal hospital in this city has been so generously provided for by a private individual for the purpose of fostering medical education and research. "It is the hope of the Medical Board," the resolutions continue, "that this gift of Mrs. Sage may establish a precedent for others which may lead to like endowment in other municipal institutions."

Commissioner Hebberd of the Department of Public Charities has issued a statement in which was laid down the terms of the gift as received in a communication from Mr. Robert W. De Foster, counsel for Mrs. Sage. Mr. De Foster's letter on the subject said:

This institute is to be organized according to the plans and under the direction of Drs. E. G. and T. C. Janeway, with whom are to be associated on the board of trustees, as *ex-officio* members, the Commissioner of Public Charities of the City of New York and the president of the medical board of the City Hospital, and as individual members Dr. D. Bryson Delavan, Dr. Simon Flexner and Professor Graham Lusk. The institute will be promptly incorporated.

The effective work of the institute depends, as you have stated, upon the maintenance and continuance of the helpful relations between the Department of Public Charities and those who are now performing the duties of pathologists to these hospitals. The income of the institute from this source will be based upon the continuance of such cooperation to the satisfaction of the gentlemen named as trustees.

Mrs. Sage hopes that as the result of this endowment the research and educational work of these hospitals will be largely increased, to the good of the general public, and particularly in dealing with the diseases to which old age is liable.

SUMMER FIELD MEETING OF THE SECTION OF GEOLOGY AND GEOGRAPHY OF THE AMERICAN ASSOCIATION

In the issue of Science for May 10 was given the full program of the meeting of Section E—Geology and Geography—of the American Association for the Advancement of Science, from July 3 to 11. It may be added that the subject of the address of Dr. Lane, the vice-president, is "The Early Surroundings of Life." It will be given in the auditorium of the Catholic Summer School, and will be complimentary to the members of the Champlain Assembly. The noon addresses to be given each day after the lunch hour on a subject connected with the excursion of the day have been arranged as follows: "Abandoned Shorelines," by Professor Woodworth; "Iroquois Extinction," by Professor Fairchild; "Paleogeography of the Cambro-Siluric of the Region from the Standpoint of the Stratigraphy," by Professor Cushing; "Lake Champlain," by Dr. Clarke; "Blastoidocrinus and its Type," by Professor Hudson; "The Lower Siluric Paleography of the Champlain Basin," by Dr. Ruedemann; "The Iroquois Beach and Related Features Northeast of Watertown, N. Y.," by Mr. Taylor; "The Adirondack Iron Ores Deposits," by Professor Kemp.

Those who attend the meeting may purchase local excursion tickets to Plattsburg. From many places these tickets are as low as one and one third single fare. The Trunk Line and New England Associations, Canadian Pacific Railway, Grand Trunk Railway, and Canada Atlantic Railway have made a special rate on the certificate plan of one full fare going and one third full fare returning plus 25 cents for certificate fee, which shall be paid to the agent when purchasing return ticket. Tickets for the going journey may be bought and certificate procured from June 11 to September 30. Tickets returning will be good to October 2. In this case tickets should be purchased to Cliff Haven, and the certificates should be procured for "The Catholic Summer School of America." In order to take advantage of this one and one third fare the sum of $1.50 must be paid for membership in the Catholic Summer School. Rooms may be secured at $1.00 a day in the buildings of the Summer School. Members may take their meals at the Champlain Club; breakfast, lunch or supper, 50c.; dinner, 75c. At the Hotel Champlain the rate will be $4.00 a day and upward.

SCIENTIFIC NOTES AND NEWS

Dr. E. H. Sellards, for three years geologist and zoologist to the Florida University, has been appointed state geologist of Florida by Governor Broward. The vacancy at the university will probably be filled by the appointment of a zoologist.

Dr. E. A. Ruddiman, professor of materia medica and pharmacy at Vanderbilt University, Nashville, has been appointed chief food and drug inspector of the Department of Agriculture.

Yale University has conferred the degree of doctor of science on Professor Joseph P. Iddings, who holds the chair of petrology in the University of Chicago, a graduate of the class of '77; and on Dr. A. B. Macallum, who holds the chair of physiology in the University of Toronto. The university has conferred the doctorate of laws on Dr. Herbert Putnam, librarian of congress.

At the fifth annual commencement of the College of Medicine of the University of Nebraska, the address was made by Dr. Nicholas Senn, of Chicago. The doctorate of laws was conferred on Major James Carroll, U. S. A.

Professor Charles S. Denison, of the University of Michigan, has received the degree of doctor of science from the University of Vermont, from which institution he received the degree of civil engineer in 1871.

Amherst College has conferred its doctorate of laws on Mr. Percival Lowell, the astronomer and author.

Oxford University has conferred honorary doctorates of science as follows: Sir Norman Lockyer, K.C.B., F.R.S., director of the Solar Physics Observatory, South Kensington; Sir Richard Douglas Powell, K.C.V.O., physician extraordinary to the king, president of the Royal College of Physicians; Sir William Ramsay, K.C.B., F.R.S., professor of chemistry at University College, London; Sir William Henry Perkin, F.R.S.; William Watson Cheyne, C.B., F.R.S., professor of surgery at King's College, London, and Ludwig Mond, Ph.D., F.R.S.

Cambridge University has conferred the degree of doctor of science on Sir Clements Robert Markham, until recently president of the Royal Geographical Society; on Sir Thomas Hungerford Holdich, known for his explorations in India, and on Sir Thomas Fraser, professor of materia medica in the University of Edinburgh.

The Academy of Sciences of Vienna has elected as honorary member Dr. A. von Baeyer, professor of chemistry at the University of Munich; and, as corresponding members, Dr. Wilhelm Waldeyer, professor of anatomy in the university of Berlin, Dr. Ernst Ehlers, professor of zoology in the University of Göttingen, and Professor Svante Arrhenius, director of the division of physical chemistry of the Nobel Institute of the Academy of Sciences of Stockholm.

The British Iron and Steel Institute has awarded its Bessemer gold medal to Dr. J. Brinell, Stockholm, for his researches on the changes in the structure of steel with temperature changes.

The Association of German Chemists has awarded its Liebig gold medal to Dr. Adolf Frank, the founder of the German potash industry.

The Italian Scientific Society has conferred its gold medal for mathematics on Professor G. Lauricella, of Catania.

A gold jubilee cup has been presented to Sir Charles A. Hartley by the European Commission of the Danube, in commemoration of the fiftieth anniversary of his engagement as engineer-in-chief to the commission.

On the occasion of the celebration of the twenty-fifth anniversary of the founding of the Russian Pirogoff Surgical Association at St. Petersburg ten foreign honorary members were elected—Drs. Senn, Roux, Lennander, Watson, Horsley, Quénu, Poncet, Rydigier, Roentgen and Trendelenburg.

Mr. Edward Roberts has retired from the position of chief assistant of the British Nautical Almanac Office, and has been succeeded by Mr. P. L. H. Davis, F.R.A.S.

Professor Arthur Fairbanks, who holds the chair of Greek at the University of Michigan, has been elected director of the Boston Museum of Fine Arts.

Professor E. H. Starling, of the University of London, has accepted the invitation to give the Herter lectures at the University and Bellevue Hospital Medical College. The lectures will commence after the Christmas recess, and their subject will be "The Fluids of the Body and their Regulation." They will deal with the production and absorption of lymph, the intake by the intestines and the output by the kidneys; with the regulation of the total amount and molecular concentration of the body fluids under varying conditions, such as bleeding, transfusion, heart-failure, dropsy, muscular exercise, high altitudes.

The Weld Hall of Ethnology of the Peabody Academy of Science, Salem, Mass., was opened on the evening of June 26, when an address was made by Dr. Edward S. Morse, the director of the academy.

Dr. Paul Gordan professor of mathematics at Erlangen, has retired from active service.

Dr. Otto Müller has been given the title of professor at Berlin, in recognition of his work on diatoms.

Professor W. G. Farlow represented Harvard University on the occasion of the Linnæan celebrations at Upsala and Stockholm.

Professor E. Riccioli, of Rome, has visited Boston and inspected the parasite work conducted by Mr. A. H. Kirkland in connection with the gypsy and brown-tail moth crusade.

At Oberlin College, the leave of absence of Professor Maynard M. Metcalf and of Associate Professor Robert A. Budington is extended for another year, owing to the delay in the completion of the zoological laboratory.

Professor J. Perrin Smith, of Leland Stanford University, and Professor J. Culver Hartzell, of the University of the Pacific, will spend three or four weeks during the summer in the western and central parts of Nevada. Dr. Smith will study the stratigraphic, and Dr. Hartzell the physiographic and structural, features of the West Humboldt, the east and the Dosatoya ranges in particular.

Professor Newton has bequeathed to Cambridge University his natural history collections and library, together with the cabinets, cases and apparatus; also his copyrights, books, pictures, prints, drawings, letters and papers relating to natural history; also the sum of £1,000, whose annual income is to be employed in keeping up and adding to the library.

Dr. Thomas Evans, professor of chemistry in the University of Cincinnati, dean of the

College of Engineering, died on June 28, at the age of forty-four years.

Mrs. Elizabeth Cabot Cary Agassiz died on June 27 as the result of paralytic stroke. Mrs. Agassiz was born in Boston in 1832 and in 1850 married Louis Agassiz, with whose work she was intimately associated, and whose life she wrote. Mrs. Agassiz was president of Radcliffe College until 1902.

M. U. Le Verrier, professor of metallurgy at the Paris Conservatory of Arts and Trades, has died at the age of fifty-nine years. He was the son of the eminent astronomer.

Civil service examinations will be held as follows: On July 17, for the position of aid in arboriculture, at salaries ranging from $600 to $1,000 in the Bureau of Plant Industry; assistant in grain standardization in the same bureau at salaries ranging from $1,000 to $1,200; as aid in the Coast and Geodetic Survey at a salary of $730; on July 24, for veterinary inspector in the Bureau of Animal Industry at a salary of $1,400, increasing to $1,800; for the position chemist aid in the Bureau of Chemistry, Department of Agriculture at a salary of $1,000, applications for which may be filed at any time. The length of time any chemist aid may serve in this capacity in the department is limited to two years. It is expected that within that time aids will qualify for other positions in chemistry through appropriate examinations.

The first party to take the field in connection with the cooperative investigation of the Atlantic Coastal Plain by the United States and the local geological surveys, under the direction of Mr. M. L. Fuller, of the United States Survey, is that of Mr. E. W. Berry, who has made a beginning on a detailed study of the Cretaceous flora in North Carolina. The work will include both an investigation of the river sections throughout the state by means of canoe and a thorough examination by wagon of the inter-stream areas. The expense is borne jointly by the North Carolina and national surveys. Much detailed information in regard to the lower Cretaceous floras of the state has already been obtained, and the results promise to throw considerable additional light on the Cretaceous geology of the region.

During the past winter, Mr. Robert T. Hill has completed his monograph of the geology of the Windward Islands for publication in the Proceedings of the Museum of Comparative Zoology at Harvard University. This work completes Mr. Hill's series of studies on the islands of the American Mediterranean. Mr. Hill has also completed the geological map of Trans-pecos, Texas and eastern New Mexico, which finishes the work upon which he has been so long engaged in the Texas region. He has also made for the first time preliminary reconnaissance geological maps of the Mexican states of Chihuahua, Sonora, Coahuila and Nuevoleon, and western New Mexico, Arizona and southern California. This series of reconnaisance maps, based upon Mr. Hill's long residence and study of the southwestern region, constitutes a map completely crossing the continent along the Mexican border region, and places on record the relations of the following geographic and geologic features of our country: the southern termination of the Rocky Mountain proper in New Mexico; the numerous individual mountains extending south therefrom, collectively constituting the Sierra Madre of New Mexico, Texas and northern Mexico; the outlines, boundaries and individual mountain ranges of the great Chihuahuan Desert; the southern edge of the Colorado Plateau, the area and boundaries of the great western Sierra Madre of Mexico, and the boundaries, mountain ranges and geology of the great Sonoran Desert also of Colorado, Arizona and Sonora. The geological map of Chihuahua will be published at an early date by the American Museum of Natural History in connection with a paper which Dr. E. O. Hovey has in press. The map as a whole, or parts thereof, are at the disposition of any research worker of the natural phenomenon who may wish to use the same.

The Journal of the American Medical Association says: "Last March many prominent physicians in America received notices to the effect that they had been elected honorary members of the *Academia fisico-chemica Italiana,* of Palermo, Italy. Each notice was accompanied by a complimentary reference to the man's scientific achievements and the request that he would send his photograph and a copy of some of his works for the library of the academy. The notice was also accompanied by a copy of the by-laws, from which it was seen that persons elected to honorary membership were expected to pay $5 for clerical expenses of the certificate of membership, etc., and an additional sum for the engraving of the medal sent to each honorary member. The *Ztschr. f. aerzt, Fortbildung,* in a recent issue, states that similar notices have been sent to numerous prominent physicians in Europe, but that inquiry in Italy brings word that 'the so-called academy is not an institution founded for scientific purposes, but consists of more or less obscure elements who under this title devote themselves to personal and material aims.' The Berlin professor whose name figures on the prospectus of the 'academy' declares that he knows nothing at all of such an institution and that the use of his name is unwarranted. Our exchange adds that a number of physicians at home and abroad forwarded the money, etc., asked for by this 'pseudoacademy in this ingenious money-making scheme.'"

UNIVERSITY AND EDUCATIONAL NEWS

THE state legislature has passed measures providing for the development of the University of Wisconsin in three important directions. It has authorized the establishment of a college of medicine prepared to give the first two years of preclinical training. An appropriation of $20,000 annually has been made for the development of the department of university extension, which includes a correspondence branch. The sum of $100,000 per annum for four years has been appropriated for the erection of a woman's building and gymnasium, and the construction of the first of a system of dormitories and commons for both men and women. In addition the legislature continued for two years more the present building fund of $200,000 per annum, which will be used to erect buildings for biology and the allied departments of pathology, physiology and bacteriology; for horse-breeding and veterinary science, and for the addition of a wing to the engineering building.

AT the recent meeting of the board of trustees of the University of Alabama the erection of the following buildings was authorized: A central heating, lighting and pumping station, an engineering building and a building for the geological museum and the schools of geology and biology. The cornerstone of the museum building was laid May 28, the address on this occasion being delivered by Governor Braxton Bragg Comer. The building is to be known as the Eugene A. Smith Hall in honor of the services rendered during many years to the university and to the state by Dr. Eugene A. Smith, professor of mineralogy and geology and the state geologist of Alabama.

THE new medical college of the University of Manila, which will be opened early in September, will pay special attention to tropical diseases. The Philippine government has appropriated $62,500 for the expenses of the first year of the institution.

GENERAL WM. J. PALMER has given the Engineering School of Colorado College, in Colorado Springs, the sum of $12,000, to be expended immediately on additional equipment in the engineering laboratories for senior work.

THE late Mr. Basil McCrea has left £75,000 to Magee College, Londonderry, for the erection of residences for the professors, the further endowment of the existing chairs, and the foundation of scholarships.

UPON the recommendation of the faculty of the college of applied science, the board of regents of the State University of Iowa has determined that the degree to be given to graduates in engineering shall hereafter be bachelor of engineering. Twenty-one graduates this year received the several degrees of bachelor of science in civil engineering, in electrical engineering, in mechanical engineering and in forest engineering.

At the commencement exercises of the university of Nebraska, June 13, degrees were conferred as follows: Bachelor of arts, 147; bachelor of science, 44; bachelor of laws, 33; master of arts, 15; electrical engineer, 1; mechanical engineer, 1; doctor of philosophy, 3. Of the bachelors of science, 17 were in electrical engineering, 10 in civil engineering, 2 in mechanical engineering, 2 in agriculture, 1 in forestry, and 12 in general science. Of those taking the master's degree 6 were in science (botany 3, chemistry 2, zoology 1), 3 in education, 3 in literature, and 3 in language. Two of the doctors of philosophy were biological students, one taking zoology as the major, with botany as the minor, while the second took botany as the major, with zoology as the minor. The third doctorate was conferred for work in ethics (major) and metaphysics (minor). Arrangements have been made for formal closing exercises at the end of the University of Nebraska Summer School on July 26, at which time degrees will be conferred upon such university students as have completed their work, whether in undergraduate or graduate courses. Fourteen students have announced themselves as candidates for degrees at this time. This arrangement makes it possible for candidates to come up for degrees in June (at the annual commencement), July (Summer School Closing Exercises), or in February (midwinter commencement).

Dr. B. H. Raymond has resigned the presidency of Wesleyan University. A chair of bible study has been established for him.

Dr. George Santayana, assistant professor of philosophy at Harvard University, has been appointed professor of philosophy.

Dr. Otto Folin, research chemist at the McLean Hospital, has been appointed associate professor of biological chemistry in the Harvard Medical School.

Dr. W. M. Munson, for more than fifteen years professor of horticulture and horticulturist of the experiment station at the University of Maine, has resigned to accept a similar position at the University of West Virginia.

Mr. L. E. Moore, instructor in theoretical and applied mechanics, University of Illinois, has been appointed assistant professor of civil engineering in the Massachusetts Institute of Technology to take the place made vacant by the resignation of Professor F. P. McKibben. Mr. Moore graduated from the University of Wisconsin in 1900 in the Department of Mechanical Engineering. He studied structural engineering at the Massachusetts Institute of Technology and has been teaching mechanics and structures since 1903 in the University of Wisconsin and the University of Illinois. He has had practical experience on the Illinois Central Railroad and also with the Phœnix Bridge Company, and other concerns.

Messrs. G. L. Hosmer, C. B. Breed, and George E. Russell have been promoted to be assistant professors in civil engineering at the Massachusetts Institute of Technology. Messrs. Hosmer and Breed are the authors of a text-book of surveying published a year ago by Messrs. Wiley.

Dr. J. Carleton Bell, Ph.D. (Harvard), instructor in experimental psychology, Wellesley College, has been appointed to take charge of the new psychological laboratory in the Brooklyn Training School for Teachers.

Miss Helen D. Cook, this year fellow in philosophy and psychology, Wellesley College, has been awarded the Alice Freeman Palmer fellowship.

Dr. Paul Clements, of Maury County, who has been serving as surgeon in the Philippines, has been elected to a professorship in the University of Manila and will sail for that place September 1.

Dr. R. K. McClung, who has been senior demonstrator in physics in McGill University for the past three years, has been appointed to the chair of physics in Mount Allison University in Sackville, New Brunswick. Dr. McClung is a graduate of McGill, and later of Cambridge, England, where he studied under Professor J. J. Thomson.

Mr. Thomas Barlow Wood, reader in agriculture at Cambridge University, has been promoted to the chair of agriculture.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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CONTENTS

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THE AMERICAN TYPE OF UNIVERSITY[1]

Mr. Chancelor, and Ladies and Gentlemen, and, more particularly, you young men and women of the Class of 1907:

There is no more fascinating, indeed no more exhilarating, spectacle than a commencement scene in an American university, on a clear and bracing morning in the rosy month of June.

It is not only the hour when an eager and ambitious class—justly proud of substantial intellectual accomplishments, with the proper confidence which comes of very considerable intellectual discipline, truly courageous and sanely idealistic through much contact with the very best in human life—receives the standard stamp of approbation and commendation which the best scholarship can give; but it is also the hour when the university comes out into the open and presents to the activities of actual life the finest new energies which it can generate and train.

There are universities—and many of them—in other countries which never have commencements. They give credits for work done, and when one has enough credits he exchanges them for a degree. I say *he* because the women have little or nothing to do with it. The whole thing is as guiltless of ideality, of imagination, of incentive, of spirit in any form, as the building of a canal-boat or the buying of a pair of shoes. There are universities in this country which have inherited so much from

[1] Commencement address at Syracuse University, June 12, 1907.

the universities of the old countries that they are able to understand the spirit and meet the educational needs of the United States only with the greatest difficulty and only in the most apprehensive, ponderous, and distressing kind of way. And there are universities in all countries which have inbred so much, which are so self-satisfied, which have got so much transmitted 'culture' which did not come through heavy work, that they are innocently unjust and necessarily unfair to the people upon whom they must depend for the continuous reinforcement of virile life. There is a scholarship so unemotional as to be gloomy, so aristocratic as to be useless, so 'cultured' as to be insipid, so cynical as to be tormenting; but scholarship of the modern type in America has little in common with it.

The great fact that makes a university commencement in our country of such absorbing popular interest is that it is the annual occasion of an *American* university. The world sees, if willing to see, a new type of university in this country in the last half-century. Let us inquire, with necessary brevity, how it has come to be, and what are the features which distinguish it.

All of the older social systems of the world, no matter how proficient in political philosophy or in the arts and sciences of civilization, have shown a distinct cleavage between the upper and the nether classes. The names of things have been different in different countries and the things themselves have had all manner of forms and colorings, but the fact has been well-nigh universal that there have been two great classes and that a small higher class has ruled a much larger lower class. As universally as this has been true, the universities have been the creations and have reflected the outlook and executed the purposes of the higher class. The outlook of the higher class has seldom caught a glimpse of the wisdom of giving every one his chance, and the self-interest of that class has never been much tempered by anxiety for widely diffusing a universal learning. The change has come through the fact that in this country the larger class is having something to say about it.

Until in our country, and practically in our time, the university has stood for some manner of exclusiveness. It may have been for a monarch and what he implies; it may have been for a more or less constitutional state; it may have been for a church; it may have been for a profession or a guild: never, until now and here, has it stood for all learning and for all the people.

This was almost as true of early American as of foreign colleges or universities. We too often forget—if, indeed, we have ever realized—that our American democracy, with its great elements of toleration, equality before the law, free right of opportunity for all, no special privileges, and with its public institutions of equal service to all, did not all at once come full-fledged into the world by the migration of a few thousand people of well-settled notions across the sea. The common thought and the social and institutional life of the old world persisted in the new world. Harvard, William and Mary, Yale, Princeton, Columbia, Pennsylvania, Rutgers, Brown, Dartmouth, all stood for aristocracy in the state, for denominationalism in religion, and for a learning which was exclusively culturing and professional. They never dreamed of uplifting the common people or of applying scientific research to the industries of the country.

It does not signify any lack of appreciation of the great qualities which the early settlers brought to this country, to say that the dominant and distinguishing thought of the nation has come from the compound-ing of a new nation out of pretty nearly all kinds of people in the world. The very necessities of the situation have broken down all general distinctions between classes and brought forth a national political philosophy with a universal freedom of initiative and a popular efficiency in consummation which the world has never seen before. It is this which has made a new manner of university. It has remodeled the earlier universities and it has brought very quickly into vigorous life many powerful institutions which stand for the universal purpose to promote the universal good. Some of them have resulted from the benefactions of a man of wealth, some from the leadership of a great executive and the work and love of a multitude of others who had little besides work and love to give, and some through the popular determination working through the political machinery of the state. But *all* have had to appeal to a constituency which was wider than any class, or sect, or party, and such as have been able to meet the needs of such a constituency have found overwhelming support and response to their ability to do it.

It is interesting to note that the university development has been strongest where our democracy has been the freest. As new states were settled to the westward by a people who lacked little in moral purpose and nothing in initiative or in courage, they not only took good care of an elementary school system but commonly provided for a state university in their new constitutions. The older states could not do that when *they* were organized because neither legal opportunity, nor political philosophy, nor educational theory, nor the force of popular initiative were up to the point of doing it at that time. And the lead in freedom and in force of popular initiative which the newer states gained from the fulness of their opportunity, they seem likely to hold. They are certainly diffusing the higher learning more completely among all the people without regard to heredity or wealth than any other people in the world. They have established proprietorship in a universal school system of sixteen grades, beginning with the kindergarten and continuing along a smooth and unbroken road up to and through the university, which is unique in the history of education. They see, as most of us in the east do *not* see, that the logical educational result of our fundamental political theory, that every child of the republic shall have equality of opportunity, leads to a university so free at least that none who is prepared for it and aspires to it shall fail to get it only because he lacks the money to pay the cost. It is as inevitable as the natural outworking of our political philosophy is certain that this ideal will obtain in the course of time wherever the presence of the flag of the union determines the educational policy of a people.

When it was settled that we were to have a universal public high school system all over this country, it was practically settled that we should have a public university system as well. One thing in intellectual evolution and educational opportunity accomplished in America, another thing—and a higher thing—will follow almost as a matter of course. If one asks where it is to end, the answer must be "I do not know." The hereafter ought to have some things to settle, and that is one of them.

The building of public high schools made it certain that the colleges already established would have to forego much of their exclusiveness and that there would be new colleges and groups of colleges in which the control would not be with any class.

The great difficulty with the systems of education in other lands is not that they have no elementary school system. They very generally have excellent ones. Attempting less than we do in the primary schools, they sometimes do it better than we do; and, better still, they have less difficulty than we do in making every child attend upon the instruction provided for him. Nor is the difficulty that they have no university system. Very generally they have an excellent one, from which we have much to learn. The difficulty is that there is no connecting link between the two, and that it is not intended that there shall be one. There is not only no continuous road from one to the other, but there are insurmountable barriers between them. The universities serve an exclusive class, and no matter how educationally entitled a child of the masses may be, it is difficult, almost to the point of prohibition, for him to secure the advantages of the advanced schools.

That is the thing which the fundamental political philosophy and the deliberate democratic purpose of this country are obviating. It is not that any of us are against all the exclusiveness that anybody wants in his private or family life. We all want some of that ourselves; it is a matter of temperament, of congeniality, of experience and of taste, and in personal affairs these are to have their way; but the public policy of the country will give every one his public chance, his equal opportunity—at least so far as the common wealth and the common political power are used to create individual opportunity at all.

Happily, the high-school movement in America has proved to be a great disorganizer of classes, as well as a great help to the diffusion of higher learning. It has made men and women of all classes know each other better and regard each other more. It has gained and retained the interest of many of quick mentality, marked business success, and newly-acquired wealth in popular education. It has been the secret spring of many a great gift to a university, and of much munificence for the common good.

And, whatever else it has done, it has created an overwhelming influence for the development of universities and for determining the essential features of new universities in America. There was reason for the earliest and most decisive manifestation of this movement in the newer states. There were no old-line academies and colleges there to stand in the way of it. The settlers were of the finest New York and New England stock: they knew about the very best in education. The parents were ready to lay down their all, even their lives, for their children; and they had a clear field. Of course, with such a people the school house became the most conspicuous building in the pioneer village, and of course a little 'college' sprang up in every considerable town. Of course, again, with such a people the public high school had its quickest and perhaps its most luxuriant development. The sooner the high school became a fact the sooner higher education became a passion. When the federal land grants were made to higher education in all the states, right at the darkest hour in the Civil War, the eastern states hardly knew about them at all, and have never made more than perfunctory and indifferent use of them, while the western states have seized them with avidity, put them to their utmost possibilities, added to them from ten to an hundred-fold, and cry for more with an eagerness and an audacity that would have made young Oliver Twist a veritable hero.

And these federal land grants in themselves have had much to do in fixing the predominant type of university in America.

With them, with the complete recognition of the principle that it is within the functions of a democratic state to do—or to delegate the legal power to do—whatsoever the people want to do for learning, and with general education boards with millions at their disposal every year for the higher institutions, it is not difficult to see that the colleges and universities in America which will endure will minister to all the people, without reference to their means, and will promote every phase of honorable endeavor without regard to class or station.

Let it not be inferred that the typical American university is, or is to be, the poor man's university. It is not to be burdened with any qualifying adjectives. It is to be the rich man's and the poor man's alike. Its strength is, and is to be, in the fact that it is representative of the common life. It is to be no more exclusive than the constitution of the country is exclusive, save upon the one point of ability to do its work. It brings rich and poor, men and women, together upon the basis of advanced scholarship, and it gives intellect an opportunity which is distinctly higher and nobler than any that can follow the mere accidents of birth or the mere incidents of life.

No university can be a real or an effective American university and follow the exclusive educational ideals of other countries and other times. A new nation has been compounded in this country out of people from all social, industrial, political and moral conditions in the world. That nation is working out its own salvation. It is doing it upon lines that are peculiar to itself. I think it is doing it safely and effectually. The net result will be the freest and the finest uplift to the intellectual and moral state of men and women that the world has ever seen. This thing is not only going through this nation, but, largely through the instrumentality of this nation, it is going through the world. It must, of necessity, create instrumentalities which are peculiarly its own. Above all, its educational institutions of the first rank, which must regulate the ebb and flow of the nation's best and truest thought, can not be limited by ideals which had reached their zenith before our nation was born and before our political science had begun to make its revolutionary impressions upon the thinking and the destiny of mankind. Nor, indeed, can we be limited by conditions which prevail at this time in other nations and their institutions. Without, by any means, descending to the low level of declaring that things in this country are better than things in other countries only because they *are* in this country, and cheerfully recognizing the vastness of the knowledge we are yet to gain from other lands, I dare make the declaration, in words that will leave little to be misunderstood, that we can not follow the British university, with its narrow, purely classical and purely English scholarship, which is studiously prevented from being broadened by that fatuous policy of the ruling classes which stubbornly refuses the organization of all secondary schools through which the only people who can broaden it may come to the universities at all. We can not accept the scheme of the French universities, overbalanced as they are with the mechanical and the imaginative, and dominated by the martial feeling and the military organization of a people who need the opportunity of thinking freely above all other things. Nor can we copy the German university, which puts the scientific method first, regards sound morals but little, and conveniently absolves itself from all responsibility about the character of its students, so long as they can use a microscope to magnify the strength of the empire. And if we can not be guided by the English or French or German universities, we can not be guided by any. We will take and we will leave whatever will serve our ends either by taking or leaving. We will build up institutions which make for scholarship, for freedom and for character, and which, withal, will look through American eyes upon questions of political policy, and train American hands to deftness in the constructive and manufacturing industries of most concern to the United States.

There has been no more noteworthy or promising development in our intellectual, political, or industrial life than the flocking of students in recent years to the universities which show a rational appreciation of the educational demands of our American life, and a reasonable disposition to meet the needs of the educational situation. Even where a university is not situated in a large city and is not sustained by an attendance which *will* go somewhere and can go nowhere else, it has stood in no need of students or of support if it could enter into the spirit of the Republic and would offer sound instruction which had some human interest and some real bearing upon practical training for our own professional and industrial life.

A mere English or culturing training, no matter how excellent and necessary a thing in itself, is no longer a preparation for the professions. The legal profession demands that and also a great and varied special library; a knowledge of legal history and theory; certainty about the statutes and the decisions; aptness at associating all in a comprehensive and logical whole, and readiness at applying the correct parts to new cases. It requires years of study under expert and practical teachers, with ample accommodations, in a special school, almost necessarily associated with a university. Medicine claims the English training, and then exacts years of research in chemistry, zoology, bacteriology, physiology and other fundamental and kindred sciences, requiring great laboratories and costly equipment which can hardly be provided at all outside of the great universities. After that, the theory and practise specially appertaining to the profession must have a special school, and again almost necessarily, one associated with a university. It is the same with architecture, and engineering, and agriculture, and all the professional and industrial activities of the country. It is even largely so with the fine arts. All demand the libraries, and laboratories, and drafting rooms, and shops, and athletic grounds, and gymnasiums, and kitchens, and all the other things which only the large universities can provide, and all students do their own work more happily and absorb much from the work of the others when they get their training in association with the crowd in the university. Wherever the university offers all these things, there the students gather; there thought is free—but is very liable to have the conceits taken out of its freedom; there the actual doing outweighs the mere talk; there practical research cuts dogmatism to the bone; there honest work has its reward, and pretense its quick condemnation; there men and women measure up for what they *are* rather than for what they claim; there inspiration is given to every proper ambition, and there a great and true American university develops.

All this has led to some very sharp differentiation between the external forms and the manner of government and the plan of work of American and foreign universities. For example, the board of trustees is largely peculiar to American universities. It stands for the mass in university government and policy. On the other side of the sea there is no *mass* in university affairs. Charters run in the name of the king; the king is the head of the university, as of the state; and the king, or the king's minister, determines the course the university is to pursue. The early American colleges were all chartered by the king; even parliament had no part in the matter. In the midst of the revolution, just following the defeat of St. Leger at Oriskany, of Clinton in his movement up the Hudson, and of Burgoyne at Saratoga, when neither king nor parliament were much in vogue in New York, and when a petition was presented to the young state government for the chartering of Union College, there was not a little embarrassment as to whether it should be addressed to the governor or to the legislature, and as to which should deal with it. Yankee ingenuity met the difficulty by addressing the prayer to both, and statecraft split the difference by creating the board of regents to deal with such matters. But, however chartered, the board of trustees stands for the donors, the creators and the public, in giving trend to the course of the university. The point of it is that the founders, either the donors or the public, or both, are represented in the matter.

There is no office like our *presidency* in foreign universities. The reason for this appears in the fact that there is no faculty to be gathered, assimilated, partly eliminated, reinforced, and dealt with, according to our usage. The reason for *this* is that the intellectual provender is provided upon the *European* rather than upon the *American* plan. You pay for what you get, rather than pay for everything and then take what you like. The charges are for single courses. The professor gets the fees. The thing works automatically. If he can not teach he lacks students and soon obliterates himself. So far it is well. If another comes along who can gather students, he is welcome. There is something to be said for the system, but it lacks comprehensiveness, grasp, and the strength to bear responsibility for the balanced training of youth and the harmonious evolution of character. It will suffice where the institution has no care about intellectual balance or morals, and therefore it will not do in this country. The office of president holds things together, makes the parts fit into each other, stands for the public, the trustees, the teachers, the parents and the students, and carries the whole forward to the great ends for which a wealth of money, and of holy effort, and of the world's wisdom, has been put into it. And there is nothing clearer than that the university flourishes, that is, that the purposes of all that centers in the creation are most completely accomplished, when it has a sane and capable all-round executive who can mark out a good way and has *will* enough to make it go.

The early American colleges, copied upon foreign prototypes, have had to do so much readjusting that their old friends would not recognize them, and the ones which came a little later have naturally been created to fit a situation and fall in with a very general order. From now on they will not be able, and probably they will not be disposed, to dominate university policy in the United States. They will be obliged to work in accord with the overwhelming number of universities, colleges and secondary schools taken together. They will have to accept students *who can do their work* and who want to do it, without so much reference to how or what they have studied somewhere else. The western boys and girls say that under the accrediting system, by which institutions are examined more than students, it is easier to get into western than into eastern universities, but that, once in, it is hard to stay in a western university, while one who gets into an eastern university can hardly fail to be graduated if he will be polite to the professors and pay the term bills. And the western people say that their way is best; that every one must have his chance; that at least his chance is not to be taken away upon a false premise; that if he "flunks out" after having had his chance it is his fault and no one is going to worry about it; and that it is better to regard the graduation standards and apply them to four years' work that the faculty must know all about than to make a fetish of entrance requirements and have so much ado about prior work—about which they can know very little at the best. It is all worth thinking about. I am not a westerner: I am thoroughly a New Yorker. But I am for the open, the continuous and the smooth road from the primary school to the university, and for every one having his chance without any likelihood of his losing it upon a misunderstanding or a hazard.

The large and strong universities will not only wax larger and stronger, but they will multiply in number. Because there will be so many of them, no one of them will serve so widely scattered a constituency as heretofore. Women are going to have the same rights as men to the higher learning. Boys will not always go to a university because their grandfathers went there. The time will come, while members of this graduating class are yet in middle life, when every large and vigorous city and the territory naturally tributary thereto will have a great university, able not only to satisfy its needs of the culturing studies but also its demands for professional and business upbuilding.

What is to become of the literary colleges? They are to flourish so long as, and wherever, they can provide the best instruction in the humanities, and do not assume names which they have no right to wear, and do not attempt to do work which they can only do indifferently. They will train for culture and they will prepare for the professional work as of yore. And wherever one does this well and is content to do so, it is to have every sympathy and support which an appreciative public can give. But no institutions, of whatever name or grade, are going to fool all the people for a great while, and the young men and women of America are going to have the best training that the world can give, and have it not a thousand miles from home. It is no longer necessary to cross the sea in order to get it, and even our own older universities are close upon the time when their work must be reinforced from the newer ones, more than the newer ones from the older ones.

Obviously, the American university, as no other university in the world, must regard the life, and especially the employments, of the people. It must exhibit catholicity of spirit; it must tolerate all creeds; it must inspire all schools; it must guard all the professions, and it must strive to aid all the industries. It must quicken civic feeling in a system where all depends upon the rule of the people. It must stand for work, for work of hand as well as of head, where all toil is alike honorable and all worth is cornered upon respect for it.

In a word, our immigration is making a nation of a wholly new order; our democracy is developing a new kind of civilization; our system of common schools, primary and secondary, has brought forth a type of advanced schools peculiar to the country. Institutions that would prosper may better recognize the fact. The universities that would thrive must put away all exclusiveness and dedicate themselves to universal public service. They must not try to keep people out: they must help all who are worthy to get in. It is not necessary that all of these institutions shall stand upon exactly the same level; it *is* necessary that each shall have a large constituency; it *is* necessary that all shall connect with some schools that are below them. It is imperative that all shall value the man at his true worth and not reject him because his preparation has lacked an ingredient which a professor has been brought up to worship. Essentially so when, in case the boy has studied the subject in the high school, the professor is as likely as otherwise to tell him that he has been wrongly taught and that he must get what he has learned out of his head before he can start right and hope to know the thing as he ought. It is necessary that all shall be keen enough to see what is of human interest and broad enough to promote every activity in which any number of people may engage.

The American university will carry the benefits of scientific research to the doors of the multitude. It will make healthier houses and handsomer streets, richer farms and safer railways, happier towns and thriftier cities, through the application of fundamental principles to all the activities of all the people. It will train balanced men and women and therefore it will promote sport as well as work and control the conduct of students as well as open their minds. It will not absolve itself from any legitimate responsibilities which instructors are bound to bear towards youth. It will preserve the freedom of teaching, but it will not tolerate freakishness or license in the name of freedom of teaching. It will engage in research as well as instruction, but when men absolve themselves from teaching for the sake of research it will insist upon a grain of discovery in the course of a human life. We have a distinct national spirit in America. An American university will understand how that has come to be and what it is aiming at, will fall in with it, will be optimistic about it, and will help it on to its fullest consummation.

I have discussed this theme here because it ought to be realized by the people and particularly by the universities of New York; because I think the university which I have the honor to address is—quite as completely as any institution in the state—actuated by the spirit and outlook which an American university must have, and therefore because I had reason to believe my discussion would have hospitality under this roof. I would be false to my sense of justice and my standard of public usefulness if I did not say that since my return to the state it has appeared more and more clearly to me that the marvelous growth of Syracuse University has resulted from the fact that it has been moved by the true spirit of modern American university progress.

I know something of the details of university evolution. I know that many people have combined to produce this splendid evolution. It has all come from individual giving and cooperative effort. The people of this thrifty inland city have surely done much for it. The return upon the investment will be a great one—how great only a few can now foresee. The Methodist church has been true to its history, its character and its aggressive democratic spirit, in the valiant support it has given to this university. The donors who have made its equipment possible, the trustees who have kept it in the middle of the road, the teachers who have given it tone and distinction, the students and the graduates who have given it reputation for energy and valor, are all entitled to a warm word of commendation and congratulation from an educational representative of the state. And to you, Mr. Chancellor, for the masterful management which has bound all of these factors together and wrought out this magnificent creation, I shall always, respectfully and heartfully, remove my hat.

I can not close without a direct word to this graduating class. It is essentially their day and my direct word to them has already been too long delayed. They would hardly realize that they had been graduated, without a little preachment. Young men and women, you have now learned enough to cause you to fear a little. But fear not overmuch. You are reasonably prepared for work; hesitate not to go about it. There is a place for you, but you will have to go and win it. The rivalries will be sharp; but you have as much chance as any. Your salvation is to come through work. The world honors the man or woman who loves and honors work. It makes little matter what the work may be; take a step at a time and keep doing it all the time. You will always have knowledge and strength for the next step. Think not so much about the wages as about health and responsibility and the knowledge and skill for more and better work. You are not entitled to exact much yet. Make the best of whatever opens to you. Be prudent, but not over-prudent. "A penny saved is a penny earned" is a maxim which is not true. In many a case the penny saved is a dollar lost, and it sometimes happens that it is public respect and fraternal regard lost. Do not stand aloof; certainly do not be a cynic; above all, do not get to be a freak. Keep step with the procession. It is a pretty good crowd and it is generally moving in the right direction. Have standards and stand by them. You can live by yourself and maintain your standards with little trouble, but then the standards will be of small account and you will make no more impression upon life than as though you had never lived. Reinforce yourself all the time. Accumulate a library. While you follow a business with devotion, seek recreation in literature, particularly in the literature of biography and history, that your lives may have more joy in them, that you may gain the inspiration that quickens action, that you may follow your business to the fullest measure of success and round out your years with the fullest regard of the people among whom you live. Be patient. Keep steady. Bide your time. Success in the game will not come by a chance play, no matter how brilliant, so much as by uniform efficiency and unceasing persistence. It is remarkable how men and women go up or down according to the direction they take and the regularity with which they keep at it. If you have a fair foothold at forty, you will be a round success at sixty. Be tolerant, but have faith in things. Do not let your student habit of inquiry and investigation unsettle all the faith that you learned at your mother's knee. Believe in your village, your ward, your city, your state. Sustain a church and at least some of the philanthropic effort that sets rather heavily on one half of the world but ameliorates the hard situations of the other half. Act with a party; yell for a ticket; whoop it up for the flag. Withal, don't take yourselves too seriously. You will count for more if you do not. See things in sane perspective. Have a sense of humor in your outfit. Cultivate cheerfulness. Love sport, and play for all you are worth. Don't get to be one of the lunatics who work eighteen hours a day, recognize no Sundays, and never take a vacation. Submit to no coercion. Think out what is about right and stand by it. The others will eventually have to come to it. If you find you are in error, back out without attempting to disguise it; the farther on you go the more humiliation you will have. Be a good mixer. Give and take. Meet every obligation. On the basis of common decency make all the friends you can. Then you will carry the spirit of your university with you and do much to pay the debt which you will always owe her.

But be on the alert for special opportunities to help her. Assume not too conclusively that it must be in the conventional way. The unexpected will happen. Half a dozen years ago the richest man in the country became suddenly ill. In the absence of his regular physician he called in a young graduate of the Harvard School of Medicine and impulsively assured him that if he would get him out of that scrape he would pay any charge that he might make. The case was not serious to an educated man. The young man understood the difficulty and soon he wrought the needed cure. No bill was sent and in time it was asked for. The young physician reminded the multimillionaire of the promise. "Oh, yes," he said, "but I assumed, of course, that your charge would be within reason." The doctor's time had come. He said: "I shall make no charge, but I shall ask you to do something for me. The Harvard School of Medicine needs help. I would help her if I could. Under all the circumstances I feel warranted in asking you to look into the matter with a disposition to aid her justly, as you easily may." The old man said, "Would you like to bear a message to President Eliot?" "Yes." "Ask him to come and tell me all about it." In a week the man of wealth had given his pledge to the president of Harvard for a million when the balance should be raised, and in a month the five millions had been assured which have erected and equipped the finest plant for a medical college that is to be found in the wide, wide world.

You may not accomplish all these things, but if you will aim at them, if you will put the training of this university to its logical use, I am sure that when the long shadows come they will bring ease and comfort and honor and that when it is all over there will be peace with the hereafter.

ANDREW S. DRAPER
DEPARTMENT OF EDUCATION,
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SCIENTIFIC BOOKS

A Text-book of Botany and Pharmacognosy, intended for the use of students of pharmacy, etc. By HENRY KRAEMER, Ph.B., Ph.D., A.B. Pp. 840. Illustrated with 321 plates and upward of 1,500 figures. Lippincott & Co.

To regard a piece of work as good pharmaceutical botany, under the educational conditions which have existed in modern pharmacy, is practically equivalent to a declaration that it is not good botany. The theory of professional education, that the technical study of a subject follows that of its general field, has not here applied, since, except in a very small minority of cases, such general preparation has been wanting. The teacher in the pharmacy school has been faced by the problem of presenting the technical aspects of his subject to students wholly unprepared for them. If he essays to supply this needed preparation, he encounters a strong protest from a profession that in the main regards schooling as objectionable in itself, and to be tolerated only as the necessary means to a pecuniary end. The chief interest, therefore, that inheres in a new book in this field of activity is the degree of ingenuity manifested by its author in juggling with his subject. If imbued, as most of these authors are, with a genuine ambition to improve existing conditions, he will not yield to the temptation to stand aloof, but will endeavor to smuggle more or less of the scientifically valuable into his presentation of the professionally necessary.

Professor Kraemer's book is more fortunate than those of his predecessors, in coming forward at a time of educational renaissance in pharmacy, a renaissance, it may be remarked, that the author has had much to do in stimulating and fostering. With high ideals of professional duty, he was expected to treat his subject honestly, which he has done to a degree that quite meets the possibilities of the situation. The method followed, for the most part, is that of first presenting his subjects, then following each with its applications in pharmacy.

Eighty-one pages are devoted to an introduction to the principal groups of plants. Greater simplicity could scarcely be found consistent with the degree of concentration required. It is an encouraging sign when pharmacy students can be expected to submit gracefully to such an introduction to their botanical course and when boards of trustees will permit it. The economic relations of the groups are briefly discussed.

The "Outer morphology" of angiosperms is treated in sixty pages, and is accompanied by much excellent elementary physiology. This division of the work is far less commendable than other chapters. Nearly all the descriptive botany that the book contains is found here, and it is inadequate even for the interpretation of the following crude drug descriptions—wholly so for that of the chapters on "classification of angiosperms." The illustrations, apparently from photographs of dried specimens, are most unforunate. Many of them, even where venation is to be illustrated, are mere smudges. The author adopts the broad interpretation of the term "flower" that has had its day in application to flowerless as well as to flowering plants. The essential characteristic of the flower as being a reproductive organism that supplies a special soil for the germination of the microspore, and for the growth and development of the male gametophyte, is not hinted at, and is indeed necessarily denied by the definition adopted. Notwithstanding this fact, it is found impossible, farther on, to avoid an incidental reference to this fundamental truth. Again, the artificial denial of the nature of the sporophyll as a leaf homologue, which has been so laboriously constructed by morphologists of recent decades, in the face of almost all natural evidence, is here adopted.

The sixty-three pages devoted to histology, under the title "Inner morphology," is most creditable. The language is simple and exhibits that clearness which bespeaks familiarity, and the illustrations are excellent and well selected. The 132 pages devoted to classification of angiosperms yielding vegetable drugs does not justify its title. The families are enumerated in order, with the drugs pertaining to each, but by no stretch of courtesy can this be called a classification. The condensation of this matter, in immediate connection with the study of drugs in the second part, Pharmacognosy, would have been more natural from the student's standpoint, and really helpful, which now one finds great difficulty in admitting.

Nearly 400 pages are devoted to pharmacognosy, the application of the matter of the first part to the study of drugs. About one fourth of this space is taken up with the subject of powdered drugs. In this entire part, special means are employed to simplify the work of actual identification, and the general discussions and instructions for procedure are admirable.

Altogether, Professor Kraemer's book is probably the most comprehensive and valuable of its kind that has yet appeared.

H. H. Rusby

The Cambridge Natural History. Edited by S. F. Harmer and A. E. Shipley. Vol. I., including Protozoa, Porifera, Cœlenterata, Ctenophora and Echinodermata. Pp. 671, 296 figures. London: Macmillan & Co.; New York: The Macmillan Co. $4.25.

To have four very interesting groups of lower animals treated in one volume is to have none of them satisfactorily handled, and in the present volume of this important series we feel the limitations that have been set the various contributors. The different divisions are unevenly balanced as to both matter and substance, and in two of the divisions at least, the impression is gained that the author had mainly a book knowledge of the group he was monographing.

The section on Protozoa written by Marcus Hartog has a great deal of interesting matter, and the various physiological activities of the unicellular animals, such as digestion, secretion, etc., and the relations of nucleus to cytoplasm and the like, are considered in a broad and suggestive way. The fact that the treatment in all such matters is strongly colored by this author's often unique ideas is only to say that it was written by Professor Hartog, and, although always interesting and on the surface convincing, the generalizations can not always be accepted. We meet again the time-worn discussion on spontaneous generation (gotten up apparently to controvert Bastian's recent outburst), and on animals and plants, but we do not find sufficient emphasis on the more important modern features that are characteristic of the protozoa, such as the physiological importance of the life cycle and the morphological importance of chromidia and nucleus.

The section on sponges by I. B. J. Sollas is not as well written as the other sections and the meaning is frequently hidden in obscurity of the construction. The classification adopted is that of W. J. Sollas and Bütschli, Minchin and Maas are followed in assigning the Porifera to the division Parazoa, apart from the other metazoa and from the protozoa. Morphology and relationships of the spicules are carefully worked out, but we find very little on sponge development. This section is full of matters of popular interest, examples of which are afforded by the suggestion of the therapeutic value of the common house sponge on account of its iodine, and a popular description of the origin of flint.

The account of the Cœlenterata and Ctenophora by S. J. Hickson is little more than a list of families and can scarcely be described as interesting reading. The monotony of almost straight taxonomy is broken a bit by a discussion of corals and coral islands, but the work for the most part is devoid of general interest. With all the valuable and biologically interesting data afforded by the cœlenterates we feel that Professor Hickson has lost here an opportunity to present a readable account of one of the most fascinating groups of invertebrates.

E. W. MacBride has given a much more general account of the Echinodermata, although here, too, a wealth of biological facts has scarcely been touched, while details of structure fill page after page. The group is taken up somewhat differently than is customary in that the Asteroidea are regarded as the most primitive of the echinoderms, while the Holothuroidea are considered as a continuation of the same line of development that led to the Echinoidea. Unlike the other contributors, MacBride has given more embryology, although his account of the development of an echinoderm taken by itself is not full enough to give a clear picture to one unfamiliar with the complicated metamorphosis of these forms.

We do not see why the Echinodermata should be included with the above lower groups of invertebrates unless it is a characteristic devotion to the tradition of Cuvier's Radiata, or indeed, mere expediency. Certainly it seems poor logic to speak of echinoderms as intermediate between cœlenterates and higher invertebrates (page 428) and then to point out the probable common ancestry of Echinodermata and Vertebrata through dipleurula and tornaria larvæ (page 617).

The volume is beautifully gotten up and has a wealth of tables and keys of classification and is invaluable to the student of animal taxonomy although disappointing here in that it will not carry him into genera and species.

G. N. C.

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Comparative Neurology and Psychology for May contains three papers. The first, "Concerning the Intelligence of Raccoons," by Professor L. W. Cole, is based upon the study of thoroughly domesticated animals which were reared in captivity. They are found to be more docile than cats and able to form much more complex associations, though they are inferior to monkeys. They do not imitate their fellows, but learn various acts from being put through them. The experiments indicate the presence of mental images. Miss Isabel McCracken, in studying "The Egg-laying Apparatus in the Silkworm (*Bombyx mori*) as a Reflex Apparatus," performed various operations on the nervous system to learn the localization of function in the egg-laying reflexes. The posterior abdominal ganglion is the controlling center and exhibits a high degree of independent activity. The vitality of the silkworm moth, as measured by length of life and capacity of the reproductive system to function, is not impaired by removal of the head. The exact influence upon the reproductive function of the cerebral, thoracic and the several abdominal ganglia was experimentally determined. "A Study of the Choroid Plexus," by Walter J. Meek, adds confirmatory evidence to the conclusion that the plexuses are concerned in the secretion of the cerebro-spinal fluid.

SOCIETIES AND ACADEMIES

THE ST. LOUIS CHEMICAL SOCIETY

At the meeting of the St. Louis Chemical Society, held June 10, three papers were presented on the general subject "The Fixation of Atmospheric Nitrogen."

1. "By Plants," J. Arthur Harris, of the Missouri Botanical Gardens.

2. "By Direct Oxidation," Carl Hambuechen.

3. "As Ammonia and Cyanides," Dr. F. W. Frerichs.

The speakers presented the general history of the several processes, and the methods employed, together with an account of the present status of the subject. Dr. F. W. Frerichs concluded that even if the Chilean sources of combined nitrogen should be exhausted within twenty-five years, and even if the low nitrogen content of mineral coal (about 2 per cent.) excluded this as a source of combined nitrogen, except in the few cases in which this nitrogen can be obtained as a by-product, still, chemistry will be quite able to supply all the combined nitrogen that shall be required.

C. J. Borgmeyer,
Corresponding Secretary

DISCUSSION AND CORRESPONDENCE

DR. EASTMAN'S RECENT PAPERS ON THE KINSHIP OF THE ARTHRODIRES[1]

Every one who labors with the time-honored problem of vertebrate descent must consider, sooner or later, the arthrodiran "fishes," for these, with forms similar but even more puzzling, were the most conspicuous and diversified of earliest chordates. They are first known in the upper Silurian, run their gamut of evolutional prosperity in the middle Devonian, and become extinct in the early Carboniferous: the earlier forms were small with tubercle-like teeth, the later, often of considerable size, with many types of dentition, tubercular, trenchant, or crushing. Unhappily, however, the various forms of arthrodires are known only imperfectly, and the fact that various writers have considered them as related to almost every and widely separated groups of living fishes is enough to indicate how little is known of their anatomy.

Among the latest contributions to this unsatisfactory theme are three papers by Dr. C. R. Eastman, and these contain such reactionary views as to the kinship of arthrodires that they merit a somewhat extended review. For, in the matter of vertebrate descent, there should, I think, be entered a friendly protest against Eastman's conclusions—all the more necessary on account of his deservedly high authority in matters of palæichthyology—and the reasons should be summarized for regarding his arguments inadequate. On the other hand, I do not believe that this is the place to support in detail a rival theory—it is rather to show the intricacy of the materials involved and the limitations to which our conclusions must be subject.

Eastman brings out in his papers three essential theses. He aims to demonstrate: (1) That arthrodires are specialized lung-fishes, principally on the evidence of dental plates and

[1] "Dipnoan Affinities of Arthrodires," *Am. Jour. Sci.*, Vol. XXI., February, 1906. "Structure and Relations of Mylostoma," *Bull. Mus. Comp. Zool.*, Vol. L., No. I., pp. 1–34, pls. 1–5, May, 1906. "Mylostomid Dentition," *ibid.*, Vol. L., No. 7, pp. 211–229, 1 pl., February, 1907.

the arrangement of the bones of the head-roof. (2) That the living types of lung-fishes, particularly the Australian *Neoceratodus*, show the closest affinities with Devonian arthrodires—especially with *Mylostoma*, the form which has pavement-like dental plates. (3) And that he has discovered the way in which the dental plates of *Mylostoma* were originally arranged. These theses may now be examined; but for convenience, they will be taken up in an inverted order.

I. *As to the dental apparatus of Mylostoma.*

In various forms of arthrodires there were present at least three pairs of dental plates;—there was possibly a greater number of these plates, in pairs or azygous, but the proof is still imperfect. In the case of *Mylostoma*, the three pairs of plates occur in a single well-preserved specimen which was first described by the reviewer (*Mem. N. Y. Acad. Sci.*, 1901), who endeavored to show that these plates corresponded to the "premaxillary," "maxillary" and "mandibular" plates of other arthrodires, and that they were arranged in the mouth in a similar manner—the smallest plate, sharply triangular, becoming the "pre-maxillary," and the medium sized, ovoidal one, the "maxillary." In the fossil, moreover, the normal position of the plates in the mouth indicated, since two of the plates, "maxillary" and "premaxillary," are preserved side by side, in singularly perfect contact. These conditions, then, become the point of departure for Eastman's detailed studies, which involve, by the way, over two-score octavo pages. Thus: taking a large series of detached dental plates (which, we infer, may well have belonged to different individuals, species and probably even genera), Eastman places them together, *secundum artem*, until their grinding surfaces fit, and thus obtains their "true arrangement." By this mode of procedure, he first of all changes the relative position of the "maxillaries," as given by Dean, and figures a pair of new elements, "vomerines," lying crosswise in the front of the mouth. This arrangement, however, does not give permanent satisfaction to its author, for in his third paper, the vomerine plates are withdrawn from the complex, and in this process each of these elements is rotated 90°, changed sides, transferred from the upper to the lower jaw, and described as having belonged to a new mylostomid. This change, however, does not deter the author from still insisting upon the actuality of vomerine plates. On the evidence of a new arthrodire, *Dinomylostoma*, in which he describes three pairs of dental plates, he argues, again from their needs in fitting together, that there must have been still another (*i. e.*, a fourth) pair of plates. Indeed, he declares confidently that, "unacquainted though we be with actual specimens, the existence of vomerine teeth in *Mylostoma*, real or potential, is an assured fact"! That this may be so one will readily admit, but it is not quite obvious from Eastman's argument, especially when it entails the corollary that the two well-known pairs of upper dental plates of *Mylostoma* are the homologue of the single pair of "shear teeth" of a closely similar arthrodire (*Dinichthys*). For we can not understand why we should be asked to believe that two arthrodires, similar to each other in a host of characters, should be so distinct in this important particular? Nor does it make the argument quite convincing when Eastman points out that the "palatine" plate in the young lung-fish, *Neoceratodus*, passes through a stage in which it shows traces of subdivision (= a "*Mylostoma* stage"), for this implies a finished perfection of the embryological record, which would hardly have been assumed by even Haeckel in his palmiest days.

In short, I can not feel that the work of Eastman on mylostomid dental plates is convincing. He has not demonstrated that the plates in *Mylostoma* were more numerous than those well known in other arthrodires, nor has he modified satisfactorily our views as to their relative arrangement. The evidence of the first specimen, which shows two of the dental plates in closely fitted contact, is still, I believe, better evidence in the matter of mylostomid dentition than that obtained by elaborate fittings of detached and possibly (bear witness Eastman's "vomerines") unrelated dental plates. The chances are infinitely small that in the fossil in question two such plates, if once separated, could have accidentally come to lie in such accurate apposition. And until more perfect material is forthcoming, the present specimen remains of paramount value, none the less so since, as the writer pointed out, the faceted surface of these combined plates corresponds to the indented area of the "mandibular," which is present in the same fossil and must have apposed them. By this view, also, the dentition of one arthrodire can best be explained in terms of another, the smaller, more irregular "premaxillary" of *Mylostoma* becoming the homologue of the smaller and more irregular "premaxillary" of *Dinichthys*, and the longer oblong "maxillary" to the long "shear tooth" of the latter form. It is not necessary, therefore, to go afield and postulate a closer affinity of the Devonian arthrodire *Mylostoma* to a recent lung-fish when a comparison can readily be made with a contemporary form (*Dinichthys*), to which in many regards it is closely akin.

II. *As to the very primitive characters of Ceratodus which ally it to Mylostoma and separate it widely from known Paleozoic Lung-fishes.*

Eastman expresses his view as to the relationship of lung-fishes and arthrodires thus: A primitive ceratodont (from which descend directly *Ceratodus* and *Neoceratodus*) was the progenitor of two side lines of fishes, one giving rise to more and more specialized lung-fishes, the other to more and more specialized arthrodires. Before the specialized line of lung-fishes became extinct it gave rise successively to such forms as *Dipterus*, *Scaumenacia*, *Phaneropleuron*, *Uronemus* and *Ctenodus*: before the arthrodire line died out it passed through phases represented in the order *Macropetalichthys*, *Homosteus*, *Mylostoma*, *Dinomylostoma*, *Coccosteus*, *Dinichthys*, *Titanichthys*. The fact that in all of the mass of Paleozoic lung-fishes there is not a suggestion of the hypothetical *Ceratodus* is easily waived aside as due to the imperfection of the geological record. And thus are rejected Dollo's illuminating researches as to the descent of the dipnoans.

We may query, accordingly, the reasons why the modern *Ceratodus* (*Neoceratodus*) is assumed to be the primitive dipnoan—to say nothing, for the present, of its kinship to the arthrodira. And here Eastman's studies do not appear adequate: *Ceratodus*, he points out, has a cutting type of dental plates, it has a diphycercal tail (rather than heterocercal), and it has fewer dermal head-plates. He does not suggest, however, that we have at the present time a fairly rich material of fossil dipnoans, and he fails to indicate that in the ceratodonts many characters common to the early forms do not appear; in a word, Eastman does not explain clearly his paradox—that we are to believe that these earliest dipnoan characters should be regarded as more modified than the structures of the modern *Neoceratodus*. Indeed, the skeptical reader remembers, on the contrary, that in the earlier fishes the teeth are in the form of tubercles, more or less shagreen-like in form and arrangement; that in all the earliest groups of true fishes, sharks, dipnoans, crossopterygians, actinopterygians, there occur no shear-like dental plates; that in the series of definitely known lung-fishes beginning with those in the Devonian, the tubercular teeth are reduced gradually, and that only with the development of their basal supports do there come to be formed cutting dental plates. Moreover, that this mode of evolution is the true one is confirmed with singular clearness in the general plan of the development of the teeth of *Neoceratodus* itself—a great number of tubercular denticles preceding the solidification of their basal supports and the growth of bony cutting ridges. In short, there is every reason to conclude that the dental plates of *Ceratodus* are derived from dental plates of dipnoans of the paleozoic type, and there is no tangible evidence that the dental plates of the recent dipnoan picture the ancestral condition.

Again, who can doubt that the descent lines of the dipnoans and the ganoids converge very closely in the earlier paleozoic times? One may even be doubtful whether certain of these genera were ganoids rather than lung-fishes, and close examination of the known structures of these forms has led every observer, as far as I am aware, to postulate the closest kinship between the two groups. From these early types, upward, one may trace in the fossil lung-fishes the dermal plates of the head-roof becoming less numerous, lighter in texture, and deeper in position, losing completely their primitive tubercle-studded surface. From *Ceratodus* (as Teller's figures indicate) to *Neoceratodus* there is a marked step in this direction, and from such a condition only can one understand the curiously reduced dermal head-roof of *Protopterus* and *Lepidosiren*. Why, accordingly, should we believe, in the face of this kind of evidence, that the condition of the head-roof of *Ceratodus* is more primitive than that of the early ganoids and dipnoans conjoined? There is certainly adduced no concrete evidence for such a reactionary view. Eastman's final evidence as to the ancestral nature of *Neoceratodus*, as far as I am able to find, is in the shape of its caudal fin: it is diphycercal rather than heterocercal. Dollo has shown, on the other hand, that the earliest dipnoans (ganoids and sharks as well) are heterocercal, and that it was only through the paleontological series, which he carefully depicts, that diphycercy was attained in the modern lung-fishes, as an eel-like adaptation to living in a muddy bottom—an evolution in the process of which the dorsal and anal fins became merged with the caudal. This conclusion of Dollo is based upon such strong testimony that it can hardly be disproved merely by the assumption that *à priori* a diphycercal caudal fin is more primitive than a heterocercal one! In short, we can find in Eastman's studies no ground for making the stock of *Neoceratodus* an ancestral one; there is, indeed, no reason evident why it should not have descended from an ancestor resembling *Uronemus* or *Phaneropleuron*.

III. *Mylostoma as a Primitive Arthrodire, related to a Ceratodont Lung-fish.*

Mylostoma differed little from its contemporary arthrodires. In its gnathal plates, however, it had evolved restricted crushing surfaces instead of the long tubercle-studded jaw-rims of *Diplognathus, Trachosteus, Selenosteus* or *Coccosteus*. *Dinichthys*, indeed, shows transitional characters, for the tubercles of the anterior reaches of the jaws are ground away when the jaws attain a shear-like action, and the gnathals of *Dinomylostoma* show a still nearer approach to the pavement-like surfaces of *Mylostoma*. In short, there is evidence that the arthrodira during their extraordinary evolution gave rise to a series of forms whose dental characters ranged from tuberculate to pavement-like—a line of evolution which, it will be recalled, is paralleled in other groups of fishes—sharks, ganoids, teleosts, and, as above noted, dipnoi. Now since the time of the classical studies of O. Hertwig (1876) on the origin of the bony plates of fishes, there has been found no good reason to doubt that the tuberculate condition was the ancestral one, and it follows, therefore, that until strong reasons to the contrary be adduced, we can safely assume that the same law of development holds true in the case of the arthrodira. That is to say, that the crushing plates of *Mylostoma* are secondary, not primitive. Eastman, however, contends that since *Mylostoma* resembles *Ceratodus*, it is therefore primitive. But if, as we have indicated above, there is little reason to regard *Ceratodus* as primitive, it is clear that the affinities of *Mylostoma* must be determined by comparison with kindred arthrodira. It might be pointed out, finally, that the great majority (possibly eight out of ten) of the genera of which jaw plates are known, bear tuberculated dental plates, including the earliest known arthrodires. And this is naturally interpreted in favor of the modified nature of *Mylostoma*, for thus historical evidence supports the findings of comparative anatomy.

If, now, the foregoing objections to Eastman's conclusions are valid, it is quite clear that the general question of the affinities of the arthrodira is just as doubtful as ever. Eastman, emphasizing the dipnoan characters of the arthrodira, points out similarities in *dental plates*, but these might ally them as well to chimæroids as to dipnoi—in the *shape of the caudal fin* and its supports, which are scarcely more dipnoan than shark-like (pleuracanth) or ganoidean—in *persistent notochord*, which might be as well shark-like, dipnoan or chimæroid,—in *punctation of dental plates*, which is a character by no means exclusively dipnoan. So that one may, I feel, hardly conclude with Eastman that the lung-fish (*Neoceratodus*) recalls "in its entire organization, save for the absence of dermal trunk-armoring, the principal features of the arthrodires," or that there are present between the modern lung-fish and the ancient arthrodire, "such intimate structural resemblances [that they] can not be explained by parallelism but point plainly to common descent." Eastman is willing to admit, on the other hand, that the evidence is questionable that arthrodires had a vestige of ventral limbs, and that they are unlike dipnoans in possessing a shoulder- and ventral-armoring. But even if we can picture such a *paleozoic descendant* of primitive lung-fishes, can we still imagine one which lacks also pectoral limbs, and opercular bones, and which possessed on the other hand shoulder joints rendering possible a curious dorso-ventral movement of the head?[2] Certain it is that the resurrected doctrine of the kinship of arthrodira and lung-fishes finds little support in the recent studies of Hussakof and others, which have shown that the gap between the arthrodira and the pterichthyids is by no means as wide as we have hitherto taught.

[2] Eastman can answer these objections only by minimizing their value, as when he maintains that the operculum is represented in the rudimentary spine of *Dinichthys*, and that the movable attachment of the rib to the cranium in *Neoceratodus* is comparable to the intermovement of head and trunk in the arthrodira. In his comparison of the gnathals of arthrodira with the splenial of dipnoans, he calls attention to a fleck of cartilage fossilized on the outer (*ectal*) face of a gnathal of *Dinomylostoma* as evidence of its attachment to a meckelian cartilage; but this evidence, even if accepted, would be as readily ganoidean as dipnoan. It may be remarked, however, that the structure in question is too obscure to warrant a definite judgment as to its nature, and the fact that the ectal surface of such a plate is sometimes known to bear tubercles quite like those of the usual head plates does not make the assumption probable that the gnathal plates were placed far from the surface of the head.

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EVOLUTION THEORIES: STATIC, DETERMINANT, KINETIC

In Science for December 7, 1906, Dr. Ortmann presents another of his series of reports upon the kinetic conception of evolutionary processes. It is very gratifying, of course, that my suggestions are receiving so much valuable time and attention, and the more to be regretted that unfortunate methods of study still interfere with the success of so persistent an inquiry.

Would it not be better, for example, to simplify the issues by omitting the discussion of the novelty or antiquity of the ideas, or at least by postponing it until the ideas themselves have been clearly perceived? It will then become evident to Dr. Ortmann that Darwin and many others have entertained kinetic views of evolution, though not bringing them to the point of definite formulation.

In estimating the value of an interpretation which differs from our own it is well to suspend or lay aside temporarily the opinions we have been entertaining, in order to see how the alternative theory accommodates the facts. But instead of making a personal inspection of the kinetic premises, Dr. Ortmann ties himself fast by italics of certitude to his static dogma: "*If the environment remains uniform, perfect uniformity of individuals will result.*" This keeps him far outside of the subject upon which he continues to inform the readers of Science.

Viewed at the long range imposed by this fictitious barrier, many things look quite the same which would be found very different on closer inspection. Thus it appears to Dr. Ortmann that symbasis is the same as amphimixis, whereas the two processes are on distinct lines and work in different directions.

Amphimixis occurs when variations originated under conditions of narrow breeding are brought again into more normal relations of broad-breeding, or into renewed contact with the unrestricted descent of the species at large. Mutative variations are often obliterated by cross-breeding, and replaced by the normal characteristics of the wild type. Amphimixis means that narrow varietal strands can be retracted and reincorporated into the specific network.

Symbasis is the free interbreeding of the normally diverse members of a species, which brings about the coherent evolutionary progress of the whole network of descent. Symbasis keeps the procession moving, while amphimixis rescues the stragglers from the side-paths. Amphimixis corrects abnormal diversity induced by narrow breeding, but does not interfere with normal diversity, nor with evolution, and only appears to do so when the degenerative mutations of narrow-bred organisms are looked upon as genuine examples of evolution.

The static assumption is that the species remains uniform and stationary until acted upon by some agency which is external, or at least intermittent. This was a very natural assumption to make in the early days of evolution because it involved the least possible modification of the earlier theory that each species was the product of a definite creative act. Under the static theory the species could still be held to be ideally uniform. Evolution could be charged to the environment, which was known to be able to influence the development of individual organisms, and could therefore be thought of as influencing whole species. This idea of definitely directed variation has been called *mutation* by Waagen and *orthogenesis* by Eimer. The formation of new species by discontinuous or saltatory variations has also been called *mutation* by de Vries.

All these conceptions are static, like the Darwinian theory of natural selection. They do not permit us to pass beyond the barrier of ideal uniformity and stability, and forbid us to find causes of evolution in anything except environmental influences. Dr. Ortmann's reasoning on the immanence of environmental causes appears to be entirely logical, but it can convince only those who disregard the facts of nature and accept the static assumption as the basis of inference.

The second alternative conception of evolution was that of Naegeli, who believed that evolutionary causes might reside in the protoplasm itself, and who worked out a theory of protoplasmic structure which would provide for systems of changes in definite directions. This excited the 'hereditary mechanism' speculations of Weismann and his successors, which continue to the present day, though it has been usual to invoke environmental causes to change the workings of the 'hereditary mechanisms' and to cause them to yield new forms, which are supposed to be preserved by selective or other isolation.

The kinetic theory differs from its predecessors in recognizing that evolution is neither initiated nor actuated by the environment. Variations appear without environmental causation and are preserved and accumulated in the species by prepotency, instead of by isolation. Isolation and narrow breeding bring the degeneration which amphimixis cures, but inside the normal network of descent individuals are diverse and new variations are prepotent. Symbasis weaves the diversities and the new characters together in endlessly varying proportions, and in this way conducts a constructive, coherent evolution, a gradual advance of the whole network of descent of the species.

Such evolution Dr. Ortmann declares to be incomprehensible, and so it may appear from his static point of view. But the difficulty can be surmounted if he will take the italics out of his *ipse dixit* of uniformity and allow himself to become acquainted with the phenomena of heterism, the contemporaneous non-environmental differences which everywhere exist among the members of species, and even among the simultaneous offspring of the same parents. The normal diversity and free interbreeding by which evolutionary motion can be accomplished are concrete and well established facts, while the ideal of stable uniformity under changeless conditions remains a pure speculation.

O. F. Cook

Washington,
December 19, 1906

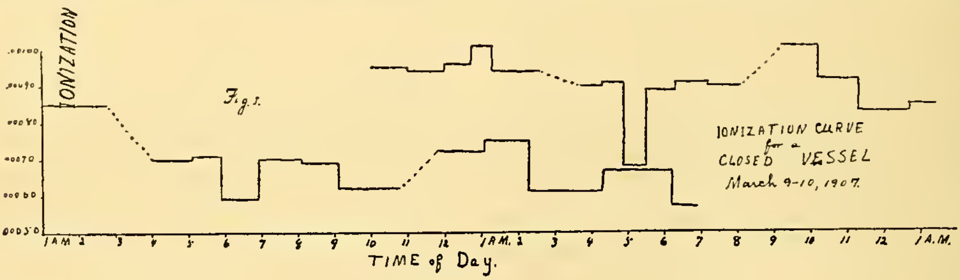
SPECIAL ARTICLES

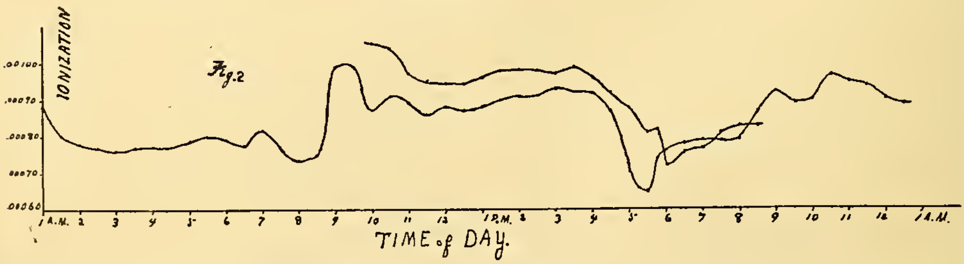
IONIZATION IN CLOSED VESSELS

In connection with some other work on the ionization in closed vessels it was found necessary to examine the daily variation of this ionization, to find what parts of the day it is most constant and to find the best methods to get as constant an ionization as possible. Soon after the work was started the article of Wood and Campbell on the 'Diurnal Periodicity of the Spontaneous Ionization of Air and other Gases in Closed Vessels' appeared.[1] It was thought that it would be of interest to find the periods of vessels was due to a variation in the penetrating radiation and that by screening this off by the use of thick lead plates one ought to get a much more constant ionization.

The ionization was measured by means of an iron electroscope 10 x 13 x 20 cm. in size. The charged electrode was bent into the arc of a circle and over this arc the gold leaf fell as the charge leaked off. The electrode was charged across a small air gap and so was air-tight. All parts except the charged electrode were earthed. The position of the gold leaf was read by means of a micrometer microscope, the cross hairs moving in the eyepiece. As the microscope was firmly clamped, the same portion of path traversed by the gold leaf would be always used. The air was enclosed some twenty days before readings were taken. The electroscope was not allowed to become entirely discharged at any time.

An electroscope similar to the above but





maxima and minima in Baltimore.

Dike[2] has also found a similar periodicity in the amount of radio-active emanation in the atmosphere and his periods agree quite well with the periods as found for the ionization in closed vessels. It would thus seem that the variation of the ionization in closed

smaller in size was also used. The readings were made in a tower room on the fifth floor of the physics laboratory. The room was not heated artificially, so that the temperature remained fairly constant. All sunlight was screened off.

Fig. 1 represents the ionization for March 9–10, 1907. About midnight it began to snow. It will be seen that the value of ioniza-

[1] *Phil. Mag.*, Feb., 1907.

[2] *Terr. Mag.*, Vol. XI., No. 3, p. 128.

tion falls very considerably. It will also be noticed that the relative minimum drop on March 10 is not nearly as large as on March 9. The dotted portions of the curve represent the times when the electroscope was recharged. That all parts of the scale were equally sensitive was shown afterwards when a lead screen was placed around the electroscope. The rate of fall of the gold leaf was then practically constant for the portion of path used. During the day there was a great deal of vibration due to travel on the cobblestone street next the building, so that the error of reading was larger.

Fig. 2 represents the ionization for several days in February and March of the present year. (*a*) is the average of readings for four days and (*b*) for fifteen days. These and other curves show maxima for February and March at about 9 A.M. and 10 P.M., and minima at about 7 A.M. and 6 P.M. Very few observations have as yet been made on the 7 A.M. and 9 A.M. periods. The most conspicuous is the minimum at 6 P.M. This occurs with considerable regularity and is very marked, the ionization often falling thirty or forty per cent. No corresponding change of temperature or barometric pressure was noticed. It will be noticed in the following table, however, that it never drops below the value of the ionization when the penetrating radiation is cut off. It has been found that sudden changes of temperature produce air currents and set the gold leaf in motion, but it hardly seems likely that this minimum is to be explained in this way. Still it seems very remarkable that the penetrating radiation should have such a marked drop and the problem as to whether it is a temperature effect is to be taken up.

The electroscope was then screened with lead plates from 4 to 5 cm. thick. A window was necessary to make the readings, however, so that the radiation was not all screened out. The rate of leak was made much more constant. The marked minimum at 6 P.M. was usually not noticeable.

The following table gives the average ionization for several days. Readings were usually taken from 10 A.M. till 6 P.M. The period of minimum is not included in the column marked average ionization. The ionization during the early part of the afternoon was found fairly constant.

Date	Weather	Average Barometric Pressure	Ionization	Minimum Ionization	Time of Minimum
Feb.					P.M.
16	Clear.		.00113	.00077	5.40–6.00
18	"		.00085	.00064	5.30–7.00
19	Cloudy.		.00100	.00078	5.00–6.00
20	"		.00100	.00092	5.00–7.00
21			.00102	.00069	5.00–5.30
22	Clear.	77.10	.00101	.00058	4.30–5.30
23		77.80	.00093	.00056	5.30–6.00
25	Clear (8″ snow)	76.25	.00090	.00051	5.30–6.00
Mar.					
3		76.50	.00088	.00078	6.00–7.00
4	Clear.	76.50	.00060		
5	"	76.50	.00075		
Apr.					
15	Clear. Lead screen put around telescope.	75.50	.00049	No drop observed.	
16	Cloudy.	75.20	.00051		
17	"	75.70	.00052		
18	Clear.	75.90	.00052		
30	Cloudy.	75.80	.00051		

In conclusion the writer wishes to express his thanks to Professor Ames for his many kindnesses and to Professors Rutherford and Dike for their suggestions.

W. W. Strong

LABORATORY APPARATUS FOR MEASUREMENT OF THE FORCE ON A CURRENT-CARRYING CONDUCTOR LYING IN A MAGNETIC FIELD

The method used by Ampère in his investigations of the effect of a magnetic field on a current-carrying conductor was to arrange the conductor so that the forces acting on one part of the circuit just balanced those acting on another part. From observations thus made and without the direct measurement of any forces in force units, Ampère established his propositions with regard to the mutual action of current-carrying conductors.

From these propositions is derived the expression for the force acting on a straight conductor lying in a uniform magnetic field. This is a very special application, but it is perhaps the most common one. Ampère's laws give as the equation for the force, F, acting on a conductor of length l centimeters lying at right angles to a field of intensity f,

$$F = ilf.$$

The lack of any simple means of measuring directly the force acting on the conductor in this case led to the construction of the apparatus herein described.

The apparatus also serves well to illustrate the basis on which we construct our definition of the absolute electromagnetic unit of current.

On account of the smallness of the strength of the earth's field, either a very large current must be used with it, to produce an effect of convenient magnitude to measure, or else delicate means of measurement must be employed. To avoid these difficulties, a field is obtained by using a C-shaped cast-iron cylinder as the core of an electromagnet. The length of the cylinder used is 9.5 cm.; its inside diameter, 7.7 cm.; and its outside diameter, 11.4 cm. The width of the air gap

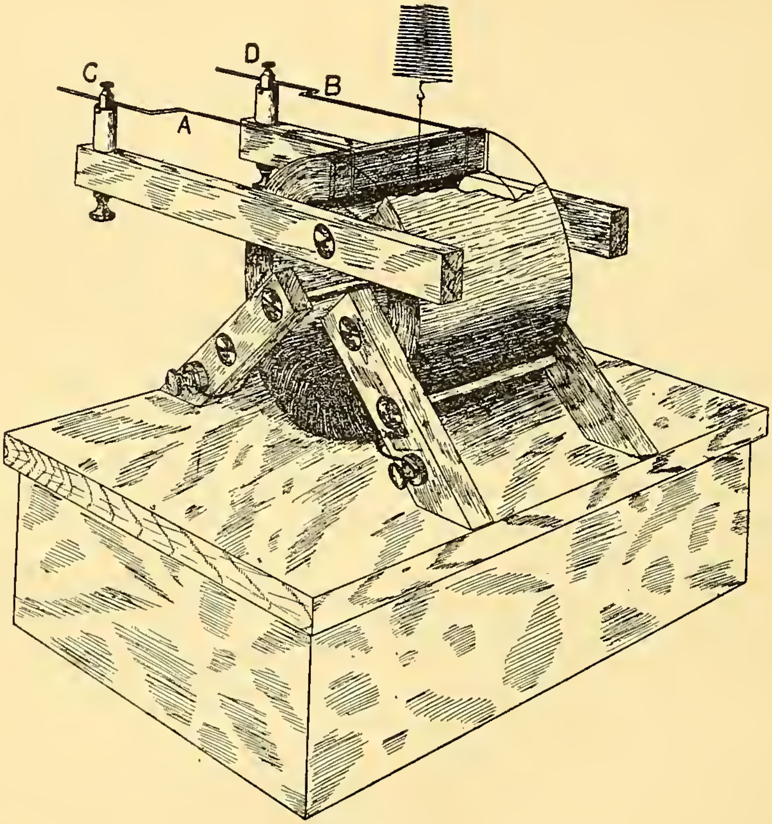


Fig. 1.

is 4.0 mm. The magnetizing coil has 400 turns of number 20 copper wire.

The method of mounting the electromagnet and conductor is shown in Fig. 1. The conductor AB, which lies in the air gap is bent up, then back, and clamped in two binding posts, C and D, through which steel pins are driven. The lower ends of these posts dip into mercury cups. The steel pins form a free axis of rotation.

The force acting on the conductor is measured by the elongation produced in the spring of a balance of the Linebarger type. In taking the observations given below, the magnetizing current and the current in the conductor were measured with two Weston portable ammeters.

Observations were first taken to show that when the field is constant, the force on a given conductor is proportional to the current flowing through it. In taking the observations given in Table I., a wire extending through the slot, then bent straight back and clamped in the binding posts was used. The conductor was therefore not in a uniform field. The table gives the first set of observations taken.

TABLE I.

Current in Conductor	Zero Reading of Balance	Elongation Reading	Elongation	Elongation / Current
amperes	cm.	cm.	cm.	
2.045	9.79	16.97	7.18	3.52
2.560	9.75	18.81	9.06	3.54
3.065	9.77	20.63	10.86	3.54
3.560	9.74	22.41	12.67	3.56
4.045	9.80	24.11	14.31	3.54
4.465	9.76	25.80	16.04	3.60
5.000	9.76	27.44	17.68	3.53

Steady current in magnetizing coil, 0.798 amperes.

In taking the next set of observations, Table II., the length of the conductor, as well as the current in it, was varied. To obtain these results, wires of the form shown in Fig. 1 were used. The length of the horizontal part of the wire lying in the slot and measured from center to center of the turned-up ends, was used as the length of the conductor. That this is the "effective" length of the conductor, if Ampere's law is true, may be shown below.

If the force acting on a straight conductor is ilf, then the force acting on an element of the conductor, of length dx, at the bend of the conductor will be equal to the product of four factors, the area of the section of the conductor to the right of dx, the current per unit area, the intensity of the field, and the length dx. Assuming that the current is uniformly distributed throughout the conductor before it reaches the turn and that it becomes uniformly distributed after it passes the turn and before it leaves the air gap, we obtain as the expression for the vertical force acting

TABLE II.

Length of Conductor (l)	Current in Conductor (i)	Zero of Balance	Elongation Reading	Elongation (E)	E/il
cm.	amp.			cm.	
7.70	2.960	3.81	11.97	8.16	0.358
	4.140	4.02	15.36	11.34	0.355
	4.900	4.03	17.48	13.45	0.357
	2.145	4.07	9.93	5.86	0.354
					0.3560
6.06	2.150	7.52	12.10	4.58	0.351
	3.215	7.60	14.48	6.88	0.353
	4.150	7.60	16.46	8.86	0.352
	4.875	7.62	18.00	10.38	0.351
					0.3518
4.96	2.175	6.79	10.57	3.78	0.356
	3.220	6.73	12.44	5.71	0.354
	4.170	6.77	14.14	7.37	0.358
	4.935	6.77	15.44	8.67	0.354
					0.3555

Steady current in magnetizing coil, 0.800 amperes.

on that part of the conductor to the right of the section AB, Fig. 2,

$$\frac{if}{\pi r^2}\int_0^{2r}\left(\pi r^2-\int_0^x 2y\,dx\right)dx,$$

where r is the radius of the conductor. Integration of this expression gives ifr as the

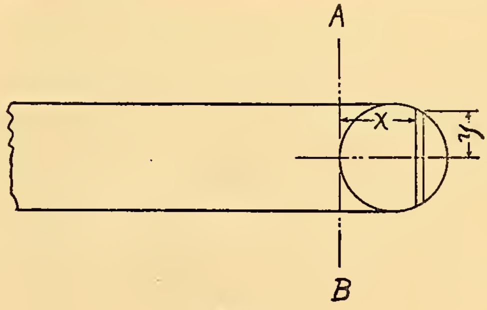


FIG. 2.

force acting on that part of the conductor to the right of AB, or r as the length to be added to the straight part of the conductor.

The third factor in the expression for the force on the conductor is f, the intensity of the magnetic field. This apparatus can be used conveniently for showing the relation between the force and f if a curve is plotted showing the relation between f and the current in the magnetizing coil. To obtain such a curve, a coil, wound on a thin rectangular bobbin which could be slipped into the air gap of the electromagnet, was connected to a ballistic galvanometer. The deflections of the galvanometer when the coil is quickly withdrawn from the air gap being proportional to *f*, the required curve can be obtained by using such deflections and the corresponding magnetizing currents as coordinates.

The curve obtained will depend on the magnetic history of the ring. If the curve is to be of any use, the initial condition of the iron must be one that can be reproduced. The ring may be entirely demagnetized initially or it may be in the condition in which it is left when a certain fixed magnetizing current has been passed through it. This current should be large enough to magnetize the core quite strongly.

Another curve can be plotted showing the relation between the magnetizing current and the force on the conductor, the current in the conductor and the length of the conductor being constant. If these two curves be plotted to the same axes, it will readily appear that the force is proportional to the intensity of the field.

The results which I have obtained from these curves for the ratio of the field to the force show a larger variation than do the ratios found in Tables I. and II., but with ordinary care the ratio of corresponding ordinates on the two curves will not vary more than three per cent. This seems to be about as great accuracy as may be expected with the apparatus in this present form. The larger part of the error is undoubtedly due to the uncertain variations in the magnetic field.

The apparatus as here described was designed for the use of students of general physics. Its special advantage is the directness with which the force is obtained in terms of quantities already familiar to the student.

R. A. Porter

Syracuse University,
March 5, 1907

QUOTATIONS

THE NEW ENGLAND COLLEGE

Some of the New England college presidents are practically facing the question whether they should not voluntarily limit the number of their students. Within the last ten years, Dartmouth, for example, has nearly doubled in size—an increase due largely to the success of its professional and technical departments. President Hopkins of Williams favors the idea of limitation in the smaller colleges; and there is much to be said for his view, provided that the income of the corporation is sufficient to support an efficient faculty. In colleges like Amherst, Bowdoin, and Williams a first-class education can now be had, even as at the large universities. But there comes a point in the development of a college when the increase in students entails an expenditure out of proportion to the gains by tuition fees. The number of instructors has to be multiplied, and there must be a greater outlay for lecture-rooms and laboratories. Many of the smaller colleges would be helped if the craze for mere numbers could be checked. The energies of the professors could then be concentrated on the instruction of their relatively small classes, they could insist on a higher standard of scholarship, and possibly make the B.A. mean as much as a degree in technology.—*The N. Y. Evening Post.*

NOTES ON ORGANIC CHEMISTRY

ANHYDROUS SULPHOCYANIC ACID

Although numerous salts of sulphocyanic (thiocyanic) acid, HSCN, are known, and some of them are of considerable technical importance, the free acid has, hitherto, never been obtained in a state of purity. Wöhler believed that he had prepared it and Liebig stated that it decomposed with extreme ease. In 1887 P. Klason distilled the aqueous acid and passed the vapor over calcium chloride, heated to 40°, the unabsorbed material was condensed at a low temperature and was thought to consist of the anhydrous sulphocyanic acid, but A. Rosenheim and R. Levy[1] have recently shown that although Klason's

[1] *Ber. d. chem. Ges.*, 40, 2166 (1907).

preparations occasionally contained as much as 40–50 per cent. of the acid, the remainder consisted of liquefied hydrogen sulphide, sulphur dioxide, carbon disulphide and hydrogen cyanide. The two chemists mentioned give the following description of the preparation of the chemically pure acid: Powdered potassium sulphocyanate, which has been fused until free from water, is mixed with an equal weight of phosphorus pentoxide in a distillation flask, connected with a receiver which is cooled in a mixture of ice and salt. The air in the flask is displaced by purified hydrogen under 40–60 mm. pressure. Concentrated sulphuric acid is now added gradually to the mixture in the flask, which is immersed in ice-water. The pure sulphocyanic acid collects in the receiver as a mass of white, dry crystals. At 0° it may be retained several hours in a closed vessel. It melts about 5°, and the liquid, in a few minutes, becomes deep red and then quickly solidifies, forming slender yellow needles; heat is evolved simultaneously. At 0° the acid dissolves in water almost without decomposition, but at the ordinary temperature polymerization products are formed. The acid has a sharp caustic odor and it rapidly attacks the skin.

J. BISHOP TINGLE

MCMASTER UNIVERSITY,
TORONTO, CANADA

GEOLOGIC WORK ON THE COASTAL PLAIN

THE active cooperation of the States of the Atlantic and Gulf coasts, from the mouth of the Potomac to the Mississippi is enlisted in an investigation for which preparations are under way at the United States Geological Survey.

A systematic study is to be made of the age, character, and general relations of the rocks of the Coastal Plain, special effort being made to determine the position and extent of beds of economic interest, including water-bearing beds, phosphate deposits, fuller's earth, and other materials.

The general plan of the investigation was formulated at Washington on the first of January, 1907, at a conference invited by the Director of the National Survey and participated in by state geologists Kummel of New Jersey, Clark of Maryland, Watson of Virginia, Pratt of North Carolina, Yeates of Georgia, Smith of Alabama, and Crider of Mississippi, the heads of the survey's geologic and water resources branches, and M. L. Fuller and T. W. Stanton, also of the National organization.

At this conference the work that had already been done was discussed and arrangements were made for one of the most extensive cooperative investigations ever undertaken by the Geological Survey. The discussion brought out the fact that the work in New Jersey and Maryland had been completed under the auspices of the states, while that in Alabama is far advanced. The Geological Surveys of North Carolina, Georgia, Alabama and Mississippi have also done considerable work in the Coastal Plain region, and reports on the water resources of Georgia and Alabama have been published by the state bureaus. The work of the National Survey in this area has been confined to investigations of underground water problems in Virginia and North Carolina and to studies of the phosphate deposits of Florida.

If present plans are carried out field work in Virginia, North Carolina, South Carolina, and Florida will be completed during 1907, and that in Georgia, Alabama and Mississippi will be reserved for 1908. It is expected that the entire investigation will be completed and a final report submitted for publication in 1909.

General supervision of the work rests with a board of which W. B. Clark, of the Maryland Survey, is chairman and which includes the chiefs of the geologic and water resources branches of the National Survey and the state geologists of the interested states. The field work, which will be directed by M. L. Fuller, will be done chiefly by members of the United States Geological Survey, but state representatives will also be employed in North Carolina, Georgia, Alabama and Mississippi. The necessary paleontologic work will be directed by T. W. Stanton.

CINDER CONE NATIONAL MONUMENT

The President of the United States has issued a proclamation as follows:

"Whereas, the elevation in the State of California, within the Lassen Peak National Forest, known as 'Cinder Cone,' and the adjacent area embracing a lava field and Snag Lake and Lake Bidwell, comprising chiefly public lands, are of great scientific interest, as illustrations of volcanic activity which are of special importance in tracing the history of the volcanic phenomena of that vicinity;

"And whereas, it is provided by section two of the act of congress, approved June eighth, nineteen hundred and six, entitled, 'An act for the preservation of American antiquities,' 'That the President of the United States is hereby authorized, in his discretion, to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon the lands owned or controlled by the government of the United States to be national monuments, and may reserve as a part thereof parcels of land, the limits of which in all cases shall be confined to the smallest area compatible with the proper care and management of the objects to be protected';

"Now, therefore, I, Theodore Roosevelt, President of the United States of America, by virtue of the power in me vested by section two of the aforesaid act of congress, do proclaim that there are hereby reserved from appropriation and use of all kinds under all of the public land laws, subject to all prior valid adverse claims, and set apart as a national monument, all the tracts of land, in the State of California, shown as the Cinder Cone National Monument on the diagram forming a part hereof.

"The reservation made by this proclamation is not intended to prevent the use of the lands for forest purposes under the proclamation establishing the Lassen Peak National Forest, but so far as the two reservations are consistent they are equally effective. In all respects in which they may be inconsistent the national monument hereby established shall be the dominant reservation.

"Warning is hereby given to all unauthorized persons not to appropriate, injure or destroy any feature of this national monument or to locate or settle upon any of the lands reserved by this proclamation."

AN INTERNATIONAL COMMISSION ON SLEEPING SICKNESS

At the invitation of the Colonial Office, Reuter's Agency reports, an important conference of the various African colonies and protectorates interested has been summoned to discuss concerted international measures for dealing with the terrible scourge of sleeping sickness, a disease which has decimated the natives in large areas of the Congo Free State, has proved fatal in the case of 200,000 natives in Uganda, has invaded French Congo and the Portuguese possessions, has appeared in the Sudan, and is now threatening German East Africa, Rhodesia and British Central Africa.

This conference met at the Foreign Office for the first time at the end of June, government delegates being present from Germany, Congo Free State, France, Great Britain, Portugal and the Sudan.

The delegates are as follows:

Germany—Herr von Jacobs, of the Imperial Colonial Office, Dr. Ehrlich and Dr. Fulleborn.

Congo Free State—Colonel Lantonnais, vice-governor general, Commandant Tonneau, M. Rutten and Dr. van Campenhout.

France—Dr. Kermorgant, Dr. Paul Gouzion, Professor Blanchard and Dr. Laveran.

Great Britain—Lord Fitzmaurice, who has been elected president, Sir W. Foster, Mr. A. W. Clarke (Foreign Office), Mr. H. J. Read (Colonial Office) and Sir Patrick Manson.

Portugal—Dr. Correa Pinto.

Sudan—Colonel Hunter and Dr. Balfour, of the Gordon College, Khartum.

The work before the conference includes the question of the holding of regular conferences, the establishment of a central bureau of information, and the assignment of definite points for investigation to particular countries or individuals.

In the case of Uganda, Mr. Hesketh Bell, his Majesty's Commissioner for the Protectorate, has prepared a scheme for dealing with the scourge in his Protectorate. The main features of the scheme are the deportation of the population from the infected lake shore and the segregation of the sick in a number of large camps, where they can be treated by atoxyl or other drugs which give hope for success.

THE INTERNATIONAL ASSOCIATION OF ACADEMIES

The International Association of Academies, which met at Vienna at the end of May, will hold its next meeting three years hence in Rome, under the auspices of the Academia dei Lincei. We learn from the London *Times* that among the decisions taken was a resolution to codify the rules of procedure of the association. The issue of a complete and authentic edition of the works of Leibnitz was agreed upon, both the mathematical and the philosophical departments of the association recognizing its desirability. Progress less marked was made in regard to the interchange on loan of manuscripts between libraries, but the question was fully discussed and a small international committee chosen to deal with it pending the next meeting.

Some advance was also made in regard to the publication of the projected standard edition of the Mahabharata, while progress was reported in the preparation of the Encyclopædia of Islam, of which Professor de Goeje, of Leyden, laid before the meeting the first section in three languages—English, French and German. General satisfaction was expressed by the delegates at Mr. John Morley's action in granting, on behalf of the India Office, £200 a year for the next ten years as a contribution towards the cost of the work. The Belgian government has announced its intention of subsidizing the scheme for an international bibliography of historical and philosophical subjects, and it is hoped that support will also be forthcoming from England and America. The proposal that the association should choose an international auxiliary language, such as Esperanto, for use in the communications between members was negatived by 12 votes to 8. France and England voted with the majority. Austria accepted the principle of an auxiliary language, but would have opposed the choice of Esperanto, on the ground that it is not a scientific medium of communication.

ADDRESS ON THE OCCASION OF THE DEDICATION OF THE LINNÆAN BRIDGE[1]

The recognition of the work of famous men is one of the happiest duties of mankind. It stimulates our endeavors and encourages us to make efforts which we would probably not make without their examples before us.

To-day we do homage to a distinguished man of science, and the unanimity with which the scientific societies and institutions of the City of New York join in this tribute is in itself evidence of the value which is placed upon his contributions to natural history.

Science has made great progress during the two centuries which have elapsed since the birth of Linnæus. Theories have in large part given place to ascertained facts or have been replaced by other theories based on more accurate knowledge of natural objects and of natural phenomena. The contributions of science to the welfare, comfort and happiness of mankind have made present human life widely different from that of two hundred years ago, and this amelioration of our condition, and the more general diffusion of knowledge has been accompanied by a vast improvement in morality.

The ceremonies of to-day are worthy of the great naturalist whose birth they commemorate. Societies and institutions all over the world join with us in honoring him, and are represented here by delegates or have transmitted documents expressing their appreciation of his life and labors. The public natural science institutions of New York have come to take leading parts in the subjects

[1] Delivered at the dedication to Linnæus of the Pelham Parkway Bridge over the Bronx River, by Nathaniel Lord Britton, President of the New York Academy of Sciences, May 23, 1907.

they teach and illustrate. Public and private philanthropy have developed them with a rapidity almost phenomenal, for they are all yet in their infancy, and on a scale commensurate with the dignity of the metropolis of America. The cordial cooperation of a municipality with public-spirited citizens to build and maintain such institutions for the welfare of the people and of science, finds here, in New York, its maximum evolution, which has as yet, however, by no means reached its complete development nor its maximum usefulness. What shall be said of their position and importance when after fifty years the New York Historical Society opens the tablet which we now place upon this bridge? And, what discoveries will science have made for the benefit of the human race during these next fifty years?

The selection of this bridge recently constructed by the park department, as a permanent memorial of Linnæus, is most appropriate. It is situated just outside the New York Zoological Park, with the New York Botanical Garden a short distance to the north, being thus between the two institutions which teach the subjects on which the fame of Linnæus chiefly rests. The suggestion that it be known hereafter as the Linnæus Bridge came from the Director of the American Museum of Natural History.

On behalf of the New York Academy of Sciences I now unveil this tablet and present it to the city of New York, there having been placed in it copies of to-day's program and other documents befitting the occasion.

SCIENTIFIC NOTES AND NEWS

Dr. Frederick L. Dunlap, instructor in the University of Michigan, has been appointed associate chemist in the Bureau of Chemistry, and will be a member of the board of food and drug inspection. The other members of this board are Dr. H. W. Wiley, chairman, and George P. McCabe, solicitor of the department.

The Vienna Academy of Sciences has awarded its Baumgarten prize (2,000 Kr.) to Dr. Egon Ritter v. Schweidler, professor of physics in Vienna, for his work on the phenomena of dielectrics; the Lieben prize (2,000 Kr.) to Dr. H. Benndorf, associate professor of physics at Graz, for his work on the transmission of earthquake-waves in the interior of the earth, and the Haitinger prize (2,500 Kr.) to Dr. Robert Kremann, docent at Graz, for his work on the esters.

Dr. E. Ray Lankester, retiring director of the natural history department of the British Museum, has been knighted on the occasion of the birthday of King Edward.

Cambridge University proposes to confer, in connection with the celebration of the centenary of the Geological Society, London, in September next, the degree of doctor of science upon Waldemar Cristopher Brögger, professor of mineralogy and geology in the University of Christiania; Geheimrath Hermann Credner, director of the Geological Survey of Saxony, professor of geology in the University of Leipzig, Professor Louis Dollo, curator in the Royal Museum of Natural History, Brussels; Albert de Lapparent, professor of geology and mining in the Catholic Institute, Paris; Professor Alfred Gabriel Nathorst, keeper of the department of fossil plants in the State Museum of Sweden, Stockholm; and Geheimrath Professor Heinrich Rosenbusch, professor of geology and mineralogy in the University of Heidelberg.

The University of Michigan has conferred the honorary doctorate of science on Mr. Carlos B. Cochran, professor of physical science of the West Chester Normal School and state analyst of Pennsylvania.

At the seventy-third annual meeting of the Royal Statistical Society, its Guy medal in gold was awarded to Professor F. Y. Edgeworth for his special services to statistical science, and for his many important and valuable contributions to the transactions of the society. A Guy medal in silver was awarded to Mr. N. A. Humphreys for his recent paper on "The Alleged Increase of Insanity." The subject of the essays for the Howard medal competition, 1907–8, was announced to be "The Cost, Conditions and Results of Hospital Relief in London."

The Hanbury gold medal has been conferred on Dr. David Hooper, curator of the economic and art sections of the Indian Museum of Calcutta.

M. St. C. Hepites has retired from the direction of the Rumanian Meteorological Institute at Bukharest, after having held the office for twenty-three years. He is succeeded by M. I. St. Murat.

Dr. Graham-Smith, Dr. Nuttall and Professor Woodhead have been nominated to represent Cambridge University at the International Congress of Hygiene and Demography to be held in Berlin in September.

Professor Hermann von Ihering, director of the Museo Paulista, São Paulo, Brazil, will represent the museum at several scientific conferences to be held this year in Europe. During his absence Mr. Rodolpho von Ihering will have charge of the museum.

Professor A. S. Hitchcock, systematic agrostologist, U. S. Department of Agriculture, has returned to Washington after five months spent in Europe studying the types of American grasses in the herbaria at Antwerp, Brussels, Paris, Madrid, Padua, Florence, Geneva, Munich, Vienna, Graz, Prague, Halle, Göttingen, Berlin, St. Petersburg, Stockholm and London. Much valuable material in the way of photographs, drawings and portions of types was secured for the national herbarium.

Dr. Charles A. Davis, of the University of Michigan, who has recently completed a report on the peat deposits of Michigan, has been engaged by the United States Geological Survey to make a reconnaisance survey of the peat formations of the coastal plain from the Carolinas northward during the summer.

The Croonian lectures of the Royal College of Physicians, London, have been delivered by Dr. W. J. R. Simpson on "The Plague."

In connection with the summer school of Columbia University, a course of lectures on recent advances in physics will be given on successive Monday afternoons at 4:30 o'clock in room No. 301, Fayerweather Hall, as follows:

July 15—"The Perception of Color and Theories of Color Vision," Professor F. L. Tufts.

July 22 and 29—"The Resolving Powers of Optical Instruments," two lectures, Professor C. R. Mann.

August 5—"The Phenomena of Radioactivity and Their Bearing on Our Theories of the Structure of Matter," Professor William Hallock.

August 12—"Some Problems in Artificial Illumination," Professor F. L. Tufts.

At the exercises commemorative of the one hundredth anniversary of Henry Wadsworth Longfellow, at Bowdoin College, it was announced that the daughters of the poet, Miss Alice H. Longfellow, Mrs. Richard H. Dana and Mrs. J. C. Thorpe, have given $10,000 to the college to endow a fellowship in literature in memory of their father.

Dr. C. B. Warring, for many years instructor in mathematics and physics in the Poughkeepsie Military Institute and the author of works on the relation of the Bible to modern science and other subjects, died on July 5, at the age of eighty-two years.

Professor Kuno Fischer, professor of philosophy at Heidelberg, and well known for his publications on the history of philosophy, died on July 5, at the age of eighty-three years.

The deaths are also announced of Dr. Karl Müller, docent in botany in the Technical Institute at Berlin; of Dr. Egon Ritter von Oppolzer, associate professor of mathematics and astronomy at the University of Innsbruck, and of Dr. Hermann, emeritus professor of mechanical engineering in the Technical Institute at Aachen.

The third Prehistoric Congress of France will be opened at Autun on August 12, under the presidency of Professor Adrien Guébhard, and will close on August 18.

The Journal of the American Medical Association says: "Representatives of the leading anatomic associations of the world gathered at Würzburg, Germany, during the last week of April. Romiti, of Pisa, presided, and numerous communications were presented showing progress in all lines of comparative anatomy and embryology, and general microscopic and macroscopic human anatomy and embryology. The congress was under the auspices of the German *Anatomische Gesellschaft,* forming its twenty-first annual meeting. Four vice-presidents were elected, who will preside in turn at the annual meetings—Waldeyer, of Berlin; Ebner, of Vienna; Stöhr, of Würzburg, and Nicolas, of Nancy. Stöhr is Kölliker's successor at Würzburg, where his assistants are Schultze, Sobotta and Sommer. They have at their disposal the remarkably well-equipped Institute of Anatomy with its unusual collections of specimens and works on anatomy, the Würzburg faculty having made rather a specialty of anatomy under Kölliker's leadership. The *Presse Médicale* for May 22 has a good report of the congress."

The Hudson-Fulton Celebration Commission has set apart the days from September 18 to 26, 1909, as the time for the observances in honor of the three hundredth anniversary of the discovery of the Hudson by Henry Hudson and the one hundredth anniversary of Robert Fulton's first practical application of steam to navigation. The exercises will include the dedication of the Robert Fulton memorial watergate in Riverside Park and various parks and memorials which it is hoped will be erected along the river.

The literature concerning the alcohol and drug problems has grown to such extent in pamphlets, books, papers and studies of every description that it is impossible to keep in touch with everything written on the subject. Hence a society has been formed in Boston, Mass., and incorporated by the laws of the state, called The Scientific Temperance Federation. This society is a bureau for the collection of every pamphlet, book and paper relating to any possible phase of this question. These are to be put on file and tabulated so as to be available for students and writers. A trained specialist will be in charge to furnish abstracts and data, or copies of the papers on file. The society will charge a small membership fee and will be endowed so that its work will be permanent. Already a nucleus has been made and the work begun. Dr. Crothers, of Hartford, Conn., is chairman of the board of directors. Miss C. F. Stoddard, 23 Trull St., Boston, Mass., is the secretary, to whom all inquiries should be addressed.

We learn from *Nature* that an exhibition of engineering models, optical, electrical and scientific instruments, technical education appliances, and tools, is to be held at the Royal Horticultural Hall, Vincent Square, Westminster, S. W., on October 22–26. In addition to exhibits by leading makers, there will be a loan collection of experimental and exhibition models and apparatus, and also lectures and demonstrations in various branches of applied science.

The *annual conversazione* of the Royal Geographical Society was held on June 14 at the National History Museum, South Kensington. Sir George Goldie, Miss Goldie and several members of the council received the guests, who numbered nearly 1,200. The okapi recently obtained by Major Powell-Cotton from the Ituri Forest, Equatorial Africa, was on view, together with a special exhibition of specimens, manuscripts and objects relating to Linnæus, arranged in celebration of the bicentenary of Linnæus's birth.

Dr. G. R. Mansfield, of Harvard University, with a party of students expected to reach Bozeman, Montana, on July 2, where they will outfit with wagons and camp equipment and start for the mountains, visiting first the geological section of the Bridger Range, then the intervening Cretaceous section to the base of the Crazy Mountains, where they will join Professor Wolff, who, assisted by Mr. H. E. Merwin, assistant in mineralogy, is making a revision of the geology of the mountains. The two parties will spend three weeks in a joint study of the eruptive rocks of the range, and of the exposures in the cañons of dikes, sills and stocks; the summer school party then returning to Bozeman and disbanding, Dr. Mansfield returning to the smaller party to study the extinct glaciation of the range.

The annual meeting of the Naples Table Association for Promoting Laboratory Research by Women held its annual meeting April twentieth, at Mount Holyoke College, by invitation of Miss Woolley on behalf of the college. Miss Sarah E. Doyle, of Providence, was elected president, Mrs. Elizabeth L. Clarke, treasurer and Mrs. Ada Wing Mead, secretary. The Table of the Association at the Zoological Station at Naples has been occupied at different times during the past year by Miss Grace Watkinson, A.B., Smith, 1902, A.M., 1904; Miss Florence Peebles, A.B., Women's College of Baltimore, 1895, Ph.D., Bryn Mawr, 1900, and Miss Anna G. Newell, A.B., Smith, 1900. It has been assigned for the spring of 1908 to Miss Mary J. Hogue, A.B., Women's College of Baltimore, 1905. The next annual meeting will be held in Providence on invitation of Dean King and President Faunce in behalf of the Women's College in Brown University. Nine theses were received in competition for the $1,000 prize offered in 1907. Three of them were sent from foreign countries. The theses showed wider range of endeavor than those received in the two previous contests as they dealt with botanical, anatomical, morphological, physiological and chemical problems. Several were of decided merit, but since, in the opinion of the examiners, no one was of adequate merit to deserve the award, the association voted to exercise its right to withhold the prize. The fourth prize is announced for 1909.

According to statistics compiled for the United States Geological Survey by Edward W. Parker, coal-mining expert in charge, the total production of coal in the United States in 1906 was 414,039,581 short tons of 2,000 pounds, valued at $512,610,744. These figures, compared with those of the preceding year, when the output amounted to 392,919,341 short tons, valued at $476,756,963, show an increase of 21,120,240 short tons, or 5.4 per cent., in quantity, and of $35,853,781, or 7.5 per cent., in value. Of the total production in 1906, Pennsylvania contributed 200,546,084 short tons, or 48.4 per cent., in quantity, and $262,182,935, or 51.1 per cent., in value, the larger percentage in the value being due, of course, to the higher value of anthracite, which is produced almost exclusively in that state. The production of coal in 1906 by states was as follows:

State.	Product.	Value.
Alabama	13,107,663	$17,467,886
Arkansas	1,864,518	2,999,774
California and Alaska	30,831	78,684
Colorado	10,114,074	12,738,509
Georgia and North Carolina	363,463	407,247
Idaho and Nevada	6,165	24,238
Illinois	41,497,435	44,742,440
Indiana	12,084,281	13,105,168
Indian Territory	2,859,450	5,481,053
Iowa	7,321,639	11,688,598
Kansas	6,010,858	8,935,195
Kentucky	9,673,536	9,794,823
Maryland	5,434,528	6,473,829
Michigan	1,336,338	2,402,529
Missouri	3,755,778	6,163,449
Montana	1,787,934	3,186,620
New Mexico	1,963,558	2,635,571
North Dakota	300,998	437,894
Ohio	27,729,843	30,386,297
Oregon	79,731	212,338
Pennsylvania:		
Anthracite	71,282,411	131,917,694
Bituminous	129,263,673	130,265,241
Tennessee	6,262,686	7,682,121
Texas	1,160,707	2,058,731
Utah	1,773,847	2,411,992
Virginia	4,275,815	4,207,521
Washington	3,276,184	5,908,434
West Virginia	43,276,485	40,777,382
Wyoming	6,138,152	8,019,486
Total	414,039,581	$512,610,744

The Meteorological Service of the Dominion of Canada is now sending time signals from the observatory at St. John, of which Mr. D. L. Hutchinson is director, by telegraph to the wireless station at Camperdown, where special apparatus has been installed to automatically transmit the signals to ships at sea within the zone of that station. Time signals will be sent each week day morning as follows: Beginning at 9h. 58m., a.m., Atlantic time, dots are made each second up to and including 9h. 58m. 57s., then a pause of two seconds, followed by a dot at 9h. 59m.; then another pause of two seconds follows; the clock then makes dots each second up to and including 9h. 59m. 50s.; a pause is then made, followed by a dot at 10h. a.m., Atlantic or Standard time of the 60th meridian west longitude, equivalent to 2h., p.m., Greenwich mean time.

UNIVERSITY AND EDUCATIONAL NEWS

The total amount of money received from the state for the maintenance of the University of Wisconsin is now more than a million dollars a year, in addition to the funds received from the federal government, from endowment and from fees.

The University of Colorado, at Boulder, will receive by the will of the late Andrew J. Mackey of that city funds amounting to about $250,000 to be used in the erection of an auditorium and main building. Another gift to the university of $100,000 for a building has been promised by a Denver citizen. The last legislature appropriated $100,000 for building purposes.

The Paris medical faculty has recently announced that henceforth the incumbents of the special chairs of anatomy, histology, physics, chemistry and pharmacology will not be allowed to take posts as physicians or surgeons in the hospitals. Professors of these branches will be obliged to agree to devote themselves exclusively to their educational work.

According to *The Experiment Station Record,* a practical school of agriculture was opened at Talca on June 29, 1906, under the directorship of Carlos Echeverria Cazotte. The school was started with an appropriation of $71,000 for land and $28,000 for equipment and maintenance. The director is also professor of agriculture and zootechny and is assisted by professors of forestry, physical and natural sciences, engineering, viticulture and the common elementary branches.

Foreign journals report that the German Colonial Secretary, Herr Dernburg, recently visited Hamburg to inspect the Institute for Tropical Diseases, the Botanical Museum, and the Museum for Ethnology and Anthropology with a view to ascertain whether the city possessed facilities enough for the study of colonial and tropical questions to justify the foundation of a colonial training college. Herr Dernburg decided to recommend the establishment of such an institution, and the courses at the new college are to be open to those who desire to engage in private commercial or industrial enterprise in the German colonies, as well as to government officials. The new institute will be modeled on the plan of existing German technical colleges. The promoters of the scheme hold that the intercourse between intending officials and young business men will contribute to the benefit of the German colonies. The state of Hamburg will for the present be responsible for the scheme, and, if the results prove satisfactory, the institution will receive official recognition in the form of an imperial subsidy.

The General Board of Studies of Cambridge University recommends that the present lectureship in physiological and experimental psychology be not continued, but that in its place two lectureships be established, one in the physiology of the senses in connection with the special board for biology and geology, and that the annual stipend of the lecturer be £100; the other in experimental psychology in connection with the special board for moral science, and that the annual stipend of the lecturer be £50.

Professor J. Playfair McMurrich has resigned the professorship of anatomy in the University of Michigan to accept a similar position in the University of Toronto.

In the College of the City of New York, tutors have been elected as follows: Charles A. Corcoran in physics; Howard C. Griffin in chemistry; and C. A. Touissaint in mathematics.

Professor John O. Reed has been appointed dean of the Department of Literature, Science and the Arts in the University of Michigan, to succeed Professor Hudson, who has resigned the position as dean, but retains the professorship of history. Professor Reed has already had experience in administrative matters, as principal of the schools of Saginaw, as professor of physics in the University of Michigan and as dean of the university summer session.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JULY 19, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

LINNÆUS AND AMERICAN BOTANY[1]

I HAVE been asked to make a short address to you on Linnæus and his relation to North American botany. That the selection fell on me was not because I was the most able one to deliver such an address, for there are many abler men present, but simply because I was born in the same country as Linnæus. In fact, my grandfather came from the same province of Smaland and even from a parish adjoining that of Stenbrohult, in which my illustrious countryman was born.

In the early part of the seventeenth century there lived in Jonsboda, Smaland, Sweden, a farmer named Ingemar Svenson. He had three children, two sons and one daughter, the grandmother of Linnæus. On the Jonsboda farm stood a very large linden tree, so old and with so many traditions that it was regarded by the people as a holy tree. Any damage done to this tree, it was claimed, would surely bring misfortune upon the head of the perpetrator. When the two sons began to study for the ministry, it was natural that they should think of this tree in selecting a family name. They called themselves Tiliander; *Tilia* is the Latin for the linden or basswood, and *andros* the Greek for man. It may not be amiss to state that at that

[1] Address delivered at the New York Botanical Garden, May 23, 1907, by Per Axel Rydberg, on the commemoration of the two-huudredth anniversary of the birth of Linnæus by the New York Academy of Sciences.

time the common people of Sweden did not have any family names, and this is true to a certain extent even to-day. A man was known by his given name, the given name of his father with the word son appended, and the place where he lived. The farmer mentioned above was known as Ingemar Svenson from Jonsboda. His father's name was Sven Carlson and that of his grandfather, Carl Johnson. The names of his two sons would have been Carl and Sven Ingemarson had they remained in the peasant class, instead of Carl and Sven Tiliander.

The daughter married a farmer, Ingemar Bengtson, and her son's name was Nils Ingemarson, until he entered the "gymnasium." He was also born in Jonsboda and, when selecting a name, he naturally also turned to the same old linden tree as his maternal uncles had done. He called himself Linnæus. It is remarkable that two of his father's maternal granduncles also bore another Latin form of the same name, viz., Lindelius. Some claim that even this name was derived from the same old linden tree, but this is scarcely in accordance with the facts. More likely it traces its origin from the Linden Farm in Dannäs Parish, where their ancestors lived.

But what has this genealogy to do with Linnæus's relation to North American botany? Perhaps nothing directly, but indirectly a great deal; for the circumstances and surroundings under which a man is born and reared to a certain extent make the man. In his younger days, Sven Tiliander was the house-chaplain of Field-marshal and Admiral Viscount Henrik Horn, who was for many years governor of Bremen and Verden, two cities with territory in Germany acquired by Sweden through the Thirty-years War. During his stay in Germany, Tiliander learned to know and love botany and horticulture and established around Viscount Horn's residence in Bremen a garden which was remarkable for that period. When both returned to Sweden, Tiliander brought with him the choicest plants from this garden and planted them around the parsonage of Pjetteryd Parish, of which he had been appointed rector. Here at Pjetteryd Nils Linnæus spent most of his youth, studying in company with his uncle's sons. Later, both as curate at Rashult and as rector at Stenbrohult, he surrounded the parsonages with gardens, in which he grew many rare and interesting plants. In the midst of these, Carl Linnæus, the famous botanist, was born and reared. Later, while a student at the university, he spent a summer vacation at home in 1732, and made a list of the plants in his father's garden. This list is still to be seen in the Academy of Sciences at Stockholm. Although defective, the first four classes being unrepresented, it enumerates 224 species. Of these, many were at that time very rare in cultivation. Professor Theodore Fries in his biography of Linnæus enumerates 36 of the rarest of these. Among them we notice six American plants, viz., *Rhus Toxicodendron* (the poison oak), *Mirabilis Jalapa* (four-o'-clock), *Asclepias syriaca* (milk-weed), *Phytolacca decandra* (poke-weed), *Antennaria* — now *Anaphalis* — *margaritacea* (pearly everlasting) and *Solanum tuberosum* (the potato). It may be remarked that the cultivation of potatoes was introduced into Sweden about twenty years later. We see from this that Linnæus had learned to know some American plants even in his early childhood.

Carl Linnæus was born the thirteenth of May (old style), 1707, at Rashult, an annex to the parish of Stenbrohult. His father was the curate there, but two years later, at the death of his father-in-law, Samuel Broderson, he became rector and moved to

Stenbrohult. In the fall of 1714 Carl Linnæus entered the school of Wexiö, and graduated from the "gymnasium" in 1727. His parents, especially his mother, wanted him to study for the ministry, but he had no love for theology, nor for metaphysics, nor the classics. He learned Latin tolerably, however, because that language helped him to study the natural sciences. He decided to study medicine and entered with that view the University of Lund, which was nearest his home, but remained there only one year, learning that there were better facilities at Upsala. At the latter place he soon became acquainted with Professors Rudbeck and Celsius, two of the most prominent scientists of that time, and was allowed to use their libraries. The former, who had many duties to perform, soon asked Linnæus to give for him the public lectures in botany. The income from these gave Linnæus means to support himself and linked him closer to his favorite study. He became acquainted with practically all the plants of the gardens and fields of the whole region around Upsala and learned all the scientific names given in the books at his disposal.

The latter was not an easy matter, when we take into consideration the form of scientific names at that period. For example, the most approved name of the common blue-grass that adorns our lawns was: "*Gramen pratense paniculatum majus, latiore folio, Poa Theophrasti.*" Other names of the same grass were: "*Gramen vulgo cognitum,*" "*Gramen pratense majus vulgatius*" and "*Gramen alterum et vulgare.*" In the first publication by Linnæus it appears as "*Poa spiculis ovatis compressis muticis.*" I think that Linnæus and his contemporaries had much more cause than we to exclaim: "Those horrible Latin names!" To us the same plant is known as *Poa pratensis* L., the name adopted by Linnæus in his "Species Plantarum."

The lectures given by Linnæus for Professor Rudbeck became very popular. This was especially the case after his return from his Lapland journey. Some persons, especially Dr. Nils Rosen, became jealous of his success and induced the university faculty to pass a resolution by which no one who had not taken the corresponding degree was permitted to give university lectures. Linnæus had not yet received his doctor's degree, and hence was debarred. As Holland was offering at that time excellent facilities both in medicine and in botany, and as living expenses were lower than elsewhere, Linnæus decided to visit that country and take his examinations there. He received his doctor's diploma at Harderwijk, and afterwards went to Leyden, where he became acquainted with three of the greatest botanists of the time, Boerhaave, Burmann and Gronovius. George Clifford, the wealthy burgomaster of Amsterdam and president of the East India Company, was a great lover of plants and had a splendid botanical garden at Hartecamp as well as a rich library and herbarium. On the recommendation of Boerhaave, Linnæus became Clifford's physician and curator of his collections and garden. Here he lived in luxury, beloved as a son.

Clifford furnished Linnæus with means to publish five of his first books, "Systema Naturæ," "Fundamenta Botanica," "Bibliotheca Botanica," "Genera Plantarum" and "Flora Lapponica," the manuscript of which he had brought with him from Sweden. In the first of these Linnæus presents his system of classification. He divides nature into three kingdoms, the mineral, vegetable and animal. In the vegetable kingdom he brings out an altogether new classification, based upon the sexual organs of plants. He divides the kingdom into 24 classes, the first 23 containing the phanerogams and the last the cryptogams. In the first 11 classes are included plants which have from 1 to 12 free and practically equal stamens; in the 12th and 13th, plants with many stamens; in the 14th and 15th, plants with 4 and 6 stamens respectively, of which 2 are decidedly shorter; in the 16th, 17th and 18th classes the stamens are united by their filaments; in the 19th they are united by their anthers, and in the 20th they are adnate to the pistil; in the 21st and 22d the flowers are unisexual, *i. e.*, the stamens and pistils are in different flowers, on the same individual in the 21st and on different individuals in the 22d; and the plants of the 23d class have both unisexual and bisexual flowers. The classes were divided into orders. In the first 13 classes the orders were determined by the number of the pistils, in the 14th and 15th by the fruit, and in the 16th and 18th and 20th to 23d by the number and distinctness or union of the stamens. The classification of the 19th class is too complex to enter into here. The 24th class was divided into 4 orders: Filices, Musci, Algæ and Fungi.

This system of classification is purely artificial. Linnæus himself regarded it only as temporary, and expected that it would soon be supplanted by a more rational one, based on natural relationship. The Linnæan system served its purpose, however. It became a means by which it was possible to tabulate every known genus of plants. Before this time there had been no systems at all, or such crude ones as we find even to-day in some popular flower-books, where the plants are classified by the color of their flowers. If the natural systems of DeCandolle, Bentham and Hooker, and Engler and Prantl are too complicated for popular books, why not go back to the simple system of Linnæus? It would at least give a good insight into the structure of the flower instead of the mere color.

In his "Genera Plantarum" Linnæus applied this system to all known genera of plants and gave each of them a concise and plain description.

Clifford had many American plants in his garden, but he sent Linnæus to England to visit Sir Hans Sloane, Professor Dillenius and Philip Miller, in order to secure American plants grown by them. Both Sloane and Dillenius treated Linnæus at first with coolness, because he "confounded" botany. On his farewell visit to Dillenius, Linnæus politely asked him what he meant by "confounding botany." Dillenius took from the library the first few pages of Linnæus's own "Genera Plantarum" and showed him where there was written at numerous places "NB." Dillenius stated that all the genera so marked were wrongly described. The first example he pointed out, if I am not mistaken, was *Canna*, placed by Linnæus in his first class, which contains plants with but one stamen. Botanists before this time had described it as having three stamens. To settle the dispute they went out into the garden and the living plant showed that Linnæus was correct. Dillenius then retained Linnæus for several days and found that the older botanists in most cases were at fault and the young Swede correct. From being an opponent, he became a friend of Linnæus and let him have all the plants he wanted.

After his return to Holland Linnæus continued his work in Clifford's garden with renewed zeal, and completed his "Hortus Cliffortianus," a large folio, in which are enumerated and described all the plants found in Clifford's collections, together with synonyms and citations of nearly all botanical works then in existence. In preparing this work he became thoroughly acquainted with almost all the literature referring to American botany, such as Morison's "Plantarum Historia," Plukenett's "Almagestrum Botanicum" and "Phytographia," Petiver's "Gazophylacium," Sloane's "Jamaica," Plumier's "Plantarum Americanarum Genera," "Plantarum Americanarum Fasciculus Primus" and "Filicetum Americanum," Catesby's "Historia Naturalis," and, later, Cornuti's "Canadensium Plantarum Historia."

After completing the "Hortus Cliffortianus," Linnæus returned to Leyden, where he spent some time helping Gronovius with the editing of his "Flora Virginica," based on a large collection of plants collected by Clayton. Here again he came in contact with American plants.

Linnæus then returned to Sweden and became a practising physician. He was soon appointed professor of medicine at Upsala, but by common agreement he exchanged chairs with Rosen, who held the professorship of botany. He now began work upon the most important book of his life, his "Species Plantarum." In this he tried to include a short description of every known species of plant, together with the most important synonyms and citations. In this book the Linnæan binomial system of nomenclature was used for the first time. Linnæus was not the first to give plants names; nor was he the first to name genera. Many Latin plant-names had come down from antiquity, while others had been proposed by his predecessors. Men like Tournefort and Micheli had in some cases clearer ideas of genera than Linnæus himself. Neither was Linnæus the first one to use binomials. In Cornuti's work on Canadian plants, for example, we find almost as many binomials as polynomials; but it is doubtful if Linnæus had seen Cornuti's book when he first wrote his "Species Plantarum." He does not cite it in the first edition, but does so in the second. Linnæus was, however, the first one to use binomials systematically and consistently. Before his time botanists had recognized genera and applied to them Latin nouns as names. In order to designate species, they added to these nouns adjective descriptive phrases. These consisted sometimes of a single adjective, as in *Quercus alba*, the white oak, but more often of a long string of adjectives and adjective modifiers, as in the case of the blue-grass mentioned above. The specific name had hitherto been merely a description modifying the generic name; from this time it became really a name, although a single adjective in form. An illustration of the pre-Linnæan form of plant-names might be had if, instead of "Grace Darling," one should say, "Mr. Darling's beautiful, slender, graceful, blue-eyed girl with long golden curls and rosy cheeks." "Grace" is just as descriptive of the girl as this whole string of adjectives. It may be that "Grace" is not always applicable to the person to whom the name is applied; but this is also often the case with many specific plant-names. *Asclepias syriaca* and *Rumex Britannica* are American plants, and *Rubus deliciosus* is one of the least delicious of the raspberry tribe. This invention and strict application of binomial names could not but cause a revolution in botany. Since the appearance of "Species Plantarum" in 1753 it has been possible to pigeonhole not only genera, but also species of plants.

Before this useful book was printed, Linnæus had become better acquainted with North American plants, and in another way. Baron Bjelke, the vice-president of the Court of Appeals of Finland, had proposed to the Royal Academy of Sciences at Stockholm to send an able man to Iceland and Siberia, countries partly in the same latitude as Sweden, "to make observations and such collections of seeds and plants as would improve the Swedish husbandry, gardening, manufactures, arts and sciences." Dr. Linnæus suggested North America instead, and recommended one of his pupils, Professor Pehr Kalm, of Abo, for the proposed expedition. Kalm spent two years in North America, traveling through Pennsylvania, New Jersey, New York and Canada, and making large collections of seeds and plants, which were preserved as living or dried specimens or as alcoholic material. During his stay at Raccoon, New Jersey, he discovered our mountain laurel. The Swedes of Raccoon called it spoon-tree, because the Indians made spoons from its hard wood. Kalm adds in his journal about this tree: "The English call this tree a Laurel, because its leaves resemble those of the *Laurocerasus*. Linnæus, conformably to the peculiar friendship and goodness which he has honored me with, has pleased to call this tree *Kalmia foliis ovatis, corymbis terminalibus*, or *Kalmia latifolia*." Here Linnæus himself gave an illustration of both the pre-Linnæan and the post-Linnæan nomenclature. Kalm became acquainted with several of the naturalists of this country, C. Colden and his daughter Jane, Bartram and Clayton, and through Kalm a correspondence was established between them and Linnæus. Linnæus also corresponded with John Ellis, who resided in the West Indies, and Dr. Gardiner, who botanized in Carolina and Florida. Later he bought a set of plants collected by Patrick Browne in Jamaica, and received a part of the collections made by Jacquin in the West Indies.

When the second edition of the "Species Plantarum" appeared, in 1762, Linnæus knew and had described nearly 1,000 plants indigenous to the United States and Canada. Besides these, he described about 1,000 more, natives of the West Indies, Mexico and Central America, and 400 or 500 South American plants. His knowledge of American plants was small compared with what he knew of plants of the old world. "Codex Linnæanus," which enumerates all plants named by Linnæus, contains not fewer than 8,551 species.

Linnæus died January 10, 1778, honored and esteemed by all. Some of his work will doubtless live as long as botany is studied by man.

We see from the preceding account that we may consider Linnæus one of our American botanists. Even the little plant which Gronovius dedicated to the Father of Botany, the twin-flower of our woods, with its exquisite perfume and its dainty pink flowers, belongs to a genus essentially North American. The genus *Linnæa* contains four forms, all closely related. One of these, the original *Linnæa borealis*, is confined to the mountain regions of northern and central Europe. Linnæus discovered it on his Lapland journey and it was then considered a very rare plant. Now it seems to be more widely distributed than it was at the time of Linnæus. Perhaps it is of American origin and has become modified since it transplanted itself on the other side of the ocean. The other three forms are North American. *Linnæa americana* Forbes, which has usually been confounded with its European cousin, is common in the woods from Labrador to Alaska, and extends in the Rocky Mountains as far south as New Mexico. *L. longiflora* (Torr.) Howell, is found in the mountains from northern California to Alaska. The fourth form is, as far as I know, undescribed and unnamed. It is with great pleasure that I here propose the following name and description for this species:

Linnæa serpyllifolia sp. nov.[2]

Apparently the same plant has also been

[2] The description has been published in the *Bulletin of the New York Botanical Garden*.

collected on the island of Sachalin by F. Schmidt, but his specimens lack flowers.

P. A. Rydberg
New York Botanical Garden

SCIENTIFIC BOOKS

An Investigation of Evolution in Chrysomelid Beetles of the Genus Leptinotarsa. By William Lawrence Tower. Washington, D. C., Carnegie Institution.

It has been an obvious criticism of many of the recent experimental and statistical investigations of matters connected with evolution that they were entirely too narrow in their scope. Even the famous studies of the evening primroses, by de Vries, suffered from the fact that their author did not really know as much about the species of *Œnothera* as was desirable, and was even ignorant of the original habitat of the species giving rise to so many remarkable mutations. The de Vriesian studies attracted so much attention that it was not long before many skilled botanists were hot on the trail of the missing data, and to-day the whole subject is on a very much better footing.

Professor Tower, in his work on the Colorado potato beetle and its allies, has not depended upon results obtained in the laboratory alone, but has undertaken a comprehensive study of the whole of the genus *Leptinotarsa,* and even of the related genera, in the field. He has compiled all the information extant in the literature of the subject, and has made repeated trips to Mexico and elsewhere to collect and study the beetles in their native habitats. He has found Mexico to contain a large number of species of *Leptinotarsa,* having characteristic habitats and habits, all of which he has described, with photographic illustrations. Southern Mexico, it is concluded, is the center of origin of *Leptinotarsa,* and consequently the Mecca of whoever would seek to unravel the secrets of its evolution.

It is not possible, of course, to give a summary of these ecological investigations in a review, but as an example we may quote from some of the remarks on *Leptinotarsa undecimlineata:*

> An instructive illustration of the manner in which the dispersion of this beetle takes place was afforded by the recent building of a railroad through a perfectly flat, frequently flooded savanna near Tierra Blanca. The food plant grows generally over the savanna, but the beetle is entirely absent excepting at a few points along the road where the work of constructing ditches to keep the roadbed intact has created new localities with favorable conditions for their existence. Over a distance of about 18 kilometers there are now located flourishing colonies at each place where the work of the railroad builders has made existence possible, while on the unmodified savanna I have not been able to locate a single colony, and doubt if there are any. In this instance the advance into a new area has occupied two years and has been rapid. That transportation [by human means] did not bring about the starting of these colonies is certain, as the work of railroad construction was entirely suspended during the rainy season, when the beetles are active and dispersion takes place. It is perfectly clear that in this case the distribution was brought about by some few individuals from a colony happening by chance to discover the newly created habitat, proper for æstivation and for the breeding of the next generation. In each generation many will perish by not being able to reach the proper habitat after once having abandoned the parent colony, but the fact remains that some do discover proper habitats, and when such are found new colonies are established. . . . It is not necessary that the soil should be of a special chemical composition or temperature and rainfall of special amounts, but it is essential that during pupation and æstivation the beetle shall not be subjected to excessive desiccation or moisture, and that the soil shall be porous enough to admit of an abundant supply of air.

This, indeed, is real biology; and how different from some ecological writings we have seen!

When we come to the potato beetle, *L. decemlineata,* the discussion is most comprehensive. The most interesting fact brought out is the retreat of *L. juncta,* of the southern states and Atlantic seaboard, before the invading hordes of *decemlineata.* Now these two species have *different food plants,* and so apparently should not compete! It appears, however, that they freely cross, and

Concerning this crossing in nature and its effect upon *juncta* I shall have more to say in a later paper. The full explanation of the extinction of *juncta* is to be found in the fact that the two species cross freely in nature, and that this natural crossing has resulted in a most interesting and peculiar case of prepotency in one species and of submergence in the other.

Chapter II., on Variation in *Leptinotarsa,* gives us a detailed account of the variation, not merely of the adults, but also of the early stages. Schemes are invented for tabulating the different kinds of variation, and abundant statistics are offered. There is a most interesting section on "Place Variation," a term used to signify "the variation in any given species in the same locality from generation to generation, or from season to season, or year to year." Professor Tower says:

As far as I am able to determine from observations and experiment, place variations result in no permanent modifications, nor do the changes seem to be inherited. . . . This place variation must necessarily be a troublesome factor in the study by biometric methods of evolution, geographical variation or selection. In my own work it has been the rock upon which many cherished schemes have been wrecked, and I suspect it has not yet completed its destructive work. If one would study any of the broader problems of evolution by biometric methods he must first of all determine whether in the material chosen for study this phenomenon exists, and if it is found, too great care or too long a time can not be spent in the elimination of this factor. At present I know of but one method of doing this—that is, by collecting data and material over a sufficiently long period to determine the range of this form of variability. Unhappily this demands time, patience and often funds which the investigator will not or can not afford. The failure to take into consideration this place variation vitiates the validity of a large part of the biometric work that has been done, and there is no reason to think that it will be otherwise in the future.

It appears from the tables given, that there was usually an oscillation, *occupying about four generations,* from one extreme to the other. This oscillation even occurred in a laboratory experiment, as shown in *A,* Plate 26. Any one observing the changes through four generations only might consider that he had a beautiful case of progressive evolution, when, in the fifth, he would be again at the starting point! It is certainly conceivable, and if true of extraordinary interest, that this phenomenon is not *wholly* due to external causes, but is in part the outcome of a rhythmic pulsation of life, as it were, analogous to that which produces the well-known phenomenon of alternation of generations.

Professor Tower sums up his views on place variation under four heads, the fourth deserving to be quoted in italics.

In place variation, whenever there occurs an extreme oscillation of the population there is an accompanying production of an unusually large percentage of extreme variations or mutants.

This he observed in nature, and also under experimental conditions. The general fact has been known or suspected for many years—see, for instance, the variable Virginia colony of *Helix nemoralis,* and other like cases—but Professor Tower has planted what was somewhat of a "castle in the air," firmly upon the ground.

In the laboratory experiments it was found that mere selection of the extremes of normal variation (say light or dark) did not affect the type, the polygons made from the offspring of light or dark beetles being practically coincident. When, however, strong environmental stimuli (say dryness and moisture) were applied, it was found that marked "place variation" occurred, resulting in distinct polygons for the lots so treated, the two not even closely approaching, much less overlapping. By the application of suitable conditions, together with rigid selection, it was easily possible to produce two very distinct races: not, however, much exceeding the extremes of normal variation for the species. Nevertheless, when these things were abated, the beetles soon went back to the normal condition of the species, no trace of the past excentricity remaining.

I have said that no trace of the excentricity remained, but while this was exactly true for the bulk of the material, *while the excentricity* *was at its greatest, several mutations were produced.*

Thus there were produced from the light (dry) series examples of *pallida* and *defecto-punctata,* and from the dark (wet), specimens of *melanicum.* The most numerous of these was the *pallida,* a form with the usual markings, but the ground color exceedingly pale. This *pallida* occurred also out of doors in the potato fields, but so rarely that Professor Tower is convinced that it is virtually impossible for it to establish itself. When isolated and inbred, however, it comes perfectly true, and in this way a very numerous colony of pure *pallida* was obtained. Some of these were bred in company with typical *decemlineata,* and it was found that the normal crossings (*i. e.,* of like beetles) were to the abnormal as 7 to 1. On account of this, the *pallida* were not swamped, but continued to increase when both were transferred to natural conditions in the grounds of the University of Chicago. Professor Tower was very anxious to allow the *pallida* to spread widely over the country, and see what would happen; but the injurious character of the insect made this impossible and so the colony was destroyed.

When bred with *decemlineata, pallida* gave the normal Mendelian results, with *decemlineata* dominant.

Melanicum, the dark variety, is in some ways even more interesting.

It appears to be very distinct, and is crossed with difficulty with *decemlineata;* when a successful cross is obtained, the results are Mendelian.

It is, moreover, ill adapted to the habitat of *decemlineata,* into which it must be born, as it is apparently able to live or reproduce only in a high percentage of humidity. My experience with them is that only the above condition can be used for their propagation in experiment, and there is every reason to believe they would require a like condition in nature.

This appears to be very suggestive of a method of origin of a new species. It is shown that the mutation *melanicum* arises from *decemlineata* when the latter is subjected to conditions of moisture, and that it requires excessive moisture. Let *decemlineata* reach a too moist region, and produce a few *melanicum;* will not these proceed still farther into the humid area, and there multiply in comfort and isolation, forming a veritable new species? This will be facilitated by the difficulty of crossing with the parent form.

Chapter IV., on habits and instincts in *Leptinotarsa,* is especially important for the understanding of the evolution of these beetles. It was ascertained that selective mating existed in respect to size, being due to the inability of abnormal individuals to properly perform the sexual act.

We do not ordinarily realize how narrow are the limits within which successful copulation can take place in insects, or how slight a variation is sufficient to prevent the performance of the sexual act with such completeness as to insure the leaving of progeny.

Nevertheless, as was to be expected, there was no trace of psychological selection.

The above account does not in any sense do justice to this remarkable work. There is much in it to which no reference has been made; and I do not attempt a summary of Professor Tower's closing chapter, which should be read in its entirety, and is too long to republish here. There are places where one does not feel quite sure that the facts justify the conclusions reached, and here and there we find inconsistencies. We also regret the absence of information in several places; thus we are told that the conditions at Cabin John Bridge were such as to produce many mutations, but just what those conditions were does not appear. We also have names for some new species and varieties, without any descriptions. These things, as I learn from a letter received from the author, will be remedied in a subsequent publication; the present volume (though of 320 pages) being merely preliminary, and representing a mere fraction of the whole material gathered.

A rumor has reached me that there is some question about the continuance of the grants upon which Professor Tower's work depends. This work is necessarily somewhat expensive; but if, in some way or another, this country can not find for Professor Tower all the money and leisure it requires, for as many years as he is willing to continue his labors, it will be disgraceful beyond measure. One of the truest tests of the intellectual status of a country is found in its ability to quickly realize the importance of a work of the first class. Since this book came out, I have asked a number of naturalists whether they had read it; and have so far failed to find one who has given it more than superficial attention. Its bulk and the fact that it is ostensibly devoted to a very limited subject—a single genus of beetles—together with its limited circulation, resulting from the mode of publication, have combined to prevent it from receiving due attention, at least in certain quarters where it should have been hailed with delight. If the present notice will serve to show that it is of the first importance to every biologist, whatever his specialty, that will be ample excuse for its length.

T. D. A. Cockerell

SOCIETIES AND ACADEMIES

THE AMERICAN SCHOOL HYGIENE ASSOCIATION

The American School Hygiene Association held its meeting for organization in Washington City, May 6 and 7, 1907, at the Hotel Shoreham. The following program was presented:

Monday, May 6, 3:00 P.M.

Report of Committee on Organization, Arthur T. Cabot, M.D., chairman, fellow Harvard University, Boston.

"Physiological Age and its Influence on School Progress," C. Ward Crampton, M.D., assistant director of physical training, New York City Public Schools.

Monday, 8:00 P.M.

"Medical Inspection of Schools in Massachusetts," Hon. George Martin, LL.D., secretary of the Massachusetts State Board of Health.

"Medical Examination in New York City Public Schools," John J. Cronin, M.D., assistant chief medical inspector, Board of Health, New York City.

Discussion opened by Thomas Darlington, M.D., commissioner of health, New York City.

Tuesday, May 7, 3:00 P.M.

"The Requirements of Proper School Furniture," Robert W. Lovett, M.D, Harvard Medical School.

(These papers are to be published by the association.)

Business Meeting.

A constitution and certain resolutions were adopted, of which a few extracts are here given.

EXTRACTS FROM THE CONSTITUTION

Article II. The objects of this Association shall be: (*a*) To stimulate research and to promote discussion of the problems of school hygiene. (*b*) To take an active part in movements wisely aiming to improve the hygienic conditions surrounding children during school life.

Article X. The Council shall be empowered to publish its proceedings in a volume or journal, together with special reports, bibliographies and articles that may aid in the objects of this Association.

Article XIV. Any person may become an active member of this Association upon recommendation of two members, election by the council and the payment of one year's dues.

Article XV. Honorary members shall be nominated by the Council and shall be elected by a two-thirds vote of the members present at the annual meeting.

Article XVI. The Association shall hold an annual meeting and such other meetings as they shall from time to time determine.

Article XIX. Funds shall be raised by annual dues of three dollars from each active member, and in such manner as shall be approved by the Council.

RESOLUTIONS ADOPTED AT THE FIRST MEETING

Whereas, The maintenance and development of the health and vigor of school children is a matter of paramount importance, and

Whereas, Experience in all great cities has shown the importance of health inspection; be it

Resolved, That in every city and town adequate provision should be made both for sanitary inspection of schools and for medical inspection, the latter to include not only inspection for contagious diseases, but also of eyes, ears, teeth, throat and nose and of general physical condition.

Whereas, The improvement in the health and of the hygienic conditions surrounding school children depends largely upon the intelligent cooperation, the competency, the interest and the faithfulness of teachers and principals in matters of hygienic importance; therefore, be it

Resolved, That all schools having courses for the training of teachers should give instruction in (*a*) personal and school hygiene and (*b*) the principles and practise of physical training, and that each of these subjects should be given as much time as the major subjects in the course.

Resolved, That examinations for licenses to teach should include questions upon these subjects, and that the answers to such questions should be given equal weight with the answers to questions upon any other subjects.

The officers elected for the ensuing year were:

Hon. President—Theodore Roosevelt.

President—Dr. Henry P. Walcott.

Vice-President—Dr. Arthur T. Cabot.

Secretary-Treasurer—Dr. Thomas A. Storey.

Members of Council for One Year—John A. Bergström, Ph.D., Elmer E. Brown, Ph.D., W. H. Burnham, Ph.D., John J. Cronin, M.D., Abraham Jacobi, M.D., LL.D., W. H. Maxwell, A.M., LL.D., John H. Musser, M.D., John Ridlon, M.D., Myles Standish, M.D., H. P. Walcott, A.B., M.D.

Members of Council for Two Years—Walter E. Fernald, M.D., C. Harrington, A.B., M.D., C. N. Kendall, A.M., Geo. H. Martin, LL.D., J. H. McCullum, M.D., J. H. McCurdy, M.D., C. A. Moore, Edw. L. Stevens, L.H.D., J. J. Storrow, Edw. Lee Thorndike, Ph.D.

Members of Council for Three Years—Champe S. Andrews, Nicholas M. Butler, A.M., LL.D., Litt.D., Arthur T. Cabot, M.D., Frederick Forchheimer, M.D., W. E. Fischel, M.D., L. H. Gulick, M.D., M.P.E., C. W. Hetherington, Ph.D., Geo. L. Meylan, A.M., M.D., Thos. A. Storey, Ph.D., M.D., William H. Welch, M.D., LL.D.

Henry P. Bowditch, M.D., professor of physiology in the Harvard Medical School was unanimously elected first honorary member of the association.

Thomas A. Storey,
Secretary
College of the City of New York

DISCUSSION AND CORRESPONDENCE

"POPULAR" SCIENCE

In a recent communication,[1] Mrs. Franklin enters a timely protest against the pseudo-science of the popular magazines. Every investigator of color vision must agree with Mrs. Franklin that Dr. Ayers's conception of color-blindness—as presented in the April *Century*—"belongs to the class of the antiquated and the non-scientific." And a more recent paper in the same magazine by Professor Stratton, of the Johns Hopkins University, is equally defective and misleading.

Under the title "Railway Disasters at Night" Professor Stratton discusses a topic which has aroused wide-spread popular interest. The author describes various real and fictitious defects of color vision, and from this sweeping condemnation of the color sense he infers that the "space sense" is more worthy of being entrusted with the responsibility of an accurate discrimination of signals. Accordingly, he recommends the disuse of the present system of railway signaling by means of colored lights, and advocates the substitution of illuminated semaphores which shall appeal to the "space sense." The author's argument centers around the problem of color vision, and it is chiefly to his discussion of this topic that exception must be taken. Most of the errors contained in the paper must be ignored in this brief communication; but I shall venture to call attention to two or three points which may have escaped the notice of the casual reader.

Among the reasons assigned by Professor Stratton for the alleged failure of colored signals is the following startling disclosure:

> The limitations of the normal eye are, however, not yet fully told. Even when it looks with fair accuracy at them, it is always at a disadvantage with regard to colors at night. The eye, grown accustomed to darkness, becomes exceedingly sensitive to faint lights, but it no longer detects their proper colors: "in the dusk all cats are gray." At nightfall a strange kind of second-sight comes in to supplement the vision of common day, now baffled; but this owl-sight of the human eye is able to catch bare light and shade and form, and is blind to the hue of things.

Now if the human retina really were color-blind at night, as Professor Stratton believes, he would undoubtedly have an argument against the present system of night signals; but he would be confronted by the difficulty of explaining how a night express ever reaches its destination in safety—since its safety

[1] Science, N. S., XXV., May 10, 1907, p. 746.

would depend upon the engineer's ability to distinguish between indistinguishable signals. As a matter of fact, the reverse of Professor Stratton's statement is true. Instead of being totally, or even partially, color-blind, "the normal eye, grown accustomed to darkness," is much more sensitive to color than is the retina in daylight vision. Indeed, the increased color-sensitivity of the dark-adapted retina is so striking and so well-known that it has in several instances been made the object of special investigation. And the investigators who have made quantitative determinations of this hyperesthesia to color agree that it amounts to, at least, *two hundredfold.*

Professor Stratton believes that another reason for the misinterpretation of colored signals is to be found in the fact that one "is incapable of seeing correctly the color of objects caught out of the corner of the eye." He represents the engineer as being so occupied with his engine and his time-piece, that he does not even see his signals until he is upon them. "The color of a signal must be caught in its flight to one side" while the engine rushes past in mad career. It seems unnecessary to discuss the question as to whether or not Professor Stratton's dramatic description represents the actual procedure adopted by the engineer in the reading of his signals; but it may be remarked that if engineers really do attempt to interpret signals under the conditions described by the author, the semaphore device which he advocates would prove to be even more defective than the despised system of colored lights. For while it is true that the outlying regions of the retinal surface are relatively insensitive to color, it is also true that these peripheral regions are even less capable of discriminating between spatial forms.

The author errs again in his discussion of the status of "color weakness." It is popularly supposed that there exists a group of individuals who are "weak in their color sense, but by no means color-blind." Professor Stratton promulgates this erroneous conception, notwithstanding the fact that in an examination of several thousand cases of "color weakness" Professor Nagel, of Berlin, found not a single instance of the defect that did not turn out, on closer investigation, to be a familiar case of color-blindness.

Professor Stratton omits to mention that the illuminated semaphore which he recommends is an antiquated expedient. It represents an earlier stage in the evolution of the present system of signaling; it was introduced into the railway service many years ago, but, for reasons which need not be discussed here, it never came into general use. Its failure and ultimate supplanting by colored lights are now a matter of history.

J. W. Baird
University of Illinois

THE DEFINITION OF RESPIRATION

To the Editor of Science: In the article "On the Teaching of the Subject of Respiration" in Science for April 19 it is stated that "the confusion of words is inconvenient enough, but there is back of it a confusion of ideas which is more serious and by which the teaching of the subject is more or less impaired." That this is true there is abundant evidence, while a very superficial glance over the recent literature of the subject shows where the trouble lies. If only one authority were consulted little difficulty would result, for the differences are concerned with words rather than with ideas; each book is clear enough if taken by itself; yet the number of definitions of respiration that are available to the student can lead to nothing but confusion. A few brief quotations will illustrate this. Barnes[1] speaks of "another false conception. . . . One often finds respiration described as a gaseous exchange—the taking up of oxygen and giving off of carbon dioxid—a trade between the atmosphere and the body." More recently Loeb[2] has stated, "By respiration we mean the taking up of oxygen and the giving off of CO_2. We shall see later that the latter process can exist independently of the taking up of oxy-

[1] "The Theory of Respiration," Science, February 17, 1905.

[2] "The Dynamics of Living Matter," 1906.

gen." Mathews[3] says that "Respiration is in fact the dissociation of water with the liberation of hydrogen." In recent school text-books there are also wide differences. "The entire process of respiration consists simply of an exchange of gases through a membrane" (Linville and Kelly[4]). "This oxygen consumption is the *respiration* of plants" (Bergen aud Davis[5]). "The process by which oxygen is taken into the body and carbon dioxide is given off is *respiration*" (Atkinson[6]). "The escape of carbon dioxide, which follows the taking in of oxygen, is the superficial indication that the very important process called respiration is going on . . . just what happens in respiration is very uncertain, but it involves a series of changes in the living substance itself" (Coulter[7]). These fragmentary quotations sufficiently demonstrate the different points of view. Hough and Sedgwick,[8] in a book which will help to raise the quality of physiology-teaching in our schools, have it that "breathing is not the fundamental act of respiration; . . . this cell breathing is the essential act of respiration, for respiration is only another name for the oxidative processes of the living body"; but later we find, "The consumption of oxygen and the production of carbon dioxide thus involve an interchange of these gases between the blood and the tissues (internal respiration) on the one hand, and between the blood and the air in the lungs (external respiration) on the other." This latter statement is similar to what may be found in most of our school physiologies, and for that reason alone would best define respiration as understood by the great majority of school and college students.

On the whole this conception seems to be the right one. It has the endorsement of the great majority of writers on physiology, while custom, the dictionary and the etymology of the word strongly support it. The present confusion is largely due to the effort to change the meaning of a word that has long been in general use, an effort that as yet seems to be confined to a few plant physiologists.

It is very desirable that the common characteristics of living organisms should not be lost sight of and that botanical physiology should not have a different terminology from zoological. It is also desirable that the language spoken in the laboratory should not differ from that which can be properly used outside. Dr. Shaw says, "To define respiration then as a gaseous exchange is to turn away from the all-important process." We can not agree with this "telling objection." As long as there is such a thing as this peculiar gas exchange some word will be needed for it; "respiration" is evidently that word and should no more turn us away from the vital process than "excretion," "alimentation" or other words necessary to describe the superficial phenomena. While respiration is not fundamental it is by no means unessential; from many points of view it is more important than the disruptive processes within the cell. In the study of anatomy, of adaptations, of habits, and of ecology in its widest sense the nature of the gas exchange and the means by which it is accomplished become of dominant importance.

If the word respiration is to be shifted to the energy-releasing process within the cell some new word will be needed to cover those processes now understood uuder that term. It would be interesting to know if the meanings of the related words "inspire" and "expire" are to be changed. Also, what becomes of the "organs of respiration"? Do they disappear? Or are we to add to lungs, gills, stomata, etc., such structures as root hairs, kidneys, the intestine or other organs that may be concerned with those exchanges between the organism and its surroundings by which the disruptive process is maintained?

"Respiration," as it has long been understood, is a useful, indeed a necessary, term; the new conception of the energy-releasing processes within the cell deserves to be dignified by a new word. The confusion that once

[3] *Biol. Bull.*, Vol. VIII., May 6, 1905.

[4] "Text-book in General Zoology," 1906.

[5] "Principles of Botany," 1906.

[6] "College Botany," 1905.

[7] "A Text-book of Botany," 1906.

[8] "The Human Mechanism," 1906.

surrounded the conception of "carbon assimilation," or whatever else it was called, has been wonderfully cleared by the adoption of "photosynthesis." It is to be believed that a similar clarifying process would take place, and the thanks of teachers of plant physiology would again be earned by Dr. Barnes, if the word "energesis" could be generally adopted.

W. E. Praeger

Kalamazoo College

VOLCANIC ACTIVITY IN ALASKA

To the Editor of Science: Mr. Arthur P. Porter, civil engineer and graduate of the Massachusetts Institute of Technology, writing from Elliott Creek, Alaska, under date of May 24, 1907, communicates the following interesting observations:

On and about April 5, several mountains of the Wrangell range in Alaska were active volcanically, sending up great clouds of steam and causing a flood in the Kotsina River that, on April 6, came down past our camp at the mouth of the Kotsina, cut us off from our supply train and prevented our going up the Kotsina on the ice.

To go more into detail, the first we heard about it was on April 1, when we were mushing down the Tonsino River. We stopped for dinner at the camp of some freighters hauling in supplies for the Hubbard-Elliott mine; and Mr. Hubbard said that they could plainly see the smoke (?) and steam rising from Mt. Wrangell. That afternoon and the following day, as we proceeded down the Tonsino and then down the Copper River, we caught occasional distant views of the mountains, but I noted nothing remarkable. (A photograph taken April 2 shows the mountains clear.) On April 5 and 6 we saw great white clouds which always rolled away from the mountains, yet never left them clear; and with the field glasses steam was seen issuing from the sides of the mountains below the tops. We were at the mouth of the Kotsina, about forty miles from the mountains, and could not positively identify the peaks. Apparently, however, Mts. Wrangell, Blackburn and Sanford were all sending up steam.

The next day, April 6, a sudden flood came down the Kotsina on top of the ice and underneath it. There had been no warm weather and no rain (28° below zero instead). The flood lasted two days and then went down. The enclosed photograph shows the head of the flood advancing down the river and spreading over the snow as it came. I stepped on an ice hummock to take the picture; and by the time I could focus my camera, the flood had passed me on both sides and nearly cut me off. The toe of the flood advanced at the rate of fifty feet a minute, actual timing, eating its way through the snow as if the water were warm.

May 28, the mountains seem to be steaming again (Mt. Drum or Mt. Sanford), and others noted the same two days ago.

W. O. Crosby

Massachusetts Institute of Technology

RANA PIPIENS

To the Editor of Science: While I was in charge of the neurological work at the University of Chicago, there were published from the laboratory eight papers dealing with the anatomy of the nervous system of the leopard frog. In these publications the species was designated as *Rana virescens brachycephala* (Cope). I have recently learned through the kindness of Dr. Leonhard Stejneger, of the National Museum, that this name is no longer used, and that the correct designation for the leopard frog is *Rana pipiens* (Schreber), as given by Jordan, "Manual of the Vertebrate Animals of the Northern United States," and adopted by Holmes, "Biology of the Frog," 1906, and Miss Dickerson, "The Frog Book," 1906.

In my further studies on the nervous system of the leopard frog, the species will be designated, therefore, as *Rana pipiens*. In view of the fact that there are several investigations on this species still to be published, I take this opportunity of calling attention to the change in name, first, because those of us who are not specially concerned with taxonomy are apt to be confused by such changes, and second, because I wish to emphasize the fact that these later studies will apply to the same species as that used in the earlier investigations.

Henry H. Donaldson

Wistar Institute of Anatomy

SPECIAL ARTICLES

ANOTHER WORD ABOUT THE NORTHERN BOUNDARY OF MINNESOTA

In examining a series of old maps of the "Hill records" of the Minnesota Historical Society, new light has been thrown on the northern boundary of Minnesota, as it was first proposed by the commissioners of the United States and Great Britain.

The first use of the term "most northwestern point of the Lake of the Woods" was in the proposed articles of a treaty of peace between the United States and Great Britain, November 25, 1782. The definition and the proposition came from Mr. Oswald, the British commissioner, who was in Paris in conference with the American Plenipotentiaries. It was adopted only five days later in the provisional articles of peace as signed and finally approved by both governments. It is the conclusion of that part of the section which defines the boundary line from Lake Superior to the Lake of the Woods. Mr. A. J. Hill has exhaustively discussed the complicated question which was raised by the attempt to extend the boundary "thence on a due west course to the river Mississippi": this interesting and long-drawn discussion, with the various phases of diplomacy which the error in the treaty entailed, is published in the appendix of Vol. VII. of the Collections of the Minnesota Historical Society. Mr. Hill also gives the steps taken by the two governments to determine the exact location of that point, but records his belief that the place contemplated by the treaty of 1783 was at the outlet of the Lake of the Woods, that is, at Rat Portage. This belief he based on the shape of the lake as represented on the "Mitchell map" used by the joint commission when they drew up the terms of the treaty. The sagacity of this opinion is fully demonstrated by the designations on an English map which I have recently had the opportunity of examining, through the courtesy of Hon. N. P. Langford, president of the Historical Society. This map was published in London, in 1794, by Laurie and Whittle, 53 Fleet Street. Therefore its date was between the signing of the first treaty and the discovery of the fact that the Mississippi did not rise so far north as the Lake of the Woods. It was evidently an important map, covering a large area and extending from Spain westwardly to a meridian in the Pacific 25 degrees west from Cape Mendocino, and from the equator to Hudson's Bay. It has no individual title nor author's name. It seems to have come from an atlas, on the cover of which the date and the publisher's name are expressed. I have not seen the whole atlas, and these details are on the authority of Mr. Charles A. Heath, of Chicago, who owns the map.

I was at once struck by the fact that the international boundary, which is distinctly shown by a heavy red line, does not follow the route for canoes which was finally settled upon as the boundary. At Saganaga Lake it runs toward the northwestward instead of southwestward, thus passing to the north of Hunter's Island, following the course of drainage from Saganaga Lake. In order to take a canoe southwestward from Saganaga Lake it is necessary to make a short portage into Oak Lake, and thus to put the canoe into a different water-course. Dr. U. S. Grant has called attention to this departure from the real water-course and to the consequences resulting in loss of territory to the United States, in a paper published in the eighth volume of the Collections of the Historical Society. He has also mentioned several other instances of portaging from the direct and usual route to other waters lying to the south; and Dr. A. N. Winchell, in his article in Vol. VIII. of the same publication, has given the history of the negotiations which resulted in the present boundary line.

What is singular is, not that the red line of the map invariably follows the regular and continuous water-course after leaving Saganaga Lake, as far as to Rainy Lake, but that it strikes the north end of Rainy Lake, and thence passes to the north end of the Lake of the Woods, at the outlet of that lake. It thus puts within the territory of the United States the whole of Rainy Lake, and the most of the Lake of the Woods.

On comparing this map with other old maps that were gathered by the late A. J. Hill, it becomes apparent not only that there are two "water" routes all the way between Saganaga and Rainy Lakes, but also two water or canoe routes between Rainy Lake and Lake of the Woods. These two routes are shown, in whole or in part, by the following maps:

1743. *Carte de l'Amérique septentrionale pour servir à l'histoire de la Nouvelle France. Par N. B.* [*Bellin?*], *Ing. du Roy et Hydrog. de la Marine.* On this map, westward from Lake Superior, are three water routes, which, notwithstanding the incorrectness of the map, can be identified as well known hydrographic features. The most northern is that which starts from Thunder Bay, ascending the Kamanistigouia River, and may be known distinctively as the *Kamanistigouia route.* It is represented as a nearly straight water-course, of which the east end flows east and the west end west. It has three connections with the more southern route, all leading to Rainy Lake, but it continues on westward and joins a stream which is represented to flow into "Lac des Bois" from the north. The next southern route (the *international boundary*) divides at Saganaga Lake. The northern branch unites with a stream that leads to the northeast corner of Rainy Lake. The southern branch, running along the south side of Hunter's Island, continues to Rainy Lake, joining it from the east. The most southern of the main routes mentioned is that which leaves Lake Superior at its most western point and is evidently meant to be that by way of the St. Louis River. It unites with the international boundary route westward from Lake Saganaga, evidently by way of the Vermilion River. Westward from Rainy Lake are two water-courses, one passing northward into the Kamanistigonia route, and the other westward, by way of Rainy River, and joining Lake of the Woods near its middle, amongst islands, from the east. The southern portion of Lac des Bois, which receives several streams from the south, is very inconsequential. This portion was afterwards known as "Lake of the Sand Hills."

1755. *Partie de l'Amerique septentrionale qui comprend la Nouvelle France ou le Canada. Par le Sr. Robert de Vaugondy, Geog.* The only route westward from Saganaga Lake, shown on this map, runs north of Hunter's Island, the southwestern route, where the actual boundary runs, being discontinued after passing through two lakes. This northern water-course unites with the northwest side of Rainy Lake, apparently by way of the Seine River. The routes westward from Rainy Lake are (*a*) the Rainy River and (*b*) a river route which has a curious course, reaching "Lac des Bois" from the northeast, thus enclosing a large island between Rainy Lake and Lake of the Woods. This northern route is simplified in later maps.

1755. *Carte de l'Amerique septentrionale depuis le 28 Degré de latitude jusqu' au 72. Par M. Bellin, Ingenieur de la marine.* By this map there are two water routes westward from Lake Superior. The most northern is that which may be known as the *Kamanistigouia route,* starting from Thunder Bay. The other is the Pigeon River route which is now the international boundary. It is an interesting fact that at Saganaga Lake this southern route branches, one branch going to the north of Hunter's Island and joining the Kamanistigouia route at a lake some distance east of Rainy Lake, thence the united routes joining Rainy Lake at the east side. The southern branch, which became later the international boundary, joins Rainy Lake from the southeast. Westward from Rainy Lake there is shown but one route, plainly that of the Rainy River, though it is represented to unite with Lake of the Woods in the northern portion of that lake instead of in the southern.

1762. *Canada, Louisiane, Possessions Angl. Par le S. Robert de Vaugondy, Geog. ord. du Roy,* etc. This map shows two through routes to Rainy Lake, of which the northern is that by the Kamanistigouia and enters that lake by the Seine River. The southern divides into two branches, of which the northern starts from Saganaga Lake and unites with the *Kamanistigouia* route at a lake east of Rainy Lake, and the southern continues through a series of lakes, now the international boundary, to Rainy Lake. There is but one route westward from Rainy Lake to Lake of the Woods, that being by the Rainy River.

1776 (?). *An accurate map of Canada, with the adjacent countries, exhibiting the late seat of war between the English and French in those parts.* Univ. Mag. J. Hinton, Newgate Street. This English map was certainly made between the dates of the cession of Canada to England and the close of the Revolutionary war, although its exact date is not known. It shows two routes of water travel westward from Lake Superior. Of these the northern is that by way of the Kamanistigouia River, passing through "Long Lake" and "Flat Lake." The southern route is by way of the Pigeon River to Lake "Sesakinaga" at its north end, and from that lake northwestwardly, evidently along the north side of Hunter's Island.

1775. *North America, from the French of Mr. d'Anville, improved with the English surveys made since the Peace.* London. "Printed for Robert Sayer and J. Bennett, Map and Print sellers, No. 53 Fleet street, as the act directs 10 June 1775." This map shows three routes to Rainy Lake, viz.: (*a*) The Kamanistiquoia route, passing through the "Long Lakes" at some distance inland. (*b*) The international boundary route, passing through "Long Lakes" near Lake Superior, leading to Saganaga Lake and there dividing, like other maps, one branch going northwest and the other southwest. Of these the northern branch only reaches Rainy Lake, the other apparently being discontinued or blending into (*c*), the third main route, which follows the St. Louis River northwestwardly, uniting with the chain of lakes of the present international route. Westward from Rainy Lake only the route via Rainy River is shown.

1780 (?). *A chart of the interior part of North America, demonstrating the very great probability of an inland navigation from Hudson's bay to the west coast.* The date of this map is uncertain. It is very generalized and its only value in this connection is its naming the "Back Road" between Rainy Lake and Lake of the Woods. This name is applied to the only water course between those lakes but is a term which afterwards was given only to the more northern route of canoe travel between them.

1790. *A map showing the communication of the lakes and the rivers between Lake Superior and Slave Lake in North America. Gentleman's Magazine,* 1790. Plate 1. This generalized map is valuable in this connection only because it shows two conspicuous water-courses leading westward from Rainy Lake to Lake of the Woods. Eastward from Rainy Lake the single water route is that which leads to the "grand portage" from Pigeon River to Lake Superior.

1826. *Map of the Missouri and higher parts of the Mississippi, and of the elevated plain where the waters divide, which run eastward into the River St. Lawrence, northeast into Hudson's Bay, north-northwest into the frozen sea and south into the Gulf of Mexico; to which is added Mackenzie's track in 1789.* From Lake Superior westward is shown but one water route, which is apparently that of the international boundary, consisting of many small lakes and short streams between them, as far as Rainy Lake. But westward from Rainy Lake are two water routes, one plainly the Rainy River route joining Lake of the Woods from the southeast, and the other running directly from the northwest corner of Rainy Lake northwestwardly to Lake of the Woods, considerably shorter than the southern route.

[*Note.*—This is the map compiled by Gen. Collot to accompany his travels in North America, 1794–96. It was engraved in 1805 and the book printed, but not published till 1826.]

1830. *United States of America, compiled from the latest and best authorities,* by John Mellish. The route here represented is that of the international boundary, through Rainy Lake and to the northern end of Lake of the Woods, where the outflow is to Lake Winnipeg. But from the northwest corner of Rainy Lake another water-course is shown, entering Lake of the Woods from the east about midway. The land thus surrounded by water is named *Maple Island.*

1860. *Map of the boundary line between British America and the United States.* Accompanying Hind's report on the Assiniboine and Saskatchewan Exploring Expedition. London Edition. This map shows excellently not only the international boundary route but also the more northern water route along which the body of water flows from Saganaga Lake to Rainy Lake, west from which the margin cuts it off.

1860. *Map of the country from Lake Superior to the Pacific Ocean.* Accompanying Hind's report on the Assiniboine and Saskatchewan Exploring Expedition. London Edition. While showing the same two routes as the last mentioned map, this shows the two routes that lead from Rainy Lake to Lake of the Woods.

Several later Canadian maps plainly delineate the routes of canoe travel between Lake Superior and Lake of the Woods, viz., Dawson's and the maps of the Geological Survey.

Conclusions. It is plain, therefore, that the proposition of the British commissioner (Oswald) was designed to carry the international boundary to the outlet of the Lake of the Woods and thence "westward to the Mississippi."

It is plain also that in London the British geographers so understood the terms of the treaty of 1789, and further that the line was to leave Lake Superior at "3 Rivers," *i. e.*, at the mouth of *Kamanistigouia River.*

It was then supposed, and is now demonstrated, that westward from Lake Saganaga, nearly all the way to Lake of the Woods, there are two canoe routes of travel which unite in the same waters only in passing through Rainy Lake, the northern route carrying the main water-flow eastward from Rainy Lake, and the southern one westward from that lake.

In order to reach the most northwestern point of the Lake of the Woods by the most direct route it would obviously be necessary to follow the more northern of these routes all the way to Rainy Lake and there depart from it, as shown by the map of Laurie and Whittle, of 1794, to take a shorter route northwestwardly to the northern part of Lake of the Woods.

It is also now plain that the provisional determination of the point of the most northwest angle was very carelessly and incorrectly done, and ought not to have been accepted by the United States.

When the Webster-Ashburton treaty of 1842 accepted that point, thus determined, and defined the boundary by specifying certain lakes through which the line should run, further uncertainty and controversy were cut off.

There was a constant tendency to shift the flexible boundary line farther and farther toward the south. This is probably attributable to the guidance of the Canadian *voyageurs,* who were the only men acquainted with the region and who were then British subjects.

In the removal of the boundary from the original route along the main water-course to its southern course, Dr. Grant has estimated the loss of land by the United States to be about 1,000 square miles, eastward from Rainy Lake.

Westward from Rainy Lake is an area of excellent agricultural land along both sides of the Rainy River, embraced within the limits of the glacial Lake Agassiz. If the original intent of the treaty of 1783 had finally become effective in the treaty of 1842, about 1,000 more square miles would have been embraced within the United States, the greater part of which is flat and arable at once on the removal of the forest.

Again, if the boundary had left Lake Superior at "3 Rivers," as indicated on the accompanying map of Laurie and Whittle, a still further large area, which may be estimated at 500 square miles, would have fallen to the United States.

Finally, it is plain that through the inadvertence of the American commissioners of 1842 about 2,500 square miles of land were yielded to the British commissioners, more than was contemplated by the original treaty —that, too, while they were very tenacious, in following the instructions of the president, *not to grant any cession of land from the territory of the United States.*

The only comfort which can be derived from this *crying over spilt milk* is that relief which comes with a gush of tears, and from the satisfaction of remembering "what might have been."

N. H. Winchell

Minnesota Historical Society,
May, 1907

REGENERATION AND THE QUESTION OF "SYMMETRY IN THE BIG CLAWS OF THE LOBSTER"

In view of several recent articles[1] on the phenomena of symmetrical chelæ in the lobster it seems desirable to offer a few further considerations on the subject of the origin of such structures.

Let us briefly present the nature of the problem. It is a matter of common observation that in the adult lobster the "great" claws are almost invariably asymmetrical with reference to each other; the claw on one side of the body being a "nipper" and the other a "crusher." In a few cases, however, a variation from this normal asymmetry has been discovered, in which the claws instead of differing from each other are very much alike and symmetrical in form. These variations fall into two categories: First, those in which both claws are of the nipper type, and second, those in which the similar claws are both crushers. Two theories for the origin of these relations of symmetry have been presented—first, that they are predetermined in the egg, and second that they may arise through regenerative processes and consequently, are not of necessity wholly determined by congenital factors. Let us consider first the variations from normal asymmetry.

I. *Explanations for Abnormally Symmetrical Claws.*

(*a*) *Similar Nipper Claws.*—Until very recently in all the authentic cases of similar chelæ, the claws belonged to the first category of the nipper type. Out of over 2,400 lobsters[2] found only three had similar claws. In an examination of some 600 specimens as they came in from the traps at the Experiment Station of the Rhode Island Commission of Inland Fisheries the writer[3] found only one lobster with both claws alike. The similar claws of these four cases were all nippers. Theoretically, it may appear quite plausible that a symmetry of this character might be congenital in origin. For in the early development of the lobster both chelæ are alike and similar to the nipper type. At about the sixth stage[4] normally one of the claws begins to differentiate into a crusher. We might thus have an adult lobster with two nipping claws because they had failed to differentiate in the usual asymmetrical manner. On the other hand, the writer has elsewhere[5] furnished evidence that this type of symmetry may also be brought about as the result of a process of regeneration.

(*b*) *Similar Crusher Claws.*—With regard to this second category, however, the congenital theory does not appear to apply so readily. For in this case the development must be conceived as starting in the normal way, and then instead of differentiating asymmetrically both chelæ have passed beyond the normal stages and developed into two crushing claws of the phylogenetically later (according to Stahr[6] and Przibram[7]) type.

[1] See especially: (1) Herrick, F. H., 1907, "Symmetry in the Big Claws of the Lobster," Science, Vol. XXV., p. 275. (2) Calman, W. T., 1906, in the "Proceedings of the Zoological Society of London," p. 633.

[2] Herrick, F. H., 1895, "The American Lobster," Bull. U. S. Fish Commission.

[3] Emmel, V. E., 1907, "Regenerated and Abnormal Appendages in the Lobster," thirty-sixth annual report of the Rhode Island Commission of Inland Fisheries, special paper, No. 31.

[4] Hadley, P. B., 1906, "Changes in Form and Color in Successive Stages of the American Lobster," thirty-fifth annual report of the Rhode Island Commission of Inland Fisheries, Special paper No. 19.

[5] Emmel, V. E., 1906, "Torsion and other Transitional Phenomena in the Regeneration of the Cheliped of the Lobster," *Journ. of Exp. Zoology*, Vol. III., No. 4.

[6] Stahr, H., 1898, "Neue Beiträge zur Morphologie der Hummerschere Jena," *Zeitschr. f. Naturw.*, Bd. 32.

[7] Przibram, H., 1901, "Experimentelle studien über Regeneration, 1.," *Archiv. f. Entw.-Mech.*, Bd. XI.

With reference to this latter type of symmetry the following observations serve to emphasize the process of regeneration as a factor in the origin of such abnormal appendages.

Heretofore, a strong presumption has existed that a crusher claw would not be developed on each of the big chelæ, first because, as has already been indicated, the claws of the young lobster are alike and similar to the nipper type, and second, that in the adult lobster, the few cases of symmetrical claws were always of the nipper or embryonic type. Up to 1905 the only case recorded of two crushing claws on a lobster was in a foot-note to Herrick's[8] description of variations in lobster chelæ: "I have heard of a single case reported by a fisherman where similar crushing claws were developed on both sides of the body" (p. 143). To Przibram writing in 1901[9] this seemed such an incredible phenomenon that in view of the theoretical reasons indicated above, he concluded that "Der eine Fall von einer Hautung beiderseitigen" crushing claw "von dem Herrick nur vom Horensagen durch Fischer Kenntnis erhielt, wird wohl in der Reich der Fischermythen zu verweisen sein" (p. 333).[10]

Since the year 1905 three authentic cases of lobsters with two crushing claws have been placed on record. One of these was reported by Dr. W. T. Calman,[11] of the British Museum. He exhibits the photograph of a lobster (*Homarus gammarus,* Linn.) "with symmetrically developed chelæ" which were both crushers (p. 634). Herrick, '07,[12] observes that "this case is, for the present, essentially unique in the literature of the subject" (p. 277), but in making this statement he has evidently overlooked my description,[13] published in 1906, of the two other lobsters with similar crusher claws. The latter two cases of similar crushers were regeneration products, and they are, as far as I am aware, the only cases on record in which the origin of the two crushing chelæ is known, for in neither of the cases recorded by Herrick and Calman has the history of the abnormal chelæ been obtained. A brief restatement of the facts with regard to these regenerated crushers may, therefore, be in place here:[14]

One of these cases was obtained in the course of a series of experiments on regeneration made during the summer of 1905, and the other during similar experiments in 1906. In both instances the lobsters had been recently taken from the traps near the experiment station, placed in floating cars and kept in as normal a condition as possible. Let us designate the former as specimen A, and the latter as specimen B.

Specimen A.—The original appendages of this specimen were all normally developed and the animal was in a healthy condition throughout the experiment. The lobster was a female and measured $8\frac{3}{16}$ inches in length. On July 26, 1905, both chelæ, and the second and third right walking legs, were autotomously removed. On September 28, sixty-four days after the amputation, the lobster moulted and then measured $8\frac{1}{2}$ inches. It had meantime regenerated both chelæ, and the second and third right thoracic legs.

The original left claw of this lobster was a completely developed crusher, characterized by the wide massive claws with an almost entire absence of tactile hairs, and by the presence of broad tubercle-like teeth. The right chela was of a characteristic nipper type with a relatively slender claw, pointed cutting teeth, and a fringe of tactile hairs along the jaws. The right and left chelæ measured 146 and 140 mm. in length, respectively.

Soon after the amputation of these limbs another pair of chelæ began to regenerate from the remaining stump or basipodite. July 18, twenty-three days after the amputation, the regenerating buds both measured 5 mm. in length. By the time

[8] *Loc. cit.* (2).

[9] *Loc. cit.*, (7).

[10] I gladly take this opportunity, however, to correct the impression which might be drawn from this quotation. For Przibram in a recent letter has kindly informed me that he has modified his earlier opinion with regard to this matter as the result of his studies on other crustacea. See especially page 215 of his monograph on "Die Heterochelie bei decapoden Crustaceen," *Archiv. f. Entw.-Mech.*, Bd. XIX., 1905.

[11] *Loc. cit.* (1).

[12] *Loc. cit.* (1).

[13] Emmel, V. E., 1906, "The Regeneration of Two Crusher-Claws following the amputation of the Normal Asymmetrical Chelæ of the Lobster," *Archiv. f. Entw.-Mech.*, Bd. XXII.

[14] For a more detailed description with figures, see *loc. cit.* (3), (13).

the segments of the future limbs were well outlined, attention was drawn to the very similar appearance of the two regenerating structures. Usually, as the lobster approaches the culmination of the moulting period, the regenerating chelæ become so clearly differentiated that a distinction between the crusher and nipper can be readily detected. In the present case, however, no characteristic differences could be observed between the right and left regenerating buds, and, moreover, the general morphological appearance of each suggested that *both* were developing into the crusher type of claws.

After the lobster had moulted, the regenerated chelæ assumed their normal shape and each measured 63 mm. in length. But the regenerative processes had not reproduced the original asymmetrical type of chelæ. The regenerated left claw was a true crusher like the former claw; but the regenerated right claw had the general characters, not of the nipper, but of a typical crusher. A close analysis of the structural features of the regenerated right claw demonstrated that, in all its morphological characters, it corresponded point for point with both the normal and the regenerated crusher of the left side, with respect to the general form, size and proportion, in the shape and arrangement of the teeth, and even in the number and distribution of the tufts of tactile hairs.

Specimen B.—This specimen was an eight-inch male lobster. The original chelæ, as in the preceding case, were also of the normal asymmetrical type, except that in this lobster the right claw was the crusher and the left a nipper. Each chela measured 162 mm. in length.

On August 4, 1906, both chelæ and the second left leg were autotomously removed. Soon after the operation another pair of limbs began to regenerate. By the time the segments of the future appendages were well outlined, the two regenerating chelæ looked very much alike, and the fact that their external characters resembled those of a crusher, suggested that both limbs would develop claws of a crushing type.

By the middle of October, 1906, the lobster had moulted and regenerated both chelæ and the second right leg. Each chela measured 111 mm. in length; they were remarkably similar in structure, and each displayed the character of a typical crushing claw.

In these lobsters, therefore, we have two cases in which the regenerated claws were symmetrical in form and of the crusher type of chelæ.

With regard to the origin of similar crusher chelæ, Dr. Calman's case has been interpreted as discrediting the regeneration theory for symmetrical chelæ, for in his discussion he says: It has been supposed that this might be due to regeneration after injury, since it is known that in Brachyura, on removal of the crushing-claw, a cutting-claw is regenerated. Przibram, however, failed to obtain such "heteromorphic" regeneration in the lobster, and the present specimen throws still further doubt on the regeneration theory, since it possesses a well-developed and quite typical crushing-chelæ on both sides of the body.[15]

Herrick in his earlier writing[16] has evidently also favored the congenital theory, for in his discussion of symmetrical claws he states that "there seems to be about as much variation as regards the details here mentioned in normal symmetrical claws as in the abnormally symmetrical ones, and it is probable that in either case the conditions met with are to some extent congenital" (p. 244). In his recent article he discusses both theories without definitely favoring either, and in conclusion states that, "The explanation just offered is based on the assumption that regeneration, following loss, actually occurs in these cases. If there has been no regeneration, we must then fall back upon the view that asymmetry in the great forceps is normally produced by changes which take place in the egg, so the rare condition of symmetry in these appendages may be casually brought about in the same way" (p. 277). With regard to Dr. Calmans's case of two crusher claws, Herrick suggests the possibility of getting such a condition through a process of regeneration. But it is important to note that neither of these writers furnishes any experimental proof for the conclusion that symmetrical crushing chelæ have arisen either congenitally or as the result of regeneration. The two cases just described furnish

[15] *Loc. cit.* (1).

[16] *Loc. cit.* (2).

such experimental proof, and *establish the fact that the process of regeneration is an important factor in the origin of the symmetrical chelæ occasionally found in the adult lobster.*

At present it seems difficult to bring these cases which show the regeneration of two crusher claws under any definite principles of regulation or a developmental mechanics. Evidently they can not be explained as due to a retardation in the process of ontogenetic differentiation, nor does it appear that they can be regarded as a reversion to a phylogenetically older type of chelæ. It is apparently impossible to interpret such a regeneration as a case of "compensatory regulation" in Zeleny's[17] sense, for the regenerated chelæ are almost identically similar in size and form. Nor is it clear that they both can be brought under the category of "reversal" phenomena, if by this term we mean a reversed order of asymmetry. At present, therefore, these cases must rather be described merely as the *substitution* by regeneration of the crusher claw in place of an original nipper chela.

II. *The Ontogenetic Origin of Normal Asymmetry.*

The main question here is, whether normal asymmetry is congenital and wholly predetermined in the egg, or whether it may be influenced by external factors during development.

With regard to this matter Herrick,[18] on the basis of his experiments with the shrimp *Alpheus*, concludes that asymmetry in the lobster "is probably one of direct inheritance, all members of a brood being either right- or left-handed. That is to say, the normal position of the toothed or crushing claw is not haphazard, but is predetermined in the egg" (p. 225). But here again there is a necessity for evidence, for it still remains to be demonstrated that such asymmetry in the lobster is thus predetermined. The results of some experiments made in order to determine whether the crusher could be developed on either side of the body by making appropriate mutilations during the larval stages, *i. e.*, at a period when the chelæ have not yet differentiated into nipper and crusher—may be here introduced. Although these experiments are still in progress, some of the data is already significant because it tends to support a different theory than that of direct inheritance.

[17] Zeleny, C., 1905, "Compensatory Regulation," *Jour. of Exp. Zoology*, Vol. II., No. 1.

[18] 1907, *loc. cit.* (1).

On July 24, 1906, two groups of second-stage larval lobsters were mutilated. In group A, the right chela was amputated, and in group B, the left chela was removed in each specimen. The lobsters were kept in separate compartments and precaution taken to keep a careful record of mutilations, moults, and regenerations for each individual. Such an experiment is especially difficult because the naturally great mortality of larval lobsters when kept in artificial conditions is greatly increased by the injury attending mutilation, but I succeeded in rearing beyond the fourth stage four specimens in group A, and nine specimens in group B. After each moult the regenerated chela was

GROUP A: RIGHT CHELA REMOVED

Specimen	Stage	Date of First Mutilation	Number of Moults	Character of the Chelæ		
				Date	Right	Left
1	2d	July 24	Six	Sept. 29	Nipper	Crusher
2	2d	" 24	Six	Oct. 6	Nipper	Crusher
3	2d	" 24	Six	Sept. 29	Nipper	Crusher
4	2d	" 24	Six	Nov. 8	Nipper	Crusher*

GROUP B: LEFT CHELA REMOVED

Specimen	Stage	Date of First Mutilation	Number of Moults	Date	Right	Left
1	2d	July 24	Six	Oct. 27	Crusher	Nipper
2	2d	" 24	Six	Sept. 29	Crusher	Nipper
3	2d	" 24	Six	Oct. 13	(?)†	Nipper
4	2d	" 24	Six	Oct. 19	Crusher	Nipper
5	2d	" 24	Six	Oct. 19	Crusher	Nipper
6	2d	" 24	Six	Oct. 19	Crusher	Nipper
7	2d	" 24	Six	Oct. 19	Crusher	Nipper
8	2d	" 24	Six	Oct. 19	(?)†	Nipper
9	2d	" 24	Six	Sept. 22	Crusher	Nipper

* This specimen was very late in displaying any asymmetrical differentiation, but by November 18 the left chela became somewhat broader, showed a characteristic crusher curve in the dactyl and tubercle-like teeth in the proximal region of each jaw.

† Up to date showed no evidence of having differentiated into a crusher.

invariably amputated. The limb on the opposite side of the body was thus given every possible advantage with regard to growth, in order to see whether this chela could be made to differentiate into a crusher. The data so far obtained for these specimens is in the table given above.

From this table it will be observed that in over 90 per cent. of the specimens the chelæ have already differentiated asymmetrically, but in no case for group A did a crusher develop on the right side, or in group B, a crusher on the left side. The evidence for specimens Nos. 3 and 9 is at present neutral, for they still appear to retain their embryonic symmetry, and it remains to be seen at the next moult, which will occur during the spring, whether they too will finally develop a crusher on the right side or not. At any rate, this experiment clearly shows that *in all cases where the chelæ have differentiated far enough to display asymmetrical characters, the crusher has developed on the chela which was given the greater opportunity for growth; i. e.*, on the side which was not mutilated.

The results so far attained, therefore, establish a strong presumption that the "right- or left-handedness" of the lobster may not be entirely predetermined in the egg. If these results are confirmed by further experiments, it ought to furnish convincing proof that the asymmetrical relation of chelæ in the lobster may under certain conditions, at least, be determined by other than hereditary factors.

This result is especially interesting in view of the fact that in the adult lobster we do not seem to meet with the phenomenon of reversal or compensatory regulation which Zeleny[19] and Przibram[20] have found in other crustacea. In the course of my experiments I have mutilated over 200 adult lobsters in which the normal asymmetrical limbs were autotomously removed and preserved for each specimen, but in no case did a crusher ever regenerate on the side which had originally carried a nipper and at the same time *vice versa* for the nipper. It has been suggested that possibly one reason why we do not get a typical reversal in the lobster is because the asymmetry of chelæ consists in a greater qualitative differentiation than in the case of the crabs and some other decapod crustacea, consequently, a true reversal in the lobster would involve more fundamental morphological transformations than in the case of these other forms. On the other hand, in the larval lobster the chelæ are very similar both qualitatively and quantitatively, and the results of our experiments seem to indicate that the symmetrical relations of the organisms are at this stage in a much more plastic condition.

We may summarize, then, this discussion of regeneration and the origin of symmetry as follows: First, positive evidence has been advanced that the process of regeneration is an important factor in the origin of symmetrical chelæ. Second, the results of the foregoing experiments on the larval stages establish a strong presumption that the right- or left-handed asymmetry of the lobster, instead of being entirely hereditary, may be influenced during ontogenetic development by external factors.

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March 6, 1907

[19] *Loc. cit.* (17).

[20] *Loc. cit.* (7).

DIE BACK OF THE PEACH TREES

(*Valsa leucostoma* Pers.)

Die back is a serious enemy of the cherry orchards of Germany. It is especially destructive in the districts along the Rhine. It is also reported as being parasitic on the stone fruits of Australia. Professor F. C. Stewart, of the New York Agricultural Experiment Station, was the first American to call attention to the parasitic nature of this fungus. Ellis and Everhart in their 'North American Pyrenomycetes' state that this organism is found on peach, plum and almond trees in Carolina, Pennsylvania, New Jersey and probably throughout the country where the trees are found.

Experiments at this station show that it is an active parasite attacking the twigs, limbs and trunk of the peach, plum, apricot and cherry trees.

On the peach, infection occurs through the buds and wounds at any time during the growing season, but its development is most noticeable during the spring months. Alternating freezing and warm periods during late winter appear to bring about favorable conditions for the growth of this organism. It often makes considerable advancement during the warm weather in winter. The young shoots are frequently killed back from two to fifteen inches during the months of January and February. As many as three hundred diseased twigs have been counted on a single tree. Twigs killed during the winter months at first have a dark purplish skin, but later the skin on the infected areas becomes leathery and shades into scarlet and purple, giving the twigs a characteristic appearance. The leathery colored areas finally change to drab, and the skin on the diseased tissue becomes loose and wrinkled. Black fruiting bodies (*Cytospora rubescens* Nitschke) soon appear below the epidermis on the drab-colored areas. These bodies gradually enlarge and push a white disk-like cap through a transverse slit in the epidermis. The entire dead portion of the twig gradually changes to drab in color and becomes more or less dotted with the black silvery capped pustules. During wet weather these black *Cytospora* bodies push out very fine red threads which are composed of masses of spores. These spores are soon scattered by the rain and insects and start new points of infection.

The diseased portion of the twig soon becomes constricted, making the division between the dead and living tissue very marked. Gum pockets also form at this point, which frequently rupture the epidermis and produce a copious gum flow.

During the spring and summer months the foliage of infected twigs frequently wilts suddenly and takes on a brown blighted appearance. This blighting is due to the fungus girdling the stem. A gradual killing back also occurs, but the injury in such case is not so noticeable.

Infections on the older branches during the winter and early spring months produce oblong wounds extending up and down the stem. The epidermis covering such wounds cracks and falls away exposing the wood. Callus soon pushes out from the edge of the injury and finally covers over the exposed tissue. The lips of the newly-formed bark, when they meet, do not unite and often leave a slit or opening through which gum exudes. Injuries of this sort finally produce slightly elevated, oval-shaped scars on the branch, and it is not uncommon to find from fifteen to twenty wounds and scars on a limb five or six feet long. In the more severe cases there is constantly an enlargement of branch about the point of injury, frequently producing rough, black barrel-shaped enlargements.

On the larger limbs and trunk, especially on the southwest side, large cankers or so-called sun scald wounds are formed. Such injuries are gradually extended, often girdling the limbs and even the trunk of the tree. The gumming is also constantly associated with these cankers.

Large limbs or even whole trees in different states of vegetation and at different times of the year die suddenly. The foliage of limbs or trees which die late in the spring and summer takes on an unhealthy, starved appearance and wilts suddenly and shrivels. The leaves of those that will die during the following winter in most cases also take on a yellowish color and fall prematurely.

On the infected areas of the limbs and trunk *Cytospora rubescens* Nitschke and *Valsa leucostoma* Pers. usually develop. Inoculations made with pure cultures of *Valsa leucostoma* on peach and plum trees produced wounds on which *Cytospora rubescens* invariably developed. Spores of *Valsa leucostoma* placed on sterilized peach twigs also produced *Cytospora rubescens*. Inoculations made with pure cultures of *Cytospora rubescens* on peach and plum trees produced wounds on which *Cytospora rubescens* constantly developed. *Cytospora rubescens* spores placed on sterilized peach twigs soon reproduced the *Cytospora* form. From our experiments it is quite safe to conclude that *Cytospora rubescens* Nitschke is the pycnidial form of *Valsa leucostoma* Pers. The pustules of these two forms are constantly intermingled, except on the twigs where the perithecia seldom develop. These forms resemble each other so closely in size, shape and color that it is usually impossible to distinguish one from the other without the aid of a microscope. When the epidermis of diseased tissue is peeled off, these bodies remain attached to it and appear like blisters on its inner surface.

The disease injures the Japan plum in much the same way as the peach. A full account of this disease will be published in bulletin form by this station some time during the present year.

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QUOTATIONS

THE IMPERIAL CANCER RESEARCH FUND

THE report of the Imperial Cancer Research Fund for the year 1906–7, presented to the general committee at their meeting under the presidency of the Prince of Wales on Monday, is calculated to impress different sections of the community in a somewhat different manner. By those who are uninstructed in scientific methods, and unacquainted with the caution necessary for the successful conduct of scientific inquiries, it is likely to be received with some impatience at the continued absence of definite results of a preventive or curative character; while those of better qualifications for the exercise of judgment will recognize that foundations are being laid which afford reasonable hope of a successful and permanent superstructure. The general summary of the superintendent, Dr. Bashford, states that, "during the past year, the hopes of advancing knowledge of cancer have become more and more centered in experimental investigations. We have learned from experiments more of the nature of the local and of the constitutional conditions associated with the origin of cancer; and we have been able to form more definite conceptions of the nature of the change responsible for the rapid multiplication of cancer-cells." The earlier conclusions that cancer is universal in vertebrate animals, without reference to the nature of their food, that its prevalence differs greatly in extent among different races of men, that it is frequently developed in parts of the body which are subjected to continued irritation, either from industrial pursuits or in association with native customs or religious rites, that it is often consecutive to some direct local injury, and that no single form of external agency is constantly associated with its development, have all been confirmed by subsequent observation and experiment. On these grounds it is pronounced to be futile to seek for a hypothetical something common to all the external agencies associated with cancer, and to be necessary to direct attention to the common intra-cellular change which, in conformity with the biological similarity of cancer throughout the vertebrates, must intervene in the transformation of normal into cancerous tissue. As there is no evidence to justify the assumption that the disease is communicated from one person to another, the search for the clue to cancer in any species of animal must take account of peculiarities in the individuals which are attacked and in those which escape. Hence, questions of individual and of family liability have received increased attention during the year.—The London *Times*.

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

LIGHT AND HEALTH

SURGEON CHAS. E. WOODRUFF, of the United States Army, in some notes on "Actinophysiology and Actinotherapy," published in *American Medicine* (Philadelphia) for April, calls attention to the injurious effects of excessive sunlight, a subject on which he has already written several articles and one book. Among the points mentioned are the retardation of vegetable growth by sunlight; the injurious effects of sunlight upon animals; the retardation of human growth by sunlight, so that the tallest men are found in the less sunny climates; the advantages of cloudy weather in increasing the vital activities; the value of dark forests as sanitaria; the dangers of too much light in the treatment of tuberculosis, etc. Many of Major Woodruff's ideas are certainly contrary to generally accepted notions regarding the importance of sunlight. He advocates playgrounds for city children, but adds, "let the parks be well shaded, and not the stunting sand baths which are so harmful." In closing his notes, Major Woodruff laments the fact that climatologists have been so slow to take up the study of light, and calls attention to the well-known lack of careful and systematic observations of the intensity of sunlight. It is well that medical men should spur on climatologists to take more and better observations along many lines, and Major Woodruff's interesting views, and his enthusiastic advocacy of them, will serve a useful purpose if they lead to further investigation by meteorologists and climatologists along actinometric lines.

FRESH WATER IN A WATERSPOUT

Waterspouts—perhaps often better called cloud-spouts—seem to draw up water from the surface over which they occur, and it is, therefore, not infrequently believed that they are largely composed of salt water in cases where they are seen over the oceans. There is an old story of a vessel which passed through a waterspout (quoted in Davis's "Elementary Meteorology," page 283). The captain was drenched in a downpour of water, which nearly washed him overboard. On being asked whether he had tasted the water he replied: "Taste it. I could not help tasting it. It ran into my mouth, nose, eyes and ears." "Was it then fresh or salt?" he was asked. "As fresh," said the captain, "as ever I tasted spring water in my life." In *Symons's Meteorological Magazine* for April, 1907, there is an account of waterspouts which were encountered by the British steamship *Dalyarth* in the Euxine, July 15, 1906. The steamer passed within one half mile of the spouts. "There was a sound of broken water, resembling distant surf on a beach; a terrific deluge of rain, which obscured all view of the waterspout—even the lightning failed to penetrate through the downpouring sheets of water. The falling water was fresh." Dead fish were later seen lying on the surface of the water, and some even fell on the decks of the steamship.

DUST WHIRL AT JOHANNESBURG

Photographs of dust whirls are not abundant, and those who are interested in such matters may be glad to note the publication of two views of a dust whirl in the "Report of the Director of the Transvaal Meteorological Department for the year ending June 30, 1906" (Pretoria, 1907). October 21 was calm and hot at Johannesburg, the conditions being favorable for the production of dust whirls. Several large ones were seen during the day. One of them, which passed over the suburbs, did some damage. The two views show different stages of the same whirl.

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CURRENT NOTES ON LAND FORMS

EARTHQUAKE FISSURES AND SCARPS

A summarized description of fissures and scarps due to earthquakes is presented by W. H. Hobbs in his essay "On Some Principles of Seismic Geology" (*Beitr. zur Geophysik*, VIII., 1907, 219–292), under the title "Dislocations at the Earth's Surface as the Result of Macroseisms" (pp. 236–253). Thirty-one examples are cited. Some of the most important are as follows: In India at the head of the Arabian Sea, 1819, the scarp "rose like a wall above the plain, 16 miles in length," with a vertical displacement of 20 feet; near Wellington, New Zealand, 1855, a cleft was formed for 90 miles with a displacement of 9 feet; in Tulare County, California, 1856, a fissure "in a uniform direction for a distance of 200 miles"; at Fort Tejon, California, 1857, a fissure 20 feet wide and 40 miles long; in Owens Valley, California, 1872, a scarp was formed 40 miles long and from 5 to 20 feet in height; in the Tarawera district, New Zealand, 1886, the main cleft was about 6 miles long, nearly straight; in the Sonora district of Arizona and Mexico, 1887, an irregular fissure, 35 miles long, with a displacemeut from 8 to over 20 feet; in the Neo valley, Japan, the Mino-Owari earthquake of 1891 produced a scarp for 40 miles, with a displacement of more than 10 meters; northwestern India, 1892, a fissure 120 miles in length; and finally the long fissure of the San Francisco earthquake of 1906. In several cases, the new fissures followed lines of depression or subdued scarps, presumably formed by earlier earthquakes.

It would be of interest, in comparing these seismic features with the straight lines representing "lineaments" which Hobbs in this and other papers draws through points where earthquakes have been recorded and along lines of coasts or valleys, to inquire carefully into the course followed by observed fissures and scarps, in order to determine how far they would give warrant for the rectilinear course of hypothetical lineaments (rectilinear, at least, on the maps employed). As far as data are at hand, it does not appear that observed fissures and scarps are straight enough to give support to Hobbs's lines, which in any case seem, as far as earthquakes are concerned, to be largely influenced in location and direction by the evidently subjective element of the location of cities and villages where observers are numerous. For example, in the absence of evidence as to recent or ancient fault lines, the fact that earthquakes have been recorded at Springfield, Hartford and New Haven is no sufficient reason for thinking that seismotectonic information can be gained by drawing a straight line across Connecticut into Massachusetts through these three cities (see Fig. 7, p. 268); indeed, there is even less reason for thinking that seismotectonic lines should be closely related to centers of urban population than that rivers should run by large cities.

FAULT SCARPS AND FAULT-LINE SCARPS

THE relation of earthquake scarps to modern and to ancient faults is to-day well proved. The San Francisco earthquake fracture followed, for at least part of its length, a previously known fault line of thousands of feet displacement, along which the signs of geologically recent movement were so manifest that those familiar with the ground had for some years expected the occurrence of further disturbance. The long fault line at the base of the Wasatch range in Utah, with its recent scarps across alluvial fans and flood plains, is well known through Gilbert's reports. These and other geologically modern fault lines are all more or less curved or irregular. Many other faults are so ancient that the faulted mass may have been baseleveled and afterwards broadly uplifted (without renewed displacement) so as to suffer revived erosion, whereby the weaker rocks, whether in the heaved or in the thrown block, have been worn away; thus fault-line scarps, as they may be called, are produced. Such a scarp differs from a fault scarp in various significant respects. A *fault scarp* is a direct measure of differential displacement, except in so far as it is defaced and dissected by erosion; its altitude equals the vertical displacement of the fault; its length equals the length of the fault; it always faces from the heaved to the thrown block. A *fault-line scarp* in its most characteristic development—namely, where the original displacement has been baseleveled in a completed cycle of erosion, and where the succeeding cycle has reached early maturity—faces the side of the weaker rocks; its altitude has practically no relation to the original displacement, but depends on the amount of elevation by which the new cycle is introduced, or on the thickness of the body of weak rocks. The length of such a scarp is not a measure of the original fault length, but of the distance over which rocks of unlike resistance happened to be brought next to each other by the faulting. When a fault-line scarp faces the heaved block it may be described as a topographically reversed fault-line scarp; but care must be taken not to confound it with a "reversed fault" of geological nomenclature. When the rocks on the two sides of a baseleveled fault are of the same hardness, then revived erosion may produce, in the early youth of the new cycle, a fault-line valley; the work of a consequent or of a subsequent stream, as the case may be.

This problem is only a special phase of the general treatment of faults from the physiographic instead of from the geologic point of view. For the geologist, once a fault, always a fault; displacement, length, heaved block, thrown block, etc., retain their values and their names indefinitely. For the physiographer, once a fault scarp, afterwards something else: the scarp retreats from the fault line; inequality of level across the fault line ordinarily decreases and ultimately vanishes, but it may for a time be reversed even in the first cycle of erosion; if a completed cycle is followed by uplift, revived erosion may produce a narrow fault-line valley; or a fault-line scarp, the aspect, height and length of which have no definite relation to the aspect and dimensions of the original displacement. The effects of insufficient attention to the physiographic aspects of faulting are illustrated in the following note, as well as in a current discussion on "How should faults be named and classified" in the *Economic Geologist,* where consideration is given only the underground elements, as is natural enough in a geological discussion, though somewhat inappropriate to the general title under which the discussion has been carried on.

FAULT-LINE SCARPS IN SWEDEN

The uplands of central Sweden possess a number of well-defined scarps, which are described by Gunnar Andersson as due to faulting, with only subordinate modification by erosion ("Om Mälaretrakternas geografi," *Ymer-tidskrift utgifven of Svenska sällskabet för antropologi och geografi,* 1903, 1–64). For reasons stated below, these features are better interpreted as fault-line scarps; but however they are regarded, they give no countenance whatever for drawing rectilinear structural lines or "lineaments" between points from which earthquake reports are received. It is true that many of the Swedish scarps have a rough east-west trend; but it would be quite impossible to determine the further extension of any one of them by continuing the trend of even the least curved part of its irregular course. These fault lines, along with many others, prove that the highly exceptional quality of a straight line is not to be expected in crustal dislocations.

Andersson infers a modern (Tertiary) date for the faults of central Sweden, because the scarps along the fault lines are still well defined; but in reaching this conclusion he has taken no account of the possibility of two cycles of erosion. He argues that, if the faults were ancient, their scarps would have been long ago planed down by erosion. On the other hand, it is manifest that even if the faults were of paleozoic date, the scarps might be distinct to-day if, after having been base-leveled, they were re-developed by the removal of weak rocks along one side of the fault line in a new cycle of erosion. That at least two cycles of erosion since the period of faulting must here be reckoned with is strongly indicated by the occurrence of numerous narrow fault-line valleys through districts of resistant crystalline rocks; the uplands on either side being of essentially equal height. An account of some striking examples of these narrow valleys is given by A. Larsson, "Topografiska studier i Stockholmstrakten," *Ymer,* 1906, 273–292. Near by, along parts of the same fault lines or of similar fault lines, well-defined scarps separate uplands of crystalline rocks from lowlands in which the crystallines are at least in some instances patched with small remnants of a former unconformable cover of relatively weak paleozoic strata. In these instances there is good reason for thinking that the now lower ground was, at the beginning of the present cycle of erosion, filled up to the level of the crystalline uplands with the paleozoic strata; and hence that while the erosion by which the fault-line scarps were developed may well be of Tertiary date, the date of the faults must be decidedly earlier.

The district here considered, lying not far west of Stockholm, will presumably be visited by excursions at the time of the next International Geological Congress in 1910. It is as unique in its way as are the zigzag ridges of the Pennsylvania Alleghenies. Its development, on the more-than-one-cycle scheme, appears to have been as follows: The great body of complicated crystalline rocks was effectively baseleveled in ancient times, and covered unconformably with early paleozoic strata. The compound mass was afterwards broken by numerous faults, which divided it into many irregular, (nearly) vertical prisms; and the prisms were irregularly jostled and tilted. At that time the surface must have been characterized by many displaced blocks, topped with paleozoic strata and separated by fault scarps. Then the whole district was again baseleveled; this being indicated by the general accordance of upland heights to-day, irrespective of faults. On the peneplain thus produced, the paleozoic strata would remain only where they lay below baselevel. A broad upwarping introduced a new cycle, which has now advanced (glacial erosion included) so far as to have almost entirely consumed the previously inaccessible remnant-covers of paleozoic strata, thus developing fault-line scarps in good number; while the fault lines through the crystalline uplands are now marked by narrow fault-line valleys.

This case is similar in some respects to that of the Hurricane ledge in Arizona, next north of the Colorado canyon. When first described by Dutton (Monogr. II., U. S. Geol. Surv.), this strong escarpment was interpreted as marking a recent fault, and its height was taken as a measure of the fault. Reasons have since been given for believing that the fault is not recent (where the N-S fault line crosses certain erosional E-W escarpments, the corresponding members of the latter are out of line by several miles, and this departure from alignment must represent the excess of escarpment retreat in the heaved block over that in the thrown block); that the original displacement was essentially obliterated by baseleveling (a level, unbroken lava flow crosses the fault line at one point, passing evenly from strong to weak rocks); and that the existing scarp is a fault-line scarp produced by the action of revived erosion on the weaker strata along one side of the fault line.

W. M. D.

STAFF OF THE ROCKEFELLER INSTITUTE

The Rockefeller Institute for Medical Research has adopted as titles for its staff member, associate member, associate, assistant, fellow and scholar of the Rockefeller Institute, and has made the following list of appointments:

Member of the Institute and Director of the Laboratories—Simon Flexner, pathology.

Member of the Institute—S. J. Meltzer, physiology and pharmacology; E. L. Opie, pathology; P. A. Levene, biological chemistry.

Assistants of the Institute—Hideyo Noguchi, pathology; John Auer, physiology; Alexis Carrel, experimental surgery; J. W. Jobling, pathology; Nellie E. Goldthwaite, chemistry.

Fellows of the Institute.—C. M. A. Stine, biological chemistry; Donald Van Slyke, biological chemistry; Martha Wollstein, pathology; Maud L. Menten, pathology; Mabel P. Fitzgerald, bacteriology; Don R. Joseph, physiology; Benjamin T. Terry, protozoology; Thomas W. Clarke, pathology.

Scholar of the Institute—Bertha I. Barker, pathology.

Grants to aid special researches have been made to the following: Robert M. Brown, New York; C. H. Bunting, Charlottesville, Va.; Katherine Collins, New York; Cyrus W. Field, New York; N. B. Foster, New York; Joel Goldthwaite, Boston; Holmes C. Jackson, Albany; Arthur I. Kendall, New York; Waldemar Koch, Chicago; W. G. MacCallum, Baltimore; Wilfred H. Manwaring, Bloomington, Ind.; J. W. D. Maury, New York; F. G. Novy, Ann Arbor; W. Ophüls, San Francisco; Richard M. Pearce, Albany; H. T. Ricketts, Chicago; Hermann W. Schulte, New York; Charles E. Simon, Baltimore; Aldred S. Warthin, Ann Arbor; Francis C. Wood, New York.

SCIENTIFIC NOTES AND NEWS

Sir Joseph D. Hooker, who celebrated his ninetieth birthday on June 30, has been made a member of the Order of Merit.

Lord Lister was on June 28, at the Guildhall, presented with the freedom of the City of London in a gold casket, in recognition of "the invaluable services rendered to humanity by his discovery of the antiseptic system of treatment in surgery."

Professor William James has been elected a corresponding member of the British Academy.

At its recent commencement, Brown University conferred its doctorate of laws on Dr. C. Barus, professor of physics and dean of the graduate department, and the degree of doctor of science on Dr. Wallace C. Sabine, professor of physics at Harvard University and dean of the Lawrence Scientific School.

Lafayette College has conferred the degree of doctor of science on President F. W. McNair, of the Michigan College of Mines.

The University of Manchester has conferred the doctorate of science on Dr. George E. Hale, director of the Solar Observatory of the Carnegie Institution and the degree of doctor of laws on Baron Kikuchi, lately minister of education in Japan.

Dr. Oscar Loew, since 1901 professor of agricultural chemistry in the University of Tokyo, has accepted the position of chemist in the Porto Rico Agricultural Experiment Station.

Dr. W. A. Henry, professor of agriculture in the University of Wisconsin since 1880, director of the Agricultural Experiment Station since 1887 and dean of the College of Agriculture since 1892, has been made professor emeritus. He proposes to make his home in Wallingford, Conn.

Mr. W. P. Pyecraft has been appointed assistant on the permanent staff of the zoological department of the British Museum.

Sir E. Maunde Thompson, director of the British Museum, has been elected president of the British Academy.

Dr. Wilfred H. Manwaring, head of the Department of Pathology in Indiana University, sailed from New York on July 14, to spend two years in research in European laboratories, under the auspices of the Rockefeller Institute for Medical Research. His address will be: Care of Dresdener Bank, Berlin.

The cooperative studies of the Atlantic Coastal Plain stratigraphy being conducted by the United States and the various State Geological Surveys were begun in South Carolina on July 1. Several parties will be in the field during the summer and autumn under the supervision of M. L. Fuller of the United States Geological Survey, acting in cooperation with Dr. Earle Sloan, state geologist of South Carolina.

Dr. John M. Clarke, director of the New York Geological Survey, will attend the centenary of the Geological Society of London as delegate from the state survey and from the Section of Geology, American Association for the Advancement of Science. The organization of the London society stimulated in very large measure that interest in geological science in America which gave birth to the earliest state surveys and the influence of its membership was particularly manifested in the original conception and execution of the New York Survey, which was organized in 1836 and has had an uninterrupted existence of seventy-one years. William Smith, Bigsby, De la Beche and Conybeare molded the ideas of early American geologists, and the personal influence of Murchison and Lyell upon James Hall was largely responsible for the classification of the New York series of geological formations. Dr. Clarke also attends the meeting of the Geological Society of Germany in Basel, whence a two weeks' trip across the Alps will be made under the guidance of the German and Swiss Geologists.

Dr. Hermann von Schrenk has resigned from the U. S. Department of Agriculture, with which he has been connected for the last eleven years, and, with two of his former assistants, has opened an office as consulting timber engineer at St. Louis. The name of the firm is von Schrenk, Fulks and Kammerer. Dr. von Schrenk has been appointed pathologist of the Missouri Botanical Garden, where he will have a fully-equipped pathological laboratory with one or more assistants.

WE learn from *Nature* that the council of the Royal Society of Edinburgh has awarded the Keith prize for the biennial period 1903–5 to Dr. Thomas H. Bryce for his two papers on "The Histology of the Blood of the Larva of *Lepidosiren paradoxa*," published in the *Transactions* of the society; and the Makdougall-Brisbane prize for the biennial period 1904–6 to Dr. Jacob E. Halm for his two papers on "Spectroscopic Observations of the Rotation of the Sun" and "Some Further Results obtained with the Spectroheliometer," and for other astronomical and mathematical papers published in the *Transactions* and *Proceedings* of the society.

DR. JAMES MERRILL SAFFORD, emeritus professor of geology in Vanderbilt University and for many years state geologist of Tennessee, died at Dallas on July 3, at the age of eighty-five years.

SIR WILLIAM PERKIN, F.R.S., the eminent British chemist, died in London on June 14, at the age of sixty-nine years.

SIR WILLIAM C. GAIRDNER, F.R.S., formerly professor of medicine in the University of Glasgow, died on June 28, at the age of eighty-two years.

CIVIL service examinations are announced as follows: On August 5, to fill two or three vacancies in the position of aid in arboriculture in the Bureau of Plant Industry, at salaries ranging from $600 to $1,000; on August 14 and 15 for the position of computer in the Supervising Architect's Office, at a salary of $1,000 to $1,600, and on August 14 and 15 for scientific assistant in animal pathology in the Bureau of Animal Industry, at a salary of $840.

A TELEGRAM has been received at the Harvard College Observatory from Professor Percival Lowell, director of the Lowell Observatory, stating that "South American Lowell Expedition cables double canals seen, oases photographed."

THE trustees of the Geologists' Association have transferred to the University of London the library of the association now at University College on condition that it form part of the library of University College.

THE fifth meeting of the Association of Economic Biologists has been held at the Imperial Institute, South Kensington, London, under the presidency of Mr. A. E. Shipley, F.R.S.

UNIVERSITY AND EDUCATIONAL NEWS

THE late M. Commercy has left $800,000 to the University of Paris for scholarships for scientific research.

MR. ANDREW CARNEGIE has given $25,000 to Roanoke College, which has collected $35,000 on which this gift was conditional.

The Experiment Station Record states that at the Massachusetts College a department of agricultural education has been established, its duties to include both instruction and research. This is an entirely new departure at the college and is believed to be the first attempt in this country to organize this kind of work on so broad a foundation. Normal courses will be offered to prospective teachers, and studies will be made of problems confronting agricultural teaching in colleges and schools of various grades, and of agricultural extension with a view to introducing agriculture into the elementary schools, establishing agricultural high schools, and correlating and unifying the agricultural instruction given in the state. The work will be in close cooperation with existing educational agencies, especially the state industrial commission. W. R. Hart, of the Nebraska State Normal School, who has had long experience in teaching and is the author of a number of monographs and other articles on educational topics, has been selected as the head of the department and will begin his duties with the next college year.

DR. ALEX. HILL and Sir Thomas Raleigh, commissioners of the treasury, have made to the Liverpool Corporation a report dealing in detail with the several departments of the university in view of the renewal of the grant of £10,000 to the university by the corporation. The commissioners praise the work that is being done at the university, and the finance committee of the corporation has recommended that the grant be renewed for 1907.

A statute will be brought forward in October for establishing at Oxford a professorship of engineering science, for which a sum of not less than £800 per annum, inclusive of a fellowship, has been guaranteed for five years. It is proposed that the professor shall lecture and give laboratory, but not workshop, instruction; and he will have charge of any engineering laboratory that may be assigned him by the university.

Dr. Winfield Scott Chaplin has resigned the chancellorship of Washington University.

Professor Harry A. Garfield, who occupies the chair of politics at Princeton University, has been elected president of Williams College to succeed President Henry Hopkins, who will retire at the close of the next academic year, when he will have passed the age of seventy years. Professor Garfield graduated from Williams College in 1885; he is the son of President James A. Garfield, of the class of 1856. President Hopkins graduated from Williams College in 1858, his father, the Rev. Mark Hopkins, having been president of the institution for thirty-six years.

Dr. C. H. Gordon, assistant geologist of the Geological Survey, will occupy the newly-established chair of geology and mineralogy in the University of Tennessee.

Dr. M. A. Chrysler, instructor in botany at Harvard University, has accepted a position as associate professor of botany at the University of Maine.

At a recent meeting of the board of trustees of the University of Illinois, the following promotions and additions were made in the department of psychology: Dr. Stephen S. Colvin, associate professor, to be professor; Dr. John W. Baird, instructor, to be assistant professor; Dr. Fred Kuhlmann, assistant in psychology at Cark University, to be instructor. The department has grown rapidly in numbers in the last few years. It will be given new and ample quarters in the addition to the Natural History Building which will probably be open for use in September, 1908.

E. J. Wilczynski, Ph.D. (Berlin), associate professor of mathematics in the University of California, has accepted a similar position in the University of Illinois. Professor Wilczynski is the author of numerous articles and of a work on *Projective Differential Geometry of Curves and Ruled Surfaces* published by B. G. Teubner, of Leipzig, in 1906. He has been both research assistant and research associate of the Carnegie Institution, and he was one of the lecturers at the Colloquium of the American Mathematical Society held at Yale University during last summer. He was also one of the organizers of the San Francisco Section of the American Mathematical Society and was elected chairman of this section at its last annual meeting.

At the recent meeting of the Board of Regents of the West Virginia University the following additions and promotions were made in the college of agriculture: John L. Sheldon, Ph.D., bacteriologist and plant pathologist of the West Virginia experiment station, was elected to the professorship of bacteriology and plant pathology in the university. W. M. Munson, Ph.D., professor of horticulture and horticulturist, Maine Experiment Station, was elected horticulturist of the West Virginia Station; T. C. Johnson, A.M., instructor in horticulture and botany, was promoted to an assistant professorship in the same subjects in the College of Agriculture, and D. W. Working, A.B., A.M., of Denver, Colorado, and formerly on the editorial staff of the *American Grange Bulletin*, was elected superintendent of agricultural extension teaching in the College of Agriculture. Also an order was passed authorizing the establishment of a department of highway construction in the college of agriculture.

The board of trustees of the Sioux City College of Medicine announces the following changes in its faculty: C. T. Stevens, professor of biology; W. W. Scott, professor of chemistry; Dr. Delmar S. Davis, assistant professor of chemistry; Dr. George S. Browning, professor of infectious diseases, and the Hon. W. L. Harding, professor of medical jurisprudence.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, JULY 26, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE GEOGRAPHICAL DISTRIBUTION OF THE STUDENT BODY AT A NUMBER OF UNIVERSITIES AND COLLEGES

THE accompanying table explains the geographical distribution of the student body of twelve American universities and four New England colleges and one Pennsylvania college for the academic year 1906–7, the summer session students being in every instance omitted. *Brown, Ohio State* and *Virginia* have been added to the table, while the *Lafayette* figures are omitted this year. The *University of California* figures include only the students in the academic colleges and are exclusive of the 174 students in the professional schools in San Francisco. In making comparisons with 1905–6, it should also be noted that the *California* figures in last year's table were those of 1904–5.

Comparing the attendance by divisions of the six eastern universities (*Columbia, Cornell, Harvard, Pennsylvania, Princeton, Yale*) with the corresponding figures for the same universities included in a similar table published in SCIENCE, N. S., Vol. XXIV., No. 606 (August 10, 1906), pp. 166–173, we note in the first place that there has been a gain for these universities, taken as a whole, in every division, the largest increase in the actual number of students, leaving the North Atlantic division—in which all of these six universities are located—out of consideration, having been recorded in the North Central division, where there has been an increase of 117 students, followed by foreign countries

RESIDENCES OF STUDENTS (*A*) *United States*

1906–1907	Amherst	Brown	California	Columbia	Cornell	Dartmouth	Harvard (Incl. Radcliffe)	Illinois	Lehigh	Michigan	Ohio State	Pennsylvania	Princeton	Virginia	Williams	Wisconsin	Yale
North Atlantic Division.	**381**	**867**	**9**	**3306**	**2626**	**970**	**3693**	**35**	**636**	**505**	**64**	**2960**	**948**	**43**	**378**	**48**	**2309**
Connecticut	17	27		62	47	19	48	2	6	10	3	35	16	2	22		1107
Maine		10		20	15	44	116		1	4	1	13	1		5	1	19
Massachusetts	170	189	3	79	87	500	2456	8	15	15	7	69	27	1	95	4	184
New Hampshire		41		11	4	233	81		1	5	3	8	2		2	2	14
New Jersey	15	19		388	157	7	69	4	55	15	2	226	279	8	36	7	107
New York	137	59	5	2607	1986	76	524	14	54	277	22	136	288	13	192	23	639
Pennsylvania	27	16	1	112	314	8	181	5	403	165	25	2457	330	17	15	9	196
Rhode Island	7	488		10	7	10	93	1	1	7		10	4	2	2	2	27
Vermont	8	18		17	9	73	25	1		7	1	6	1		9		16
South Atlantic Division.	**9**	**10**	**3**	**113**	**176**	**8**	**128**	**17**	**106**	**47**	**11**	**165**	**105**	**537**	**3**	**19**	**102**
Delaware		2		2	9	1	5		7			40	6	5			16
District of Columbia	4	3	1	7	48	6	37	5	22	13	1	29	15	11	2	4	19
Florida				4			4	1		6		5	4	10			9
Georgia		1	1	23	7		14	1		4		13	2	13		6	12
Maryland	4	2		16	53		23	3	54	5	4	34	49	31	1	6	14
North Carolina				21	12		10	2	1	2		12	5	18			10
South Carolina			1	15	4	1	12	1		2		5	6	15		1	4
Virginia		1		17	35		12	1	14	6	1	18	12	412			11
West Virginia	1	1		8	8		11	3	8	9	5	9	6	22		2	7
South Central Division.	**6**	**9**	**5**	**83**	**93**	**5**	**102**	**48**	**8**	**68**	**22**	**61**	**55**	**156**	**3**	**22**	**79**
Alabama	1			19	13		13	4	1	4	1	18	5	30		2	2
Arkansas				2	6		6	7		6		4	4	11		3	1
Indian Territory					2			4		3							1
Kentucky	2	3		17	15	3	33	11	3	23	8	15	20	38	2	8	25
Louisiana			1	7	7		10	2		2	1		1	10		1	8
Mississippi		1		8	13	1	2	2	1	2		4	5	20		2	3
Oklahoma		1		4	3		8	7		13							2
Tennessee	1	2		14	13		16	2	2	4	4	6	9	34		1	17
Texas	2	2	4	12	21	1	14	9	1	11	8	14	11	13	1	5	20
North Central Division.	**62**	**18**	**27**	**329**	**377**	**122**	**522**	**3597**	**13**	**3436**	**1908**	**176**	**184**	**33**	**86**	**3486**	**577**
Illinois	16	4	5	38	102	67	116	3203	3	296	5	15	48	3	35	214	143
Indiana	1	2	3	41	31	5	37	65		173	17	13	18	3	6	33	29
Iowa	5	3	7	25	20	7	49	78	1	70	4	20	12		5	81	30
Kansas		1	2	14	10	2	15	24	1	27		14	3	1	1	9	17
Michigan	6			28	30	3	24	29	3	2358	3	6	17	2	3	25	36
Minnesota	2		2	23	11	2	35	19	1	19	3	11	9	1	9	31	53
Missouri	15	4	1	29	20	7	59	40		70	1	16	15	14	2	23	63
Nebraska	2		1	12	7	6	11	13	2	20		1	8		2	21	17
North Dakota			1	7	2	3	2	3	1	3	1		3			10	1
Ohio	10		4	80	128	17	141	33	1	342	1870	69	42	7	14	29	159
South Dakota				2		2	7	15		18		1	2			16	7
Wisconsin	5	4	1	30	16	1	26	75		40	4	10	7	2	9	2994	22
Western Division	**9**	**1**	**2655**	**105**	**86**	**20**	**126**	**53**	**3**	**166**	**6**	**40**	**36**	**10**	**6**	**37**	**99**
Arizona			1	2				3		4							3
California	2		2592	29	21	5	55	8		27	1	2	8	4	2		32
Colorado	3		8	25	22	12	27	13		40	3	12	15	1	2	8	31
Idaho			3	1	1	1	1	2		4		2				2	1
Montana			1	15	6		5	4		32		1	5	3		9	7
Nevada			3	2			2	1				1		1			1
New Mexico			1	1			3			6						4	
Oregon	3	1	30	4	14		10	3	1	9	1	1	2	1	1	2	10
Utah			1	13	9		6	6	1	11	1	10	4			1	4
Washington	1		15	11	10	2	16	13	1	13		11	1			11	9
Wyoming				2	3		1			9			1		1		1
Insular and Non-Contiguous Territories			**13**	**7**	**22**		**13**	**16**	**3**	**13**	**10**	**7**	**1**	**1**		**11**	**10**
Alaska			3														
Hawaiian Islands			6	4	3		9			2		2					5
Philippine Islands			4		13		1	16		5	8	2				10	4
Porto Rico				3	6		3		3	6	2	3	1	1		1	1
Total	**467**	**905**	**2712**	**3943**	**3380**	**1126**	**4484**	**3766**	**669**	**4224**	**2021**	**3409**	**1329**	**780**	**476**	**3623**	**3176**

with an increase of 64 students, and the South Atlantic division with an increase of 42 students. In the South Central and Western states and in the insular possessions these eastern universities have made only a slight gain. The total increase in divisions outside of the North Atlantic this year is larger than it was last (189 against 91), while there has been a small decrease in the gain of students from foreign countries (64 against 87). The figures show conclusively that the six eastern universities mentioned, taken as a whole, are more than holding their own in

(B) Foreign Countries

1906-1907	Amherst	Brown	California	Columbia	Cornell	Dartmouth	Harvard (Incl. Radcliffe)	Illinois	Lehigh	Michigan	Ohio State	Pennsylvania	Princeton	Virginia	Williams	Wisconsin	Yale
North America	**1**	**3**	**6**	**46**	**47**	**3**	**54**	**8**	**17**	**24**	**5**	**51**	**6**			**17**	**25**
Canada	1	1	4	30	23	1	43	4	1	18	2	15	3			8	23
Central America				5	4		2					16				1	
Cuba		1	2	8	11		1		10		2	9	2			1	
Mexico				2	9	2	5	4	3	5	1	5	1			6	1
West Indies		1		1			3		3	1	1	6				1	1
South America			**6**	**13**	**27**		**4**	**4**	**3**	**2**	**13**	**20**		**3**		**6**	**2**
Argentine Republic			3	1	14		3	3			13	3				6	
Brazil			1	1	5							8		2			1
Chili			1	2								5					1
Colombia				3			1	1	2	2		1					
Ecuador			1	4	2				1			2					
Peru				2	5							1		1			
Uruguay					1												
Europe	**1**	**1**	**5**	**39**	**23**		**33**	**6**		**9**	**9**	**45**	**6**			**5**	**18**
Austria-Hungary				1			1					3					
Belgium				1													
Bulgaria				1	1		1			1	1						
Denmark												1					1
France	1	1		4	2		4					7					3
Germany			2	8	2		3			5	1	8					1
Great Britain and Ireland			2	7	5		14			1		8	5			1	7
Greece				2													
Holland			1	1	2			1		2		5				2	
Iceland																1	
Italy				3			3	1				1					1
Norway				1	1			2									1
Portugal							1					2				1	
Rumania											2						
Russia				5	4		1	1			2	6					
Spain				1				1				1					
Sweden				1	2							2					
Switzerland					2		2					1					
Turkey				3	2		3				3		1				4
Asia	**6**	**6**	**27**	**44**	**36**	**1**	**35**	**7**	**2**	**21**	**8**	**22**	**6**	**2**	**3**	**8**	**38**
Burmah										1							
Ceylon												3	1				
China		5	15	9	16		20		1	2	1	4		1			10
Corea							1										
India	2	1	6	5	10		3	4	1	5		1					1
Japan	4		3	27	8		10	2		9	3	12	5		3	8	22
Persia				1													
Siam			3														
Turkey (in Asia)				2	2	1	1	1		4	4	2		1			5
Africa			**1**	**2**	**1**		**4**			**1**					**1**		**2**
Egypt				1													
South Africa			1	1	1		4			1					1		2
Australasia			**1**	**2**	**3**		**3**			**1**	**1**	**32**					**2**
Australia			1	2	3						1	22					2
New Zealand							3			1		10					
Total (Foreign Countries)	8	10	46	146	137	4	133	25	22	58	37	170	18	5	4	36	87
Total (United States)	467	905	2712	3943	3380	1125	4484	3766	669	4224	2021	3409	1329	780	476	3623	3176
Grand Total	475	915	2758	4089	3517	1129	4617	3791	691	4282	2058	3579	1347	785	480	3659	3263

sections outside of the North Atlantic, this being especially true of the North Central division. Calculated on a percentage basis, the total gain of the six universities in the North Atlantic division during the past year amounted to 3.51 per cent., as against a gain of 5.73 per cent. outside of the division mentioned. In the South Atlantic division all of these institutions show a gain, with the exception of *Cornell;* in the South Central states gains by *Columbia, Cornell* and *Harvard* more than compensate for the losses of *Pennsylvania, Princeton* and *Yale;* in the North Central division all of them with the exception of *Cornell* and *Princeton* show substantial gains; in the western states *Columbia* alone has suffered a loss; in the insular territories the registration has undergone no change worthy of mention in any of the institutions, while in foreign countries *Columbia* and *Princeton* show a slight decrease. Comparing this year's figures with those of two years ago, we observe that the most substantial gains have been made by *Columbia* (67), *Pennsylvania* (37) and *Yale* (71) in the North Central division, by *Yale* (21) in the Western division, and by *Columbia* (29), *Cornell* (37), *Harvard* (39) and *Pennsylvania* (44) in foreign countries. At Columbia the attendance from outside of the North Atlantic states has increased from 15.07 per cent. to 19.15 per cent. during the last five years.

Taking the universities in the accompanying table by divisions, we find that *Harvard* and *Columbia* have the largest representation in the North Atlantic division, *Pennsylvania, Cornell, Yale* and *Princeton* following in the order named. *Michigan's* representation has increased from 394 to 505 in two years, while the other western universities—*California, Illinois, Ohio* and *Wisconsin*—and the *University of Virginia* attract only a few students from this section of the country. *Harvard* continues to lead in all of the New England states, with the exception of Connecticut, where *Yale* naturally has the largest following. *Columbia* and *Cornell*, as we should expect, have the largest representation in New York state, *Yale, Harvard, Princeton* and *Michigan* following in the order named, as they have during the past two years. *Michigan's* increase in this state—from 195 to 277 in two years—is noteworthy. In New Jersey there has also been no change during the past two years, the order still being *Columbia, Princeton, Pennsylvania, Cornell, Yale, Harvard.* The *University of Pennsylvania* naturally leads in its own state, followed by *Princeton, Cornell, Yale, Harvard* and *Columbia*, as heretofore.

Examining the attendance of the colleges from these states, we note that the order for the entire division is *Dartmouth, Brown, Lehigh, Amherst, Williams. Dartmouth* continues to lead the colleges in Maine and Massachusetts—*Harvard* being the only one of the universities having a larger following in these states than the New England college in question—as it does in New Hampshire and Vermont. *Brown* and *Harvard* are the only institutions that attract students from Rhode Island in any considerable number. In Connecticut the order is *Brown, Williams, Dartmouth, Amherst*, all of the eastern universities, except *Princeton*, having a larger representation in this state than any of the New England colleges included in the table. *Dartmouth, Lehigh* and *Williams* show an increase in their representation from the North Atlantic states, while *Amherst* shows a slight decrease. In New York the order for the colleges is *Williams, Amherst, Dartmouth, Brown, Lehigh*, and in New Jersey *Lehigh, Williams, Brown, Amherst, Dartmouth.* Of the four New England colleges here included, 36 per cent. of the students of *Amherst*, as against 43 per cent. last year, have their permanent home in Massachusetts; 21 per cent. of *Dartmouth's* student body, as against 24 per cent., come from New Hampshire (27 per cent. as against 32 per cent. from New Hampshire and Vermont), and 20 per cent., as against 21 per cent., of the student enrolment of *Williams* hail from Massachusetts. In other words, each of these three New England colleges shows an increase in the proportion of students coming from without the borders of its own state. *Lehigh* shows a decrease from 60 per cent. to 58 per cent. in the number of students hailing from Pennsylvania, while *Brown* draws 53 per cent. of its student body from Rhode Island. The table furthermore shows that *Dartmouth* attracts more students from Massachusetts than from all of the other states in the North Atlantic division combined, *Wil-*

liams draws more from New York than from Massachusetts, while *Princeton* draws more from Pennsylvania and more from New York than from New Jersey.

Of the eastern universities, *Pennsylvania* continues to have the largest percentage of enrolment from its own state, namely, 69 per cent., as against 67 per cent. last year; of *Columbia's* student body 64 per cent. come from New York state, as against 66 per cent.; *Cornell's* percentage of New York students continues at 56 per cent.; of *Harvard's* students 53 per cent., as against 54 per cent., are residents of Massachusetts; of *Yale's* students 34 per cent., as against 33 per cent., have their permanent residence in Connecticut, and finally, of *Princeton's* students only 21 per cent., as against 20 per cent., are residents of the state of New Jersey. The only institutions of this group which exhibit a gain in the percentage of students from outside their own state are therefore *Columbia* (2 per cent.) and *Harvard* (1 per cent.).

Coming to the South Atlantic division and taking into consideration only the six eastern universities, we note that *Harvard's* registration from this section now exceeds that of *Columbia*, the order this year being *Cornell, Pennsylvania, Harvard, Columbia, Princeton, Yale.* The *University of Virginia* naturally has the largest following in this section; *Michigan* is the only one of the western universities represented in the table to make a fair showing in these states, while *Lehigh* is the only one of the colleges with a good representation from this division, its main strength lying in Maryland and the District of Columbia. *Lehigh,* in fact, has a larger following in this section than either *Princeton, Yale* or *Michigan.* So far as the individual states are concerned, *Pennsylvania* leads in Delaware, *Cornell* in the District of Columbia, *Virginia* in Florida, *Columbia* in Georgia, North Carolina and South Carolina (with *Virginia*), *Lehigh* in Maryland, and *Virginia* in its own state (with *Cornell* second) and in *West Virginia.* Leaving the state of Virginia out of consideration, both *Cornell* and *Pennsylvania* have a larger clientele in the South Atlantic division than *Virginia.*

In the South Central division *Virginia* heads the list, followed by *Harvard* (102, as against 80 two years ago), *Cornell* (93–76), *Columbia* (83–72), *Yale* (79–80), *Michigan* (68–64), *Pennsylvania* (61–44), *Princeton* (55–72) and Illinois (48–47). *Wisconsin's* representation from this section has increased from 8 to 22 in one year, while *Lehigh's* has dropped from 15 to 8. The New England colleges and *California* have only a small following in the states in question. The above figures show that *Princeton's* clientele in this division has fallen off during the past two years, while *Yale's* has remained stationary. The largest representation in the individual states is found at the following universities: Alabama—*Virginia, Columbia, Pennsylvania;* Arkansas—*Virginia, Illinois;* Indian Territory—*Illinois;* Kentucky—*Virginia, Harvard, Yale;* Louisiana—*Harvard* and *Virginia;* Mississippi—*Virginia, Cornell, Columbia;* Oklahoma—*Michigan, Harvard;* Tennessee—*Virginia, Yale, Harvard;* and Texas—*Cornell, Yale, Harvard* and *Pennsylvania.* Kentucky continues to send by far the largest delegations to the institutions mentioned in the list, followed by Texas, Tennessee and Alabama.

In the North Central division the four universities of that section, *Illinois, Wisconsin, Michigan* and *Ohio,* naturally have the largest clientele, standing in the order named; *Michigan* was at the head of the list last year. Of these four institutions *Michigan* draws the largest percentage of students from outside of its own state, 55 per cent. of its enrolment hailing from Michigan, the corresponding figures for *Wisconsin, Illinois* and *Ohio* being 82 per cent., 84 per cent. and 91 per cent., respectively. The clientele of the three middle western state universities last mentioned is, therefore, much more local in character than that of any of the eastern institutions comprised in the table, whereas *Michigan* attracts a larger percentage of students from outside of its own state than do *Pennsylvania, Columbia, Cornell* or *Lehigh*. Of the eastern universities *Yale* still has the largest clientele in this section of the country, followed by *Harvard, Cornell, Columbia, Princeton* and *Pennsylvania,* as last year. The largest gains in individual states (15 or over) during the past two years have been made by *Columbia* in Wisconsin, by *Harvard* in Missouri, by *Pennsylvania* in Ohio, and by *Yale* in Ohio, the greatest loss being that of *Harvard* in the state last mentioned. *Columbia's* representation in this group of states has grown from 262 to 329 in two years, *Pennsylvania's* from 139 to 176, *Yale's* from 506 to 577, while *Cornell's* has dropped from 381 to 377, *Harvard's* from 526 to 522 and *Princeton's* from 209 to 184. Of the New England colleges *Dartmouth* has the largest following in the North Central division, with *Williams* second and *Amherst* third, *Brown's* representation being small. The representation of *Amherst* in these states has grown from 43 to 62 during the past year, that of *Dartmouth* from 91 to 122, while that of *Williams* has remained stationary at 86. *Lehigh* exhibits an increase from 6 to 13. *California* and *Virginia* have a smaller following in this division than any of the eastern universities or colleges, with the exception of *Brown* and *Lehigh*. Leaving the *University of Illinois* out of consideration, *Michigan* has the largest following in Illinois, followed by *Wisconsin, Yale, Harvard, Cornell,* each of which has over one hundred students from this state. *Michigan* also leads in Indiana, followed by *Illinois, Columbia, Harvard, Wisconsin.* In Iowa the order is *Wisconsin, Illinois, Michigan, Harvard, Yale, Columbia;* in Kansas—*Michigan, Illinois, Yale, Harvard;* in Michigan (leaving the state university out of consideration)—*Yale, Cornell, Illinois, Columbia, Wisconsin, Harvard;* in Minnesota—*Yale, Harvard, Wisconsin, Columbia, Michigan;* in Missouri—*Michigan, Yale, Harvard. Illinois, Columbia;* in Nebraska—*Wisconsin, Michigan, Yale, Illinois, Columbia;* in North Dakota—*Wisconsin, Columbia;* in Ohio (leaving the state university out of consideration)—*Michigan, Yale, Harvard, Cornell, Columbia;* in South Dakota—*Michigan, Wisconsin, Illinois;* and in Wisconsin (leaving the state university out of consideration)—*Illinois, Michigan, Columbia, Harvard, Yale.* The main strength of *Amherst, Dartmouth* and *Williams* in this division lies in the state of Illinois. Excluding in each case the respective state university, the state of Illinois is represented by 1,110 students at the institutions mentioned in the list, Ohio by 1,076, Wisconsin by 252 and Michigan by 215, *i. e.*, 63 per cent. of the state of Ohio's representatives at all of the institutions included in the table are enrolled at the state university, while the percentage for Illinois is 74 per cent. and for Michigan and Wisconsin it is 92 per cent., as last year.

In the western division (leaving *California* out of consideration) *Michigan* continues in the lead, with *Harvard* and *Columbia,* each of which attracts over one hundred students from this section, following; then come *Yale, Cornell, Illinois, Pennsylvania, Wisconsin, Princeton,* the order being identical with that of last year, with the exception of *Wisconsin,* which has passed *Prince-*

ton. The remaining institutions attract only a few students from this section of the country, with the exception of *Dartmouth*, which continues to draw a fair delegation from Colorado. *Michigan* has grown from 134 to 155 in two years; *Harvard* has remained stationary at 126; *Columbia* has dropped from 111 to 105; *Yale* has grown from 78 to 99; *Cornell* from 76 to 86; *Illinois* from 41 to 53; *Pennsylvania* from 22 to 40; while *Princeton* has dropped from 41 to 36. *Michigan* leads in Arizona, Idaho, New Mexico and Wyoming, although the representation from each of these states is quite small; in California (leaving the state university out of consideration) *Harvard* continues to lead, with *Yale, Columbia* and *Michigan* following; in Colorado the order is *Michigan, Yale, Harvard, Columbia;* in Montana, *Michigan, Columbia, Wisconsin; California* leads in Nevada; in Oregon the order is *California, Cornell, Harvard* and *Yale;* in Utah—*Columbia, Michigan, Pennsylvania;* and in Washington—*Harvard, California, Illinois* and *Michigan*. Of the states in the Western division, Colorado and California continue to send by far the largest delegations to the eastern institutions in the list. California sent 164 students to the institutions outside of its own state represented in the tables of 1906 and 1907 in the former year, as against 191 in the latter, showing that the San Francisco disaster did not seriously affect the attendance of California students at institutions in the east and middle west. It should be pointed out again in this connection that the figures for most of the state universities, and this applies particularly to the *University of California*, are not absolutely reliable, inasmuch as students frequently claim the state in which the university is located as their permanent residence (although in fact it is only a temporary one), in order to be exempt from tuition fees. In addition a tendency exists at all of the institutions to give the place in which the college or university is located as the home address.

Cornell continues to lead in the number of students from the insular possessions, followed by *Illinois*. Alaska, which had a solitary representative in Princeton in 1905 and none whatever in 1906, has three representatives in California this year. *Harvard* leads in the Hawaiian Islands, *Illinois* in the Philippine Islands, and *Cornell* and *Michigan* in Porto Rico. There are less students from the Hawaiian Islands at the institutions represented in both tables this year than there were last. The delegation from the Philippine Islands has increased 25 per cent., while that from Porto Rico has remained stationary.

The total number of students from foreign countries in attendance at the institutions represented in the accompanying table as well as in that of last year has grown from 792 to 897, a growth of no less than 13 per cent., to which the various continents contributed as follows: North America's representation has grown from 286 to 305; South America's from 62 to 87; Europe's has dropped from 211 to 190; Africa's from 15 to 12; Australasia's from 47 to 44, while Asia shows the largest gain—one from 171 to 256. *Pennsylvania* has the largest foreign clientele this year, followed by *Columbia, Cornell, Harvard,* each of which attracts more than one hundred foreigners. Of the western institutions, *Michigan* continues to have the largest foreign clientele, followed by *California, Ohio, Wisconsin, Illinois. Virginia* and the New England colleges attract only a few students resident in foreign countries, while *Lehigh* continues to have a fair foreign representation. Examining the foreign delegations at the different institutions by continents, we note that the order in North

America is *Harvard, Pennsylvania, Cornell, Columbia, Yale, Michigan;* in South America—*Cornell, Pennsylvania, Columbia* and *Ohio;* in Europe—*Pennsylvania, Columbia, Harvard, Cornell, Yale;* in Asia—*Columbia, Yale, Cornell, Harvard, California;* in Africa *Harvard* leads, while in Australasia *Pennsylvania* alone has a good representation. The countries of North and Central America naturally continue to send the largest foreign delegations to the institutions represented in the tables of 1906 and 1907, but Asia has passed Europe, and South America has increased its delegation by 40 per cent. As for individual countries, there is no change in the order for Canada, namely, *Harvard, Columbia, Cornell* and *Yale; Pennsylvania* continues to have the best Central American representation; *Cornell* attracts the largest number of Cubans and of Mexicans, and *Pennsylvania* the largest number of West Indians. Of the North American countries, Canada sends the largest delegation—177—followed by Cuba with 47, and Mexico with 44. Counting only the institutions represented in both this and last year's table, the Canadian representation shows an increase of 13, while Cuba exhibits a slight gain and Mexico a small loss. *Cornell* leads in the Argentine Republic and Peru; *Pennsylvania* in Brazil and Chili; *Columbia* in Colombia and Ecuador. Of the South American countries, the Argentine Republic sends the largest delegation, followed by Brazil, the position of these two countries having been reversed since last year.

In the European countries that send ten or more students the order is as follows: France—*Pennsylvania, Columbia* and *Harvard;* Germany—*Columbia, Pennsylvania* and *Michigan;* Great Britain and Ireland —*Harvard, Pennsylvania, Columbia* and *Yale;* Russia—*Pennsylvania, Columbia, Cornell; Pennsylvania* leads in Holland and *Yale* in Turkey. England sends the largest number, namely 50, followed by Germany with 30, France with 22, and Russia with 19. Of the Asiatic countries, Japan sends 116, China 84 and India 39, both China and India having more than doubled their representation at the institutions contained in both this and last year's tables, while Japan's delegation has remained practically stationary. A number of residents of Asiatic Turkey were represented last year under Turkey in Europe, which accounts in part for a number of the changes affecting the respective representations from the two continents in question. *Harvard* draws the largest number of students from *China, Cornell* from India and *Columbia* from Japan. Practically all of the members of the Australian and New Zealand delegations in *Pennsylvania* are enrolled in the dental school, where most of this institution's foreigners are registered. In fact, the greatest percentage of foreign students enrolled in the universities of the United States is found in the professional and graduate schools; if these were omitted in the figures here given, the showing of the larger universities especially would be changed considerably.

Rudolf Tombo, Jr.,
Registrar

Columbia University

THE RELATIONS OF THE ENGINEERING SCHOOLS TO POLYTECHNIC INDUSTRIAL EDUCATION[1]

The impulses which caused the settlers of New England to found schools and colleges simultaneously with clearing the land for their dwellings seem to have universally affected the pioneers of this country,

[1] Address of president of the Society for the Promotion of Engineering Education, delivered at Cleveland, O., July 2, at the annual meeting of the society.

and the establishment of schools has played a notable part in their policy. The hardy frontiersman has seldom blazed a trail which schools have not promptly followed.

This regard for school education is not singular with the American people, but it has been singularly universal with them, and a comprehensive educational system has resulted which reaches even to the remote byways of the country. An educational system which meets the needs of the country, however, must be something more than a mere comprehensive school system in touch with the people. It must not only offer education in general, but it must also offer those special educations which are necessary for the fullest development of each branch of human endeavor and service. In satisfaction of this condition, the great variety of professional schools have been established—divinity schools, law schools, medical schools, schools for the professional engineer—and, on the other hand, trades schools of various characters. In the latter respect, however, this nation has been at fault. Some trades schools have been established and maintained, and manual training has come to be highly regarded—perhaps here and there too highly regarded in the high schools, though insufficiently established in the grade schools; but the development of trades schools has been insufficient to the country's need, and foremen's schools are still almost unknown.

A wise enactment looking towards the establishment of these schools throughout the nation was passed by the national congress during the period of the civil war, whereby each state of the United States was allotted an acreage from the national public lands in proportion to its national representation, the proceeds to be applied more particularly to instruction in agriculture and the mechanic arts, without excluding other subjects of study. This wise enactment, born in the midst of civil strife, has been the foundation of many of the great state universities which make a notable feature of various of our western states. The United States Congress of recent years has added continuing appropriations of money for the same purposes, but more particularly with the design of supporting agricultural research.

These appropriations have been used with wisdom and with great advantage to the nation and its people; but, as far as mechanic arts are concerned, the term has been construed liberally and the work of the colleges using these appropriations has been largely in the grade of professional engineering work, or trending in that direction. The demand for university-trained engineers has been marvelous and the "land-grant" appropriations have been insufficient to support more than one educational effort in this line, and in many states they have been insufficient to support even one fully, so that it has been excusable in the past for the state colleges and universities to limit their activities. The diversion of fine private bequests from their apparently intended use for the foundation of trades and foremen's schools, to a support of attempted professional engineering schools alongside of engineering schools already in existence, seems to me not so excusable.

In agriculture, the situation has been different. The individual farmer, as a rule, is unable to carry on extended and expensive experiments for the benefit of himself and his fellows, and the agricultural schools have turned their attention toward helping the individual farmers or dairymen by teaching them how best to carry on their trades. Some of our best schools of agriculture are what, in industrial lines, would be called foremen's schools, that is, they teach of the particular craft involved and the way in which the craftsmanship may be most advantageously invoked and applied by a master craftsman in everyday employment. These agricultural schools also support courses of instruction in scientific agriculture which are of university grade, and they maintain extensive and well-manned departments of research which have returned uncounted advantages for the appropriations expended.

The agricultural schools have thus undertaken to cover a triple field: The field of the master craftsman, the field of the scientific or professional agriculturalist and the field of agricultural research; and, in the main, they are occupying each of the fields well. This is in great contrast to the situation of industrial education, in which schools for master craftsmen—*i. e.*, foremen's schools—are so few as to be almost unknown.

The lead of the agricultural schools arises partially from a lack of farsighted altruism amongst the agricultural people, who clamor for the expenditure of public funds to advance agricultural education in all its branches, and especially those branches that come close home to the individual farmers and dairymen, but are selfishly unwilling to see public funds expended in those lines which appear to immediately aid the manufacturers, who, allege the farmers, are able to help themselves. This line of argument springs from the idea that the prosperity of the country rests upon its agricultural resources; and any one who has lived, as I have, for years amongst the people of the fertile plains of the central west and northwest can not help but be convinced that this line of argument contains much of truth. However, it is false in its premises, because it fails to remember the unassailable fact that the prosperity of the agricultural interests and the concurrent contentment of the agricultural population are dependent in this country to an extended degree on the intelligence and prosperity of the industrial population. The interests of each—the agricultural and industrial populations of this country—are so bound up together, that only by friendly cooperation in most things, including the educational interests, can the highest welfare of either be conserved. It seems to me that it is of almost as much interest to the mechanic or mill foreman that the farmer shall be taught how best to perform his labor to bring forth the largest and best matured crops as it is to the farmer himself. And conversely, it seems to me that it is almost equally to the interest of the farmer and of the industrial foreman that the latter shall be afforded the best available training for the practise of his vocation.

Now, let us turn to consider the relative importance of proper education.

> Upon the subject of education, not presuming to dictate any plan or system respecting it, I can only say that I view it as the most important subject which we as a people can be engaged in.

What Abraham Lincoln thus said in 1832 is even more applicable to the conditions of our times. Only the education to be found in the elementary common schools was probably then in the mind of the speaker, and the extended school educations of a vocational nature, and especially of a professional nature, were apparently not within the purview of his experience; but these were not outside of his horizon, for he would have an extension of that education which leads to morality, sobriety, enterprise and industry, as is shown by another sentence from the same address:

> For my part, I desire to see the time when education—and by its means morality, sobriety, enterprise and industry—shall become much more general than at present, and should be gratified to have it in my power to contribute something to

the advancement of any measure which might have a tendency to accelerate that happy period.

The happy period referred to in this quotation has manifestly made its appearance, but it is right to give sober thought as to the effectiveness of its coming and whether much is not yet to be done to accelerate the period. It is particularly appropriate for us, of this society, to take this sober thought and give consideration to this matter on account of the close relation that engineering instruction ought to bear to the industrial affairs of the nation.

It is a question to be seriously considered whether the faculties of the engineering schools have yet duly recognized the responsibilities for the extension of the education through which comes "morality, sobriety, enterprise and industry," which rest on them because of their relations to industrial affairs. I believe that the agricultural schools, whatever their defects in altruism, have done better through more distinctly recognizing and assuming their part of such responsibilities.

The engineering schools, like their friendly rivals, the agricultural schools, have before them a field which may be divided into three parts—a triple field—two parts being semi-professional or completely professional, and the third vocational and subordinate to the others. The engineering schools have occupied only one effectively, though a few are now growing towards an occupation of the second.

These three parts to which I refer are the divisions of the educational scheme of the nation in which fall: (*a*) engineering research and the advanced professional instruction which is being given here and there to a few graduate students; (*b*) the engineering courses of study as they are now ordinarily planned; and (*c*) the instruction of artisans and especially instruction adequate to the needs of individual foremen or sub-superintendents, that is, master craftsmen.

The second of these educational divisions, in the order here named, it seems to me the engineering schools are occupying very well, but even here there is a lack of effectiveness which seems due to lack of correlation between the schools and lack of study of pedagogic history by those persons responsible for the direction of the schools. Reasonable independence and individuality in methods of teaching are due to the individual men who are experienced and worthy in each school, and the individuality of the several schools must not and can not be infringed; but, unhappily, in the past there have been contrasts of pedagogic views and professional ideals that can not be justified, for in these things (matters of judgment though they be) truth can lie only in one direction, however diverse may be the paths over which it may be approached. In harmonizing these differences, pointing out the better paths to follow, and bringing the professional work of the several schools into correlation with professional practise, and especially in advancing the interests of engineering research and advanced professional studies which go to the solution of those numerous great problems of engineering which can best be solved by men independent of commercial industrial control, but working in full harmony with the best engineers and manufacturers of the day, this society ought to have a large influence. I regret to feel that the society has not heretofore maintained a large influence in these directions, but these matters will be brought before you for discussion in connection with a resolution which I propose to later introduce and in connection with certain proposed constitutional amendments that will come before you.

It is therefore not to these that I am here attempting to particularly direct your attention, but it is to the third educational subdivision that comes distinctly within the purview of the influence and direction of the engineering schools, though preferably not within the scope of their curriculums. This is the instruction for artisans, and particularly the instruction intended for foremen and sub-superintendents.

The reports of the eleventh census give some illuminating figures in regard to the number of skilled workmen and the number of foremen in industrial pursuits. The figures must be admitted to be lacking in precision on account of the difficulty of drawing an exact line of demarcation between skilled and other workmen and the difficulty of phrasing an inclusive definition of the services that make a man of the rank of foreman, but the figures referred to are staggering in their indication of the magnitude of this problem in education.

As a further indication pointing in the same direction, but belonging distinctly in secondary instead of higher education, I will call your attention to the fact that the first Industrial Commission of Massachusetts pointed out in its report of 1906 that there are no less than 25,000 boys and girls between fourteen and sixteen years of age in the state of Massachusetts who are now in various kinds of juvenile employments or are idle, and all of them without any adequate trade education. The secondary industrial schools of the country are utterly without adequacy in numbers or extent to meet this problem in secondary education; and the schools suitably planned for the appropriate education and improvement of foremen are almost unknown with us.

I lay this latter fact at the door of the engineering schools, and hold that the members of the faculties are not guiltless unless they make adequate efforts to get filled this need in education for master craftsmanship in the industries, which comes within the purview of their influence and direction.

The governing boards of the engineering schools must divide the guilt with the faculties, if they continue their common failure to provide sufficient teaching force in the engineering departments, thus putting any effort which reaches beyond the routine of the department curriculum and touches the larger interests of the industrial body beyond the physical endurance of the individual members of the faculties.

The situation is better in our agricultural colleges.

Governing bodies have also been at fault heretofore by too close adherence to a standard for engineering teachers in which mere ability to impart information in the class-room, without consideration of any breadth of ambition, has held too predominant a place in the selection of men; and breadth of view in industrial affairs accompanied by clearness of judgment has had too small a place. I do not undervalue the technical ability to impart information in the class-room and assent that this should be properly given much weight in selecting men for the engineering faculties; but this ability, however largely developed and however fully accompanied by engineering skill, is far from sufficient to make an adequate member of an engineering faculty.

The acts of many governing bodies heretofore are in some degree excusable in consideration of the breathless growth of engineering schools which has seemed to make impracticable any pause for thought or consideration of needs beyond those of the day's pressing want of active teachers and suitable appliances to give strength to their teaching. It seems to me less excusable that so large a proportion of the leading men in the engineering schools should neglect on their own part a due consideration and study of pedagogic history and the development of the lines of philosophy and sound pedagogic thought, which lead inevitably to broader sympathies and more comprehensive professional views. An engineer who has cultivated a correct professional spirit ought to promptly recognize and fully appreciate the importance of careful study of professional precedents of the best types, and if the engineer is also a teacher, he seems to be under obligation to take a comprehensive view of both sides of his vocation, the side of engineering and the side of education.

I believe that such views lead emphatically to the proposition that engineering schools are called upon to extend their influence so that they will continue their present work of education for the scientific engineer; advance the work of engineering research and advanced professional study; and also foster the establishment, maintenance and development of polytechnic schools for master craftsmen.

As instances of a start in the direction of such polytechnic schools fostered by the faculties of engineering schools, I will point to the Summer School for Artisans at the University of Wisconsin, and the Lowell Institute School for Industrial Foremen at the Massachusetts Institute of Technology. Certain courses of the Pratt Institute are instances of work successfully done in the same direction in an independent school, but even there the work is directed by men who have had experience in the faculties of engineering schools. Such schools supported by endowments or by the state could wisely be founded in each large industrial center, but in each instance the school government needs the combined interest, activity and support of the better manufacturers and of suitable members of the faculty of a great engineering school. It must always be borne in mind that these schools should equally assist the craftsmen, and the industries employing them, and thereby improve the fitness and promote the prosperity of the state.

In the first part of this address I have pointed out that the contrast between the hitherto development of farm and dairy education and industrial foremen's education is partially due to a certain trade selfishness of the farmers; but there are also two other active causes which are particularly strong in the eastern states. One of these is a hesitation on the part of associations of industrial workmen to give countenance to education which cultivates and strengthens the special aptitudes of each man and thus tends to accentuate and enlarge the differences between the abilities, usefulness and earning powers of individuals. This jealousy of education, notable on the part of some, is an unhappy phase of the development of civilization, but right-minded men soon find that appropriate and thorough education for one's particular work not only adds to earning power and ease and satisfaction for the individual, but it also reduces jealousies and tends toward a brotherhood which improves the condition of all workers. We are compelled by the inexorable facts of life to see that men are of different abilities, and nothing is gained by an attempt to deny or evade the truth. The best that we can do is to place each individual man, as far as may be, in the situation that he is best adapted to fill by ability and education. Then the advancement of any individual is a cause for the congratulation of all, for it makes new opportunities all along the line, for each individual to profit by in proportion to his demonstrated abilities, education and experience, and his readiness to work in cooperative relations with his fellows. For these and many other reasons which show that education is useful to all the men who are willing to profit by it, the organizations and associations of workmen should not oppose, but should favor, the purposes of trades schools and foremen's schools. Happily, the more influential of such organizations are coming more and more to lend their favor to such schools.

This brings me to the second of the above-mentioned contributing causes to the contrast between the condition of development of the agricultural and the industrial schools. Relatively few men have come to large fortunes through agricultural pursuits, but those whose fortunes have been so founded have ordinarily discharged their obligation by extending their personal favor and aid to agricultural education, and through endowments given for the same cause. Indeed, large numbers of men who have only won a fair competency through agricultural pursuits have given liberally of their time and even of money for the encouragement and support of agricultural education, and have seen to it that the expenditures have been made in the manner most useful to the people.

I am sorry to say that the men who have made fortunes through the manufacturing industries and transportation have seemingly not proportionally supported industrial education. Some large endowments and bequests have been worthily bestowed where the income is used in engineering education, and a few endowments are directed toward the support of trades schools, but all that has thus far been done is wholly inadequate and disproportionately small in comparison with the annual returns coming each year from the manufacturing and transportation industries.

The men who have come to wealth through association with these industries seem to prefer to found great art galleries or museums rather than industrial schools. Galleries and museums have been proclaimed more widely, and their needs may have thus been brought more directly to the attention of those who have come to fortune through the industries and have money to bestow. In respect to that, while asserting that I will not take second place to any one in appreciation of the fine influences of art galleries and museums, I also insist that at the present juncture of education in this nation any man with a fortune to bestow can do a more pervading good by aiding the engineering schools to develop the work of engineering research, and by establishing schools for industrial foremen to be directed with the assistance and advice of the engineering schools.

Our communities maintain manual-training schools and here and there a trades school, and great professional engineering schools are maintained in the east by private endowments and in the great states of the west by appropriations from the state governments; but there still remains a gap in industrial education which lies between the elementary trades schools and the professional engineering schools of university grade. This gap must be filled and it will be filled promptly if the men who are and who ought to be members of this society do their duty. It is imperative to give to the thousands of young men who are to make the bulk of the corporals and sergeants of industry that education which makes for self-support in the best sense, makes for proper parentage, and makes for a good grade of thoughtful citizenship (to which foremen's schools may be directed in keen fashion), before the education which lends figure and charm to a man's recreations (such as so fortunately comes from the art galleries and museums) is taken up. I believe that no use of money can bring greater returns to the state, or greater satisfaction to the giver who understands the educational situation, than large gifts for the purposes of industrial education that I name. Dugald C. Jackson

Massachusetts Institute of Technology

SCIENTIFIC BOOKS

Stohr's Histology Arranged upon an Embryological Basis. By Dr. Frederick T. Lewis. Sixth American edition from the twelfth German edition. Philadelphia: P. Blakiston's Son and Company.

At the close of the eighteenth and at the beginning of the nineteenth century, anatomy reached a high degree of development. Soemmering had completed his 'Bau des menschlichen Körpers' and Bichat had given us his master work—'Anatomie générale.' With the completion of the latter the scalpel reached its highest attainment. The microscope, so successfully introduced into anatomical studies by Malpighi and Leeuwenhoek, replaced to a certain extent the scalpel and histology began to occupy a prominent place in the medical curriculum.

In the development of this branch of anatomical study, Würzburg has taken a prominent place. The first name we meet, one now but little known, is Heusinger, called by Hessling 'unser histologischen Nestor.' Some thirty years later, Kölliker published the first and, in some respects, the best edition of his 'Gewebelehre' and now his place is taken by Stöhr.

'Stöhr's Histology' is well and favorably known to American students, not only in the German but also through the English translation. In the previous five American editions but little change has been made from the German. The present edition has been rewritten and 'adapted * * * to American needs.'

The idea of arranging the book on an embryological basis is excellent, but it has not been carried out as thoroughly as it should have been. The book is intended primarily for students of medicine. It is, therefore, eminently proper that human embryology should form the basis of the work. Instead of this, we find the rabbit, the chick and the pig occupying a prominent place; for example, of the five figures to illustrate the formation of the germ layers, only one is taken from a human embryo.

In reviewing an American edition of a German text-book, it is interesting to see to what extent American work is recognized. Kollmann in his recent 'Entwicklungsgeschichte des Menschen' has recognized very generously American work, and the prospectus of the new embryology by Keibel also shows a good American representation. In the American edition of Szymonowicz and of Böhm and Davidoff American investigation occupies a prominent place. Lewis has not been as generous and fails in many places to use available literature.

The work of Mall on the connective tissues is not given as fully as it should have been. Lewis still describes the so-called 'fenestrated membrane' as being perforated, though Mall has shown that this is not the case. No reference is made to the work of Bardeen on the histogenesis of striated muscle, or that of MacCallum on heart muscle. The work of Huber and De Witt on muscle spindles is passed over and no reference seems to be made to the work of Donaldson and his students on the nerves and nerve cells.

That Lewis should make his own work the basis of his description of the lymphatics is very natural and it justly deserves a prominent place, but some reference should be made to the excellent work done on the same subject by Miss Sabin, even though he is not in perfect accord.

The description of the vascular supply of the lymph nodes could be made clearer by using the diagrams of Calvert.

The work of Mall on the spleen is given scanty notice and is dismissed with the statement that Stöhr says: 'a division into lobules in the interior of the spleen is impossible.' Even though Stöhr can not see the lobules, or structural units of the spleen, they are there, and it is interesting to note that after the publication of Mall's article there appeared in the German edition of Stöhr a diagram which was constructed in accord with Mall's description. If memory serves the writer correctly the lobule of the liver was doubted for many a year.

The development of the alimentary tract in man has been worked out carefully by Mall and his illustrations are very complete, but no reference is made to it. Bensley has also done work of high character on the stomach; this is also ignored.

The work of Mall on the liver came out too late for the present edition, but it is to be hoped that in a future edition it will receive due recognition. The work of Hendrickson on the bile capillaries and on the musculature of the bile ducts should not, however, have been passed by. No use has been made of the work of Opie on the pancreas and the work of De Witt is too recent to be incorporated in the text.

In his statement on page 242 that "atria are not recognized by German writers," Lewis shows a lamentable ignorance of the German literature on the subject. If he will but glance through the volume by Oppel on the organs of respiration or look into Spalteholtz's atlas he will find abundant evidence to the contrary. As was the case with the diagram which Stöhr gives of the lobule of the spleen, so with his diagram of the lobule of the lung; it is constructed after Miller's description, and appeared first after his publication. The fact that a German says a thing is so does not make it so and the converse is true. The writer has a strong admiration for the German worker and what is stated above in no way reflects on his integrity; it only calls attention to the narrowness of many American minds in that they are not capable of judging work on its own merits but must wait and "see what the Germans say."

The vascular supply of the ovary has been followed out from the embryo to the adult by Clark and his diagrams are very helpful to the student; but one looks in vain for any of them.

Flint's work on the adrenal and on the submaxillary gland are apparently unknown to Lewis.

Miss Sabin's work on the medulla is surely worthy of notice in an American edition of any text-book on histology or anatomy, but it, too, is ignored.

There are many other Americans, who have done work which is even recognized by the Germans, who fail to find a place in this American edition of Stöhr.

The book, however, is not without its merits. Lewis has preserved the simple style of illustrations so successfully used in the German editions and, in general, his selection of new illustrations is good. The lettering of figure 147 is incorrect and one wonders just what figure 228 B is intended by the author to represent; but these are inconsequential; probably they, as well as other inaccuracies, have already been noted by the author himself, as he has used the book in his laboratory.

The use of the B. N. A. nomenclature is to be commended.

Lewis deserves much credit for showing us the possibilities of an histology based on embryology. The ideal histology is yet to be written. There is much to be said in favor of a modern book along the lines of Stricker's 'Lehre von den Geweben,' each topic being written by some one who has given special attention to it. The only trouble with this is that it would make too cumbersome a book for the laboratory. Probably a book like Howell's 'Physiology' would be better.

Whatever form the future histology may take, it is to be hoped that more attention will be paid to human tissues than in the past. In the dissecting room the pig and dog have been replaced with the human cadaver. Rabbit, cat or frog histology is not human histology; if, for any reason, it seems best to use these tissues in the laboratory the student should be informed from what animal the tissue is taken and how it differs from the human.

The way may seem clear to Professor Lewis to break away from some other man's foundation and give us a new American histology written on broad and generous lines.

W. S. M.

SCIENTIFIC JOURNALS AND ARTICLES

The June number (volume 13, number 9) of the *Bulletin of the American Mathematical Society* contains the following articles: Report of the April Meeting of the American Mathematical Society, by F. N. Cole; Report of the March Meeting of the Chicago Section, by H. E. Slaught; "On a Limit of the Roots of an Equation that is Independent of All but Two of the Coefficients," by R. E. Allardice; "On the Distance from a Point to a Surface," by Paul Saurel; "The Calculus in Our Colleges and Technical Schools" (Presidential Address), by W. F. Osgood; "Notes"; "New Publications."

The July number, concluding the volume, contains: "Modular Theory of Group Characters," by L. E. Dickson; "On the Shortest Distance between Consecutive Straight Lines," by Joseph Lipke; "Note on the Commutator of Two Operators," by G. A. Miller; "A Theorem in the Theory of Numbers," by D. N. Lehmer; "Projections of the Globe Appropriate for Laboratory Methods of Studying the General Circulation of the Atmosphere," by Cleveland Abbe; Shorter Notices (Fazzari's Breve Storia della Matematica dai tempi antichi al medio evo, by D. E. Smith; Vessiot's Leçons de Géométrie supérieure, by C. L. E. Moore; Liebmann's Nichteuklidische Geometrie, by E. B. Cowley; Fisher's Introduction to the Infinitesimal Calculus, by E. L. Dodd; Baire's Fonctions discontinues, by W. D. A. Westfall; Campbell's and Cohen's Differential Equations, by C. R. MacInnes; James's Kinematics of a Point and Rational Mechanics of a Particle, and Andoyer's Cours d'Astronomie, by K. Laves; Föppl's Mechanik, third edition, and Gauss's Works, volume 7, by E. B. Wilson); "Notes"; "New Publications"; "Annual List of Published Papers"; Index of the volume.

SOCIETIES AND ACADEMIES

AMERICAN SOCIETY OF BIOLOGICAL CHEMISTS

The recently organized American Society of Biological Chemists[1] had its first special session in Washington, D. C., May 8 and 9, 1907. Four meetings were held, one of which was in affiliation with the American Physiological Society[2] and another in affiliation with the Washington Section of the American Chemical Society.[3]

Members present at one or more meetings—John J. Abel, A. E. Austin, Lewellys F. Barker, S. P. Beebe, H. D. Dakin, Edward K. Dunham, Otto Folin, William J. Gies, C. A. Herter, Holmes C. Jackson, Joseph H. Kastle, Arthur S. Loevenhart, Graham Lusk, A. B. Macallum, John A. Mandel, John Marshall, Lafayette B. Mendel, Alfred N. Richards, Philip A. Shaffer, Herbert E. Smith, Torald Sollmann, Alonzo E. Taylor, Victor C. Vaughan, George B. Wallace, H. Gideon Wells, C. G. L. Wolf.

Scientific Programs[4]

First meeting

George Washington Medical College. Wednesday morning, May 8.

Presiding officer: The Vice-President, John J. Abel.

John J. Abel: "On the Behavior of Frog's Muscle toward Acids."

Joseph H. Kastle and H. L. Amoss: "A New Reagent for the Recognition and Estimation of Free Hydrochloric Acid in Gastric Contents."

Joseph H. Kastle: "Phenolphthalin as a Reagent for Oxidases and Other Oxidizing Substances in Plant and Animal Tissues."

Philip A. Shaffer: "Protein Metabolism in Exophthalmic Goitre."

C. A. Herter: "On the Bacterial Production of Skatol and its Occurrence in the Human Intestinal Tract."

H. Gideon Wells: "The Chemical Composition of the Liver in Acute Yellow Atrophy."

G. Voegtlin (by invitation): "The Appear-

[1] Science, 1907, XXV., p. 139.

[2] Science, 1907, XXV., p. 861.

[3] Science, 1907, XXV., p. 969.

[4] Abstracts of the communications appeared in the *Journal of Biological Chemistry*, 1907, III., p. vii.

ance of Millon's Reaction in the Urine, in the Absence of Proteins, as a Criterion in the Tuberculin Reaction."

Lawrence J. Henderson and Charles T. Ryder: "A Method for the Direct Determination of Heats of Reaction."

Alonzo E. Taylor: "On the Conversion of Glycogen into Glucose."

Jacques Loeb: "On the Influence of the Concentration of the Hydroxyl Ions of a Salt Solution upon the Physiological Effects of its Cations."

Holmes C. Jackson and L. K. Baldauf: "Fatty Transformation in the Liver."

J. George Adami and Oscar Klotz: "The Existence of Cholesteryl Esters of the Fatty Acids in Gall Stones and their Bearing upon the Formation of Cholesterin Gall Stones."

Second meeting

George Washington Medical College. Wednesday afternoon, May 8.

Presiding officer: The Vice-President, John J. Abel.

Alexander Lambert and C. G. L. Wolf: "The Metabolism of Nitrogen and Sulphur in Pneumonia."

John Marshall: "A Brief Note on a Source of Error in the Use of a Certain Petroleum Ether as an Extracting Medium."

Herman M. Adler (by invitation): "A Clinical Method for Determining the Alkalinity of the Blood."

A. E. Austin: "Calcium Metabolism in a Case of Myositis Ossificans."

J. A. Mandel and P. A. Levene: "Hydrolysis of Spleen Nucleoprotein."

Henry L. Wheeler and Treat B. Johnson: "A Color Test for Uracil and Cytosin."

Oswald Schreiner and Howard S. Reed (by invitation): "The Rôle of the Oxidizing Power of Roots in Soil Fertility."

Oswald Schreiner and M. X. Sullivan (by invitation): "The Products of Germination affecting Soil Fertility."

Raymond H. Pond: "Solution Tension and Toxicity in Lipolysis."

William H. Welker: "On the Cause of a Red Coloration in the Iodoform Test for Acetone when Applied to Distillates obtained from Urine Preserved with Thymol."

R. F. Ruttan (by invitation): "On the Glycol Fats and the Chemical and Physical Relationship of Cross Fats."

Third meeting

George Washington Medical College. Thursday morning, May 9. Joint session with the American Physiological Society.

Presiding officers: The President of the American Physiological Society, William H. Howell, and the Vice-President of the American Society of Biological Chemists, John J. Abel.

Walter Jones and C. R. Austrian: "On the Occurrence of Ferments in Embryos."

C. G. L. Wolf and Philip A. Shaffer: "Protein Metabolism in Cystinuria."

C. G. L. Wolf: "Protein Metabolism in the Dog."

A. B. Macallum: "On the Glomerular Excretion under Certain Conditions."

C. C. Benson: "On the Composition of the Hourly Excretion of Urine."

S. P. Beebe: "The Inhibition of Tetany Parathyreopriva by Extracts of the Parathyroid Gland."

Victor C. Vaughan: "Proteid Susceptibility and Immunity."

A. D. Emmett and William J. Gies: "On the Chemical Relation between Collagen and Gelatin."

Lafayette B. Mendel: "Embryo-chemical Studies—The Purin Metabolism of the Embryo."

Reid Hunt: "Notes on the Thyroid."

Waldemar Koch: "The Distribution of Sulphur and Phosphorus in the Human Brain."

Fourth meeting

Cosmos Club. Thursday evening, May 9. Joint session with the Washington Section of the American Chemical Society.

Presiding officers: The President of the Washington Section of the American Chemical Society, Peter Fireman, and the Secretary of the American Society of Biological Chemists, William J. Gies.

Joseph H. Kastle: "Chemical and Bacteriological Standards now in Use in Water Analysis."

H. C. Sherman, William N. Berg, L. J. Cohen and W. G. Whitman: "Ammonia in Milk and its Development during Proteolysis under the Influence of Strong Antiseptics."

H. C. Gore: "Studies on Apple Juice."

Hugh McGuigan: "Sugar Metabolism."

Oswald Schreiner and Edmund C. Shorey: "The Presence of Secondary Decomposition Products of Proteids in Soils."

P. A. Levene and W. A. Beatty: "On Lysylglycin."

JACOB ROSENBLOOM and WILLIAM J. GIES: "Some Azolitmin Compounds of Mucoids, Nucleoproteins and Other Proteins, with Exhibition of Products."

WALTER E. GARREY: "Negative Evidence of the Adaptation of Dog's Salivary Secretion to meet the Digestive Requirement of the Diet."

CLARENCE E. MAY and WILLIAM J. GIES: "On the Quantitative Determination of Mucoid in Urine, Blood and Tissue Extracts."

WILLIAM J. GIES (by invitation): "On the Nature and Objects of the American Society of Biological Chemists." (See SCIENCE, 1907, XXV., p. 139.)

Executive Proceedings

Charter members.—The roll of charter members, as announced by the council and ratified by the society, was the following: John J. Abel, J. George Adami, Carl L. Alsberg, Samuel Amberg, Henry P. Armsby, James P. Atkinson, A. E. Austin, Lewellys F. Barker, W. A. Beatty, S. P. Beebe, Francis G. Benedict, C. C. Benson, William N. Berg, Orville H. Brown, Russell Burton-Opitz, Russell H. Chittenden, H. D. Dakin, A. L. Dean, Edward K. Dunham, Cyrus W. Field, Otto Folin, Nellis B. Foster, C. Stuart Gager, Walter E. Garrey, Robert B. Gibson, William J. Gies, H. S. Grindley, John T. Halsey, H. D. Haskins, Shinkishi Hatai, Robert A. Hatcher, Philip B. Hawk, Lawrence J. Henderson, C. A. Herter, Reid Hunt, Holmes C. Jackson, Walter Jones, Joseph H. Kastle, Waldemar Koch, William F. Koelker, P. A. Levene, Jacques Loeb, Arthur S. Loevenhart, John H. Long, Graham Lusk, Francis H. McCrudden, Hugh McGuigan, J. J. Mackenzie, A. B. Macallum, J. J. R. Macleod, John A. Mandel, John Marshall, Albert P. Mathews, Lafayette B. Mendel, Gustave M. Meyer, C. H. Neilson, Frederick G. Novy, W. R. Orndorff, Thomas B. Osborne, William H. Parker, Raymond H. Pond, Franz Pfaff, Alfred N. Richards, Herbert M. Richards, William Salant, Philip A. Shaffer, H. C. Sherman, Charles E. Simon, Herbert E. Smith, Torald Sollmann, Lyman B. Stookey, Alonzo E. Taylor, Frank P. Underhill, Victor C. Vaughan, Alfred J. Wakeman, George B. Wallace, William H. Welker, H. Gideon Wells, Henry L. Wheeler, R. A. Witthaus, C. G. L. Wolf.

Time and place of the next meetings.—On recommendation by the council it was decided to hold the next meetings in Chicago, during convocation week, 1907–8.

Resolutions regarding federal supervision of matters pertaining to public health.—At the joint meeting of the American Physiological Society and the American Society of Biological Chemists (May 9) the following resolutions were adopted by unanimous vote:

"We approve of the movement represented by the Committee of One Hundred of the American Association for the Advancement of Science to increase and coordinate the present activities of the federal government in matters pertaining to public health.

"We therefore urge upon the President of the United States and members of congress the favorable consideration of such legislative measures as are best adapted to secure this result."

Copies of these resolutions were immediately forwarded to President Roosevelt, to members of congress, to the Committee of One Hundred of the American Association for the Advancement of Science and to the permanent secretary of the American Association for the Advancement of Science.

WILLIAM J. GIES,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 431st meeting was held May 4, 1907, President Stejneger in the chair.

Professor W. W. Cooke gave a résumé of the present migration season. He said the spring of 1907 at Washington, D. C., has been characterized by extremes in temperature. The last week in March and the first few days in April were the warmest ever known for the time of year. This excessively warm spell was followed by the coldest April in thirty-five years. It is interesting to note how these variations from normal temperature were reflected in the times of arrival of the birds. Spring opened normally and the birds arrived as usual until the first warm spell of late March, when the Brown Thrasher appeared seventeen days early, and the Blue-gray Gnatcatcher, sixteen days. During the warm days of early April the Ruby-crowned Kinglet was seen six days ahead of the average date. At the end of the hot wave, April 6, all the birds due were present except the purple martin, due March 28, and not seen until April 5—the latest date for the past seven years. The severe cold spell lasted from April 6 to April 24. During this time only seven species appeared of the twenty species due; one, the spotted sandpiper, a single day late, the others an average of seven days late. During the cold weather, the house wren appeared at several places three days early and a single wandering wood thrush was seen six days ahead of time.

A large wave of migration occurred during the nights of April 25 and 26. Fourteen new species appeared and three more reported the following day very probably arrived a day earlier than they were seen. Thus about one sixth of all the species of migrant land-birds usually seen here during the spring arrived in two days. These arrivals were from two to nine days late. They included all the missing birds except the grasshopper sparrow and the black-throated green warbler, each of which was diligently sought in favorite haunts, but not seen until much later. This pronounced bird wave also brought with it some birds ahead of time, *e. g.*, the kingbird and the scarlet tanager each four or five days early.

After April 27 for the rest of the migration season of 1907 the weather conditions were nearly normal and the arrival dates were quite close to the average; eighteen species averaged three days late, sixteen species three days early and three species were seen on the average date. The average dates referred to have been deduced from more than thirty years records of arrivals in the files of the Bureau of Biological Survey.

Dr. Barton W. Evermann gave a lantern slide lecture on "The Golden Trout and the Southern High Sierra." The investigations which resulted in the discovery of two undescribed species of golden trout of great beauty and value were undertaken by the Bureau of Fisheries at the instance of President Roosevelt, to whom had been represented their threatened extermination. The speaker and his party in the summer of 1904 entered the Kern River region, the native habitat of the golden trout, by pack train, and explored the Kern River basin, obtaining collections of the fishes, particularly the trout. The artist of the expedition made water color paintings of the principal trouts, including the two handsome new species *Salmo roosevelti* and *S. whitei*. Four species of trout of the rainbow series inhabit the Kern River basin. Chiefly in Kern River occurs abundantly *S. gilberti*, a trout without golden colors but from which the three golden trout have descended. The latter have lost the rainbow hues and in part the black spots of the Kern River species and taken on the characteristic golden and allied bright colors. Their separation from the parent stock and from each other is a result of their isolation in tributaries of the Kern, by the formation of impassable waterfalls and by barriers due to volcanic action. The most interesting and strikingly colored species—the most brilliant of its family—the Roosevelt trout, is found only in Volcano Creek. It, together with its congeners of the region, will be exterminated in a few years unless measures are taken to protect it. Fish culture and legal restrictions should combine to perpetuate it. In accordance with the recommendations resulting from the investigations a close season for two years has been established, with continuing restrictions thereafter, and a movement is under way to extend the Giant Forest Reservation to include Volcano Creek.

The 432d meeting and last of the season was held May 18, 1907, President Stejneger in the chair. The evening was chiefly taken up with an exhibition of projection apparatus with short descriptions by members of objects brought by them for illustration. The apparatus combined ordinary, micro, vertical and opaque projection, and lantern slides, microscopical preparations, living fishes and other opaque objects were shown on the screen.

M. C. Marsh,
Recording Secretary

DISCUSSION AND CORRESPONDENCE

DR. MONTGOMERY'S PROPOSED AMENDMENT TO THE RULES OF NOMENCLATURE

DR. MONTGOMERY'S communication to SCIENCE of July 5, seems to be based partly on a misconception of the meaning of the word "indication" in Art. 25, ¶ *a*.

This word is generally understood to cover cases where a name newly proposed is based (1) on a reference to a previously published description or figure; or (2) on a figure accompanying the new name; or (3) on a list of previously established species now first associated in a new group.

That a new name in zoology might be based on a mere reference to an otherwise unnamed specimen in a museum, is a proposition which would hardly be maintained by any one, and which Dr. Montgomery hardly needed to condemn.

But Dr. Montgomery's other suggestion, that a name must be accompanied by a description, and that this description must be "adequate" or the figure "recognizable," is a reversion to a state of mind from which, or rather from the consequences of which, modern nomenclature has been struggling for half a century to free itself. It would perhaps have been as well if the original requirement of some sort of a description had been maintained, not because the description in itself would have been of great value, but because this rule would have eliminated from consideration many publications which have added greatly to the complexity of nomenclatorial problems. However, it is too late now to recede, in regard to this point. But the determination of what is or is not "adequate," or "recognizable," would plunge the investigator into a morass of personal opinions which would render any attempt at a stable nomenclature hopeless.

WILLIAM H. DALL

SMITHSONIAN INSTITUTION,
July 9, 1907

THE RULES OF NOMENCLATURE

IN SCIENCE of July 5, Dr. Montgomery so well stated the opinion held by naturalists who require that something more than an "indication" should accompany a name before it merits adoption into zoological nomenclature, that space need not be taken to elaborate his argument, and my purpose is only to lay stress upon an additional need which follows logically.

There will always be many to whom the proposition that in naming systematic groups we are naming objects, not concepts, is philosophically unacceptable, and to these persons concepts must be defined before they can be named. Such naturalists now and always will require that a generic name, like those of higher groups, must be associated with a definition which, as a concession to lack of knowledge at an earlier day, may be incomplete, but must not be actually erroneous or contradictory to the facts which at a later day it is sought to bring under it.

An example of the anomalous and absurd result sometimes reached by the contrary practise under the Draconian law of uncorrected priority is found in the water snakes. This group has been generally known under the name *Tropidonotus* Kuhl (1826). Cope in 1888 substituted *Natrix* Laurenti (1768) on the ground that while *Natrix* was a heterogeneous collection, its type was *Natrix vulgaris* (= *T. natrix*) the type of *Tropidonotus,* and in this he has been followed by some American herpetologists. Now Laurenti's definition of *Natrix* was as shapeless as definitions usually were in his time. Loosely rendered it is: "Head shielded with flat scales; flattened and triangular; the hinder part broad; in front contracted to the snout. Body smooth and shining; narrower behind the head; the middle between the head and end of tail much thicker. Tail conical, elongated and attenuated." The one character of value in identification, "*Truncus glaber nitidus,*" is all there is in the definition that might not be applied to almost any snake known, and yet the method of "type by tautonomy" applies the name to a group having the exactly opposite character of most conspicuously rough, keeled scales. Indeed, few snakes are more at fault with Laurenti's language. Laurenti named under *Natrix* twenty-two species, of which eight are unrecognizable and the remainder are now assigned to eight widely separated genera. Of these the two belonging to *Tropidonotus* are the only ones which fail to correspond to the generic character quoted above. No matter, says the extremist in priority, under the rules they must furnish the type!

It has by now become quite clear that uniformity is not to be reached through any of the codes in use, if indeed it ever can be retroactively established by any other not yet constructed, for there will always be some who will not purchase it at too high a price, and the prevailing demand of the moment forgets that there is value also in diversity. Then again, the uncertainty attending the practical application of some of the rules now most advocated precludes denial.

A high authority in matters of nomenclature, whom we all respect and esteem, has lately said in SCIENCE that even elimination can lead to only one result when properly applied—but the trouble is that each eliminator thinks that his way of applying it is the proper one. It is easy to get men to agree to abide by law, but another thing to get agreement as to how the law works.

The devious paths to diverse goals followed by those who have attempted the elimination of *Coluber* Linn. is illuminating as to the certainty of the method—but who shall say, as yet, which one is right?

Cope in 1886 was led by the "rules" to *Natrix* as the proper name for *Coluber*. In 1888 the "rules" led him to substitute it for *Tropidonotus*.

The fact is that meaningless conglomerates such as *Natrix* and many other genera of the early days of zoological classification can not be used now under the rules for determining types without doing occasional violence to intelligence. They never did represent definite conceptions and they ought not to be considered in nomenclature. By consent we allow them to Linnæus, but there is no reason why the privilege should be extended to his successors.

ARTHUR ERWIN BROWN
THE ZOOLOGICAL GARDENS,
PHILADELPHIA,
July 9

THE DISTANCES OF THE FIXED STARS

IN various astronomical and other scientific publications misleading statements are frequently made concerning our knowledge of the distances of the fixed stars. In parallax work practically all reliable observations are of a differential nature, and the interpretations of the resulting measures for distance are largely dependent upon preconceived views as to the arrangement of the stars in space.

For some years past I have been engaged in observational and theoretical work on that intricate problem—where is the origin and what is the physical structure of our sidereal system? The results so far obtained are novel, since they indicate that the structure is radial, in other words the stars and nebulas of our system are moving either directly towards or directly away from our sun; the observed derivations from radial motion being attributed to the unsymmetrical distribution of the attracting masses, and also to the presence of bodies having a secondary origin.

The indications also point to the conclusion that, as seen from our sun, a vast majority of the stars and nebulas are confined to a region whose radial depth is much less than the distance of this region from our sun. Since bodies so situated may be comparatively near to us and still have various radial velocities without causing sensible changes in the configuration of the heavens, the seemingly unchanging aspect of the Milky Way[1] and other celestial regions is explained without the necessity of assigning such great distances (and consequently such great masses) to the bodies of our system.

Considering the still undetermined constants entering into the problem, and the lack of a rigorous method for making direct measures, it surely is no exaggeration to say that a trustworthy value of a star's parallax has not yet been obtained.

The award of the Boyden Premium by the

[1] Whether the theory is in agreement with the actual facts or not, I demonstrate that the inclination of the plane (?) of a Milky Way to the plane of the sun's equator is a necessary consequence of such a structure.

Franklin Institute to Dr. Heyl is doubtless a well-deserved honor, but when one reads in SCIENCE for June 28, 1907, on page 1013, that a definitive result is based upon the wholly unproved claim that "the distance of Algol is no less than forty light years" it seems desirable to emphasize the fact that in the present state of our knowledge the approximate distance of any particular fixed star must still be regarded as an unknown quantity.

J. M. SCHAEBERLE

ANN ARBOR,
June 30, 1907

SPECIAL ARTICLES

HENS THAT HAVE LAID TWO EGGS IN A DAY

IT is so generally believed that it is not possible for a hen to lay more than one egg in a day that a few observations that show this is not always true may be of interest.

The number of eggs laid by a hen in a year has been greatly increased, the maximum number reported by Professor Gowell, of the Maine Experiment Station, who has for a number of years been breeding to increase the yearly output, being 255. It would seem that there is no known biological reason why the maximum daily rate should be one each day, any more than that the number of eggs per year should be limited to a few broods. In either case the ultimate limit of *possibility* would seem to depend upon the ability of the individual to assimilate and transform the materials taken as food into the materials of the eggs. There may be difficulties that are not understood that would make it impossible to develop a race of hens that would habitually lay more than one egg in a day, as there have been difficulties encountered in getting birds that will lay every day in the year, but *a priori* there seems to be no known biological reason why a hen should not lay more than one egg in a day.

While experimenting on the fertility of eggs it became necessary to keep a daily record of the hens that laid. This was done by means of trap nests that were arranged so whenever a hen entered a nest a door was dropped behind her that not only kept her prisoner until she was liberated by the attendant, but excluded all others. That is, the door was locked so it would not swing in either direction. The ordinary numbered leg bands were used to distinguish individuals. The birds under observation were White Wyandottes.

The latter part of February or early in March, 1906, a pullet that had recently begun laying apparently laid two eggs in a day. Although it seemed a clear case it was not recorded as it was thought possible that a mistake had been made in reading the number on the band. When the same hen again laid two eggs on March 21, record was made and to guard against possible errors in reading the number on the band she was banded on both legs, thus distinctly marking her, as no other hen in the house had two bands.

During March and April there are records of five days on each of which this hen laid two eggs. Although her record was carefully kept for more than a year and a half, there are no other records of her having laid more than one egg in a day. It should be added that the records of days on which she was known to lay two eggs come during the months of her greatest egg-producing activity. In fact it will be seen that in the thirty-three days listed in the following table the hen actually laid thirty-four eggs.

HEN NO. 1. MARCH, 1906

Date	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Eggs........	1	1	1	1	1	0	1	1	2	1	0	1	1	1	1	1	1	1	2

APRIL

Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Eggs...	0	1	2	1	2	1	2	1	1	1	1	1	1	0

During the year and a half over which my observations extend there have been a number of instances of hens laying two eggs in a day, but the records show that in most cases on either the day before or the day after that on which two eggs were deposited, no egg was laid. Such cases may reasonably be accounted for by supposing premature or delayed delivery, but this can not be true of the hen whose record has been given, where, for the five days beginning with April 3 and ending with April 7, eight eggs were laid.

There are two other instances where an average of more than one egg in a day for a limited period was made. In both of these cases the possible mistake in the reading of the numbers on the bands is to be considered, as the hens had no other distinguishing mark. The records for the particular period for each of these hens follow.

HEN NO. 27. JUNE, 1906

Date	5	6	7	8	9	10
Eggs......	0	1	1	2	1	0

HEN NO. 203. MAY, 1907

Date	1	2	3	4	5	6	7	8	9	10	11	12
Eggs..	0	1	1	1	1	1	1	2	1	1	1	Set

There are eight other instances recorded where hens laid two eggs in a day but in all of these cases on either the day previous or succeeding the day on which two eggs were laid, no egg was laid.

It should be distinctly understood that these were not double yolked eggs, which are not uncommon. Usually one egg was delivered in the morning and the other in the afternoon. In all of the recorded cases, the eggs were of normal size and shape and in most cases they were tested and found fertile.

It is worthy of notice, but not necessarily significant, that the single pullet hatched last year from an egg laid by the hen whose record is first given, did not make an ordinarily good record this year.

Gilman A. Drew
University of Maine,
Orono, Maine

ON THE ORIGIN OF LIMESTONE SINK-HOLES

The following are some of the statements found in texts and other books relating to sink-holes and their origin:

1. It is for this reason [solution] too that Limestone districts abound with funnel-shaped cavities, descending from the surface vertically into the rock, into which water sinks and disappears. They are often called swallow-holes or swallows. Wherever there was any little despression in which water could lodge, the bottom was eaten away lower and lower, and a pipe formed at last leading from the surface into the undeground channel. ("Physical Geology," Part I., by A. H. Green, p. 191.)

2. In regions of soluble rocks, as we have seen, many inequalities of the surface are brought about by the chemical and mechanical action of underground water. Most frequently the depressions caused by the collapse of subterranean galleries and caves contain no water. ("Earth Sculpture," by James Geikie, p. 282.)

3. In limestone regions the solvent action of water has frequently gone on so extensively as to leave its imprint upon the topographic features of the landscape. . . . Entire landscapes are undulating through the abundance of sink-holes—shallow depressions down through which water has percolated and escaped into the underground passages. ("Rocks, Rock-Weathering and Soils," by Geo. P. Merrill, p. 259.)

4. From the surface sink-holes and pipes are dissolved downward, while in the mass of rock caverns are dissolved out, often, as in the Mammoth Cave of Kentucky, many miles in extent and with rivers of considerable size flowing in them. ("An Introduction to Geology," by William B. Scott, p. 89.)

5. It has been estimated that there are in Kentucky 100,000 miles of subterranean channels sufficiently large to permit the passage of a man. Many "sinks" are found on the surface, due to subsidence. ("A Text-Book of Geology," by Albert Perry Brigham, p. 87.)

6. When a considerable area has thus been undermined, the upper rocks may cave in, thus letting down the surface of the land above. Many small lakes in Kentucky occupy such sink holes. ("An Introduction to Physical Geography," by Gilbert and Brigham, p. 99.)

7. Thus across the limestone upland of central Kentucky one meets but three surface streams in a hundred miles. Between their valleys surface water finds its way under-

ground by means of sink-holes. These are pits, commonly funnel-shaped, formed by the enlargement of crevice or joint by percolating water, or by the breakdown of some portion of the roof of a cave. ("Elements of Geology," by William Harmon Norton, p. 46.)

8. Underground caves sometimes give rise to topographic features which are of local importance. When the solution of the material in a cavern has gone so far that its roof becomes thin and weak, it may collapse, giving rise to a sink or depression of the surface over the site of the original cave. This is so common that regions of limestone caves are often affected by frequent sinks formed in this way. They are a conspicuous feature of the landscape in the cave region of Kentucky, and are well known in many other limestone districts. They are known as *limestone sinks*. ("Geology," Chamberlain and Salisbury, Vol. I., first ed., p. 216.)

9. Sometimes the ceiling [of caves] gives way, forming the funnel-shaped "sink-holes" or "lime-sinks" so familiar in some of the Mississippi valley states. ("Soils," E. W. Hilgard, p. 41.)

Statements 1, 3 and 4 account for sink-holes entirely by solution. Statements 2 and 5 imply that they are due to the collapse of the roofs of caverns. Statements 6, 8 and 9 plainly say that they are due to the collapse of cavern roofs. Statement 7 teaches that some sink-holes are formed wholly by solution, while others are formed by the collapse of cavern roofs.

The writer thinks that he is not mistaken in stating that the common idea of sink-holes is that they are due to the falling in of the roofs of caverns. That sink-holes are sometimes so formed is certain, but that this method of formation is the rare exception and not the rule becomes evident from the following common features of such depressions:

1. Their almost universal funnel shape.

2. The absence in them of coarse débris such as would be derived from the collapsed roof.

Caverns are irregular in shape. The subsidence of the roof, therefore, would produce in nearly all cases a depression of irregular outline. Of many sink-holes the writer has seen, but one is recalled that was irregular in outline instead of being circular or of a form closely approaching a circle. In this single exception, the roof of the cavern had been of sandstone, and the outline of the "sink" was very irregular. In the bottom were large amounts of débris from the former roof. The limestone had been dissolved out beneath the sandstone roof until the latter could no longer support itself, when the collapse took place. Sink-holes of this character would be expected in regions containing limestone caverns if the surface rock above the limestone were thin and consisted of sandstone, or some other insoluble material. But regions where sink-holes are common are those in which limestone is the surface rock.

In no case except the one mentioned has the writer observed coarse débris, such as would be derived from the roof of the cavern, in sink-holes. In course of time such débris would wholly disappear by weathering, but if it had ever existed a portion of it would be expected to remain, in many, if not in the majority of cases.

The claim is not made that limestone roofs of caverns never collapse, for it is reasonable to suppose that they sometimes do. But certainly such collapses are rare. The rule in the formation of sink-holes is that they are the result of solution *at the surface*. Their locations are determined by crevices in the limestone, that permit the localization of the downward-moving water along tube-like passages that are more or less vertical. The water near the surface, in moving toward this tube, enlarges the upper end by solution, forming a small, funnel-like depression. This depression invites more drainage, resulting in a greater amount of solution and the enlargement of the funnel.

Sink-holes sometimes open into caverns below. The entrances to caves are sometimes at the bottom of these depressions. But probably in the majority of cases there are no caverns of considerable size immediately connected with the sink-hole. The tubular drainage course may pass into a cavern some distance away, or issue at the surface as a spring.

Where the latter condition exists, the surface above the subterranean passage may subside by solution, producing a ravine of solution. Thousands of such exist over the limestone region of northern Arkansas and southern Missouri, known in geological literature as the Boone chert area.

These ravines have been discussed by the writer under "Valleys of Solution in Northern Arkansas."[1] Wide observation since the time of writing the above article has confirmed the belief that the ravines have their origin from solution, but has modified the opinion therein expressed as to their method of development. Instead of beginning at the mouth and developing backward, the usual method was that of starting with sink-holes, well up on the hillside. The drainage from these sink-holes was along subterranean, tubular passages, to the bases of the hills. The gradual subsidence from solution, of the rocks above the subterranean drainage lines, resulted in the numerous striking ravines that form such a conspicuous topographic feature of the region mentioned.

A. H. Purdue

University of Arkansas,
Fayetteville, Ark.

[1] *Journal of Geology*, Vol. IX., No. 1, January–February, 1901, pp. 47–50.

QUOTATIONS

THE FUTURE OF THE TROPICS

What the comparatively new science of bacteriology has accomplished for mankind could never have been forseen a few years back, and even now we probably have a very inadequate idea of its possibilities. The recently expressed opinion of Colonel W. T. Gorgas, that within the next two or three centuries the tropical countries, which offer a much greater return for man's labor than do the temperate zones, will be settled by the white races, and that the centers of population and civilization be transferred to the equatorial regions, may not prove a strictly correct prophecy, but its possibility can not be denied, *a priori,* as once it would have been. The discovery of the malaria germ and of the transmission of it and of that of yellow fever by mosquitoes has abolished the principal drawbacks to the habitability of these regions by the white races to a very great extent, and opened for the use of civilized man large portions of the earth's surface that were formerly practically forbidden to him. The question, of course, still remains to be settled whether the white man can retain his physical stamina and energy through residence in the tropics for many generations, and whether the mere conquest of pathologic germs is all that is required. The productiveness of tropical regions is of itself a drawback. The average man works only from necessity, and what renders mere existence the easier does not necessarily tend to the higher development of the race. It was Sir Charles Dilke, we believe, who once called the banana the curse of the tropics, and held that where it abounded human progress and ambition disappeared. There is some truth in this, but it may not be an absolute truth. It is not likely, however, that the tropics will be the leading centers of civilization in the future. The temperate zones, where the struggle for existence brings out the higher abilities of man, will always dominate, and it is not improbable that the tropics will be the recourse of the pervasive yellow races rather than of the white. There is every prospect that with our almost certain conquest of the pathologic conditions that exist in those regions their utility to mankind will be vastly increased and that higher civilizations than now occupy those lands will be developed. We may not be able to look on the tropics as a permanent home for the best of the ruling white races, even two or three centuries hence, but there is hardly any question but that they will be much more habitable and useful than they have been in the past.—*Journal of the American Medical Association.*

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

ROYAL METEOROLOGICAL SOCIETY'S LECTURES

The Council of the Royal Meteorological Society in 1905 appointed a lecturer "to give information on meteorological subjects to scientific societies, institutions and public schools in various parts of the country." The object was to advance "the general knowledge of meteorology, promoting an intelligent public interest in the science, and making the work of the society more widely known." This plan has met with marked success. Mr. William Marriott, assistant secretary of the society, who is the lecturer, is now giving lectures on the following subjects: (1) A Chat about the Weather; (2) Weather Forecasting; (3) Rain, Snow, Hail and Thunderstorms; (4) The Upper Regions of the Atmosphere; (5) Clouds, Fog and Sunshine; (6) Climate and Health; (7) Meteorology in Relation to Agriculture; (8) How to observe the Weather. These lectures are all illustrated. The Royal Meteorological Society is also ready to send meteorological instruments and illustrations to any meetings of scientific or other character.

AFRICA AND THE WHITE MAN

The Handbook for East Africa, Uganda and Zanzibar for 1907 notes that more and more European settlers are occupying land in the elevated Kikuyu district, where "one sees now at intervals European farmers with, here and there, rosy-faced children who bear witness to the suitability of the climate for Europeans." This statement is, of course, to be received with caution. The elevated parts of the tropics are well known to be best suited for European settlement, but sufficient time has not yet elapsed to enable us to draw definite conclusions regarding the ultimate effect of the climate upon the white race.

INDIAN METEOROLOGICAL MEMOIRS

VOL. XVIII., Part I., of the *Indian Meteorological Memoirs,* a series of reports of unique value in meteorology, contains "A Discussion of the Anemographic Observations recorded at Rangoon from June, 1878, to October, 1901," and "A Discussion of the Anemographic Observations recorded at Chittagong from June, 1879, to December, 1896," by Sir John Eliot, lately Meteorological Reporter to the Government of India (fol. Calcutta, 1907, pp. 122, pls. XXVII.). These reports are of the same high standard of excellence and thoroughness as that of the volumes which have preceded in this same series. The investigation of Indian meteorology continues with unabated vigor.

RAINFALL OF NORTHERN GERMANY

AN important discussion of the rainfall of northern Germany, by Dr. G. Hellmann, summarizes what the meteorological observations of recent years in that region have brought to light. The title of the work is "Die Niederschläge in den norddeutschen Stromgebieten" (3 vols., Berlin, Reimer, 1906). These volumes afford an excellent illustration of the extreme care and proverbial thoroughness with which German meteorological investigations are carried out. Those who are studying European meteorology or hydrography will find this work indispensable.

MARYLAND WEATHER SERVICE

THE Maryland Weather Service has already published some excellent reports on the climate and weather of Maryland, reference to which was made in these columns at the time of their publication. Dr. Fassig's report on the climate and weather of Baltimore is the most thorough discussion of the kind in this country. Since then, separate chapters on the climate of three counties (Allegheny, Cecil, Garrett) have been issued, and it is intended ultimately to cover every county in the state. The latest publication in the series is that on "The Climate of Calvert County," by C. F. von Herrmann (Maryland Geol. Survey, Baltimore, 1907). The general plan of all these climatic sketches is the same. While there are distinct objections to treating climate according to political divisions, and especially by such small and irrational divisions as counties, there are also a good many arguments, of local value, which may be urged in favor of the plan. In any case, meteorology is the gainer by such publications as those of the Maryland Weather Service. Would that all the states would do likewise.

RAIN-MAKING AGAIN

The compiler of these notes has been requested to act as a director in the "Continental Rain-making Co.," which is to be incorporated in Arizona. From the circulars sent out by the Chief Rain-maker we learn that he "will not be responsible for any storm, flood, or any excesses of nature whatever." "Reliable agents wanted to take up subscriptions in dry sections." "Favorable scientific press comments solicited; unfavorable not wanted." Can not the mails be closed against such swindling schemes as this?

MOON AND CLOUDS

The old question of the supposed influence of the moon in causing a decrease in the amount of cloud has again been investigated, this time by Otto Meissner (*Met. Zeitschr.*, May, 1907). It appears that this supposed cloud-dispelling effect does not exist. Clouds frequently disappear in the evening. When there is a moon, especially a full moon, the clouds can be much more easily seen, and their disappearance makes much more impression than on a dark night.

CLIMATE OF VICTORIA, B. C.

The May, 1907, number of the *National Geographic Magazine* contains a short article on "Factors which Modify the Climate of Victoria," by A. W. McCurdy. The insular position; the proximity of the warm Pacific; the prevailing westerly winds; the local topography and the small precipitation, permitting abundant sunshine throughout the year, are enumerated as the most important climatic controls. Victoria shares with other places along the Pacific coast of North America the advantage of mild winters and moderately cool summers, and it has the additional advantage of being so situated that its rainfall is much less than that of more exposed stations.

SONNBLICK VEREIN

The Fifteenth Annual Report of the Sonnblick Verein, for 1906, is one of unusual value. It contains a presidential address by Dr. Hann on the present aims of meteorological investigation; an appreciative review, by A. von Obermeyer, of the twenty years of meteorological work at Ben Nevis Observatory, with illustrations, and a discussion, by Dr. Hann, of the results of the meteorological observations on the Sonnblick during the past twenty years. The frontispiece is an excellent engraving of Dr. Hann.

NOTES

"Der Meteorologische Aequator im Stillen Ozean" (*Archiv. deutsch. Seewarte,* XXIX., 1906, No. 1) is the title of a very thorough investigation, by R. Westermann, of the conditions of temperature, pressure, rainfall, cloudiness, winds, humidity and ocean currents along the meteorological equator in the Pacific Ocean.

Vol. LXXX. of the Denkschriften of the Vienna Academy of Sciences (*math.–naturwiss. Kl.*) contains a second instalment of Hann's discussion of the daily march of temperature in the tropics. A former publication dealt with the inner portion of the tropical zone; the present one concerns the outer portion (A. *Das amerikanische und afrikanische Tropengebiet*).

An historical review of our knowledge of land and sea breezes, and a presentation of existing theories regarding these winds, has been published in several recent numbers of *Das Wetter.* The final instalment appears in the issue for May, 1907.

R. DeC. Ward

Harvard University

SCIENTIFIC NOTES AND NEWS

Dr. G. W. Hill, of Nyack, N. Y.; M. Camille Jordan, of Paris, and Drs. Guido Castelnuovo and Vito Volterra, of Rome, have been elected honorary members of the London Mathematical Society.

The University of the South has conferred the degree of D.C.L. on President Ira Remsen, of the Johns Hopkins University.

Cambridge University has conferred the degree of LL.D. upon Nicholas Murray

Butler, Ph.D., president of Columbia University.

DR. PHILIP HENRY PYE-SMITH, F.R.S., of London, known for his researches in anatomy and physiology, has been given an honorary doctorate of medicine at the University of Dublin.

THE Norwegian Storting has voted the sum of 40,000 Kroner to Mr. Roald Amundsen in recognition of his services to science in traversing the northwest passage and relocating the magnetic North Pole.

DR. OTTO ZACHARIAS, director of the Biological Station at Plon, and Dr. C. G. Schillings, the African traveler, have been given the title of professor by the German government.

THE Nettleship gold medal of the Ophthalmological Society of the United Kingdom has been awarded to Dr. J. Herbert Parsons, for his work on "The Pathology of the Eye."

THE Royal Academy of Sciences, Berlin, has elected James Henry Breasted, professor of Egyptology and Oriental history at the University of Chicago, a corresponding member.

WE learn from *Terrestrial Magnetism* that Dr. Doberck, having reached the age limit for colonial service, will retire from the directorship of the Hongkong Observatory next September and will be succeeded by Mr. F. G. Figg.

Nature states that the vacancy in the tidal and optical departments of the National Physical Laboratory, occasioned by the appointment of Mr. J. de Graaf Hunter to the post of mathematical expert on the Indian Survey, has been filled by the appointment of Mr. T. Smith, formerly scholar of Queens' College, Cambridge.

DR. HERMANN MUNK, professor of physiology in the veterinary school of Berlin, has retired from active service.

WITH the death of Professor James M. Safford, formerly state geologist of Tennessee, and the decease within the present year of Professor E. T. Cox and Dr. Carl Rominger, Dr. Charles A. White becomes the oldest living geologist of North America. Dr. White is now in his eighty-second year, and is still engaged in scientific work, his latest article being a historical one, on the "Archaic Monetary Terms of the United States," published by the Smithsonian Institution.

ACCORDING to *Nature,* those who have accepted invitations to be present at the Leicester meeting of the British Association, which opens next week, are as follows: Section A: Professors L. Natanson, D. J. Korteweg, H. G. van de Sande Bakhuyzen, Dr. Oskar Backlund, Professor Donner, M. Ch. Féry; Section B: Professors R. Abegg, A. Tschitschibabin, T. W. Richards, A. Werner, F. M. Jaeger; Section C: Professors H. Sjögren, F. Frech, C. Diener, J. P. Iddings; Section D: Professor H. Simroth; Section E: Professors P. Vidal de la Blache, Max Eckert; Section H: Professor E. Naville; Section I: Professor N. Zuntz; Section K: Professors J. P. Lotsy, R. Chodat, H. Conwentz, O. Uhlworm; Section L: Dr. Otto Anderssen, Dr. F. Rönning, Professor M. L. Morel. Corresponding members, Baron D. Kikuchi, Professors P. H. Schoute, R. Nasini and George F. Barker have also expressed their intention of being present.

PROFESSOR E. W. D. HOLWAY and Mr. F. K. BUTTERS, of the University of Minnesota, are spending the summer in the Canadian Rocky Mountains and the Selkirk Mountains, collecting botanical specimens, especially the rusts (*Uredineæ*) and other fungi.

IN connection with the cooperative investigations of the Atlantic Coastal Plain stratigraphy, Dr. H. B. Kummel, state geologist of New Jersey, and Mr. M. L. Fuller, supervising geologist of the investigations for the United States Geological Survey, have taken the field for the purpose of reviewing the Cretaceous, Tertiary, and Pleistocene succession in New Jersey.

THE following course of public lectures is being given in connection with the summer session of Cornell University. The general topic treated is Public Health and Preventive Medicine:

July 8—"The Contribution of Biology to Improved Conditions of Life," Professor Simon H. Gage.

July 15—"The Nature of Infectious Disease," Professor Veranus A. Moore.

July 22—"Tuberculosis," Professor Veranus A. Moore.

July 29—"The Duty of the Teacher in Prevention of Disease," Professor Veranus A. Moore.

August 5—"The Preservation and Purification of Public Water Supplies," Professor Emile M. Chamot.

A committee of which M. Emile Loubet, ex-president of the French republic, is chairman, has been formed for the erection of a monument to the late Professor Brouardel. The artist selected for the execution of the work is M. Denys Puech.

Dr. William L. Ralph, the well-known oologist, died on July 8, at Washington, D. C., in his fifty-seventh year. He was for many years an enthusiastic collector, and early made the acquaintance of Major Bendire, who was then the foremost authority on the subject in this country. On the death of the latter, in 1897, he became curator of the Section of Bird's eggs, in the U. S. National Museum, which post he retained until his decease. His collection, numbering some 10,000 specimens, including many rarities, was deposited in the National Museum several years ago.

Sir William Henry Broadbent, Bart., F.R.S., a leading London physician, died on July 10 at the age of seventy-two years.

Professor Siegfried Czapski, director of the Zeiss Optical works at Jena, died on June 29, aged forty-six years.

The Institution of Mechanical Engineers will hold its summer meeting at Aberdeen from Tuesday, July 30, to Friday, August 2.

The Royal Society of Medicine, composed by a union of medical societies in London, has received a royal charter. The society begins with a membership of 4,000 and an income of $40,000. Sir William Church has been elected the first president.

The thirty-sixth annual meeting of l'Association française pour l'Avancement des Sciences will be held in Rheims on August 1–6, under the presidency of Dr. Henrot, honorary director of l'Ecole de Médecine at Rheims. The presidents of the sections are: Sections 1 and 2 (Mathematics, Astronomy, Geodesy and Mechanics), Professor C. Bourlet; Sections 3 and 4 (Navigation and Civil and Military Engineering), M. Bourguin; Section 5 (Physics), Professor Blondin; Section 6 (Chemistry), Professor Hugounenq; Section 7 (Meteorology), M. Luizet; Section 8 (Geology and Mineralogy), M. Peron; Section 9 (Botany), Professor Lecomte; Section 10 (Zoology, Anatomy and Physiology), Professor Caullery; Section 11 (Anthropology), Dr. Guelliot; Section 12 (Medical Science), Professor Landouzy; Section 13 (Medical Electricity), Professor Guilloz; Section 14 (Odontology), M. Francis Jean; Section 15 (Agronomy), M. Armand Walfard; Section 16 (Geography), M. Richard; Section 17 (Political Economy and Statistics), Dr. Papillon; Section 18 (Pedagogy), Dr. Bérillon.

At a meeting of the board of directors of the American Electrochemical Society, held on June 1, Professor S. A. Tucker, Mr. F. J. Tone and Mr. F. A. J. Fitzgerald were elected to fill the vacancies on the board caused by the election of Mr. C. F. Burgess to the presidency and of Professor Jos. W. Richards to the secretaryship, and the resignation of Colonel Samuel Reber, vice-president, owing to his transference to Manila. Dr. Harrison E. Patten was appointed chairman of the committee on papers. The following were elected as an executive committee: C. F. Burgess, Chas. A. Doremus, Carl Hering, J. W. Richards, E. F. Roeber, S. S. Sadtler, S. A. Tucker.

The American School Hygiene Association has appointed as delegates to represent at the second International Congress of School Hygiene, to be held in London, from August 5 to 10 the following: Henry P. Walcott, A.B., M.D., president of American School Hygiene Association, chairman of Massachusetts State Board of Health; William Henry Burnham, Ph.D., professor of pedagogics, Clark University; Luther H. Gulick, M.D., M.P.E., director of physical training, New York City public schools; Thomas Darlington, M.D., commissioner of health, New York; John J. Cronin, M.D., assistant chief medical inspector, Board of Health, New York City; Robert W. Lovett, A.B., M.D., instructor in orthopedic surgery, Harvard Medical School; R. Tait McKenzie, A.B., M.D., professor and director of physical education, Universiy of Pennsylvania; Edmund J. James, LL.D., president, University of Illinois; Champe S. Andrews, president, Public Health Defense League, New York City; Elliot G. Brackett, M.D., surgeon, orthopedic department, Massachusetts General Hospital; George H. Martin, LL.D., secretary, Massachusetts State Board of Education; Miss Evelyn Goldsmith, teacher in charge of School for Crippled Children, New York City; Miss Jessie Benton Montgomery, principal and critic of grammar department, Wisconsin State Normal School; Miss Brigham, director physical training, Wisconsin State Normal School; Miss Isabel Bevier, professor of domestic sciences, University of Illinois; Francis C. Woodman, head master, Morristown School, Morristown, N. J.; Joseph P. Chamberlain, Santa Barbara, Cal.; Anna J. McKeag, M.D., Wellesley College, Wellesley, Mass.; William Oldright, M.D., Toronto, Canada; F. C. Robinson, LL.D., professor of chemistry and mineralogy, Bowdoin, and member State Board of Health, Brunswick, Me. The international vice-presidents representing the American School Association are Dr. Walcott, Dr. Gulick and Dr. Lovett.

AT the recent Los Angeles meeting of the National Education Association, the board of directors voted that the action of the association in 1898, accepting the simplified spelling of the "twelve words," should be rescinded, and the old spellings of these words adopted for all the association's correspondence and publications. At the final session of the association, however, by a vote of 209 to 22 the following resolution was passed:

> The National Educational Association approves the efforts of the Simplified Spelling Board, and other bodies, to promote the simplification of English spelling by the judicious omission of useless silent letters, and the substitution of a more regular and intelligent spelling in place of forms that are grossly irregular and anomalous, such amendments to be made according to the existing rules and analogies of English spelling, with a due regard to the standards accepted by scholars; and the association hereby approves the simpler forms contained in the list of three hundred words now spelled in two or more ways, published by the Simplified Spelling Board, and containing the twelve simplified forms now used by this association, and directs that those simpler forms be used in the publications of the association in accordance with the rule now in force.

PLANS for the present season's work of the Illinois Geological Survey have recently been adopted and are now being carried out. In the coal investigations Mr. David White, of the U. S. Geological Survey, is making a general investigation of the paleobotany of the coal beds. Mr. F. W. De Wolf, assisted by A. J. Ellis, is making detailed surveys in the southern part of the state and near Springfield. Dr. J. A. Udden and I. J. Broman are making detailed surveys in the area east of St. Louis. Dr. Stuart Weller is extending his systematic researches on the Mississippian stratigraphy. Mr. T. E. Savage is carrying on similar investigations of the Devonian under the direction of Dr. Schuchert. Dr. U. S. Grant, assisted by G. H. Cady, John Udden and others, is investigating the Portland cement materials of the state. E. F. Lines is to study certain clay deposits and H. F. Bain is looking up the oil fields. Professor Salisbury, assisted by Messrs. Trowbridge and Jones, is studying the physiography and Pleistocene deposits of the Wheaton and Springfield quadrangles. In the laboratory, Professor Parr and Mr. W. F. Wheeler are continuing their study of the composition of coals, while Professor Bleininger will assist in the study of cement materials.

Nature states that the New Zealand government is about to undertake extensive trawling of an experimental nature. Mr. L. F. Ayson, chief inspector of fisheries, will be in charge, and Mr. Edgar R. Waite, curator of the Canterbury Museum, Christchurch, has been appointed zoologist to the expedition. Collections will be made of all marine products, which will be investigated, so far as possible, by New Zealand naturalists, and the material obtained will be the property of the Canterbury Museum. The committee for biological and hydrographical study of the New Zealand coast, appointed by the Australasian Association for Advancement of Science, will provide certain equipment for use in the deeper waters. The *Nora Nevin,* a new steam trawler just from the stocks at Grimsby, England, built to the order of the Napier (N. Z.) Fish Supply Company, has been chartered by the New Zealand government, and it is anticipated that operations will extend over a period of three months.

UNIVERSITY AND EDUCATIONAL NEWS

The town council of Aberdeen has agreed to give £15,000 towards the erection and equipment of a technical college in the city.

We learn from the *Experiment Station Record* that at the last session of congress an appropriation of $1,000 was made for the purpose of continuing and extending the school-garden work which has been carried on for a number of years in a cooperative way by the public schools and the Department of Agriculture. Beginning four years ago with a few gardens on the department grounds and a little improvement work around a single school, the movement has grown until this year 700 children have gardens on the department grounds, 124 school buildings in the district have gardens, and 160,000 packets of seeds have been sold for home gardens.

The registration in the summer session of Cornell University is 745, an increase of more than 100 over last year.

Professor W. F. M. Goss, dean of the Schools of Engineering and director of the Engineering Laboratory of Purdue University, has accepted the position of dean of the College of Engineering in the University of Illinois.

At a special meeting of the trustees of Union College, Schenectady, N. Y., on July 18, the resignation of Dr. A. V. Raymond as president was accepted, and Dr. George Alexander, pastor of the University Place Presbyterian Church of New York, was elected temporary president in his place. Dr. Alexander is a trustee of Union College, from which he graduated in 1866.

At the University of Virginia, members of the faculty have been elected as follows: Dr. Stephen H. Watts, of the Johns Hopkins University, to be professor of general surgery and director of the hospital; Dr. Thomas Leonard Watson, of the Virginia Polytechnic Institute, to be professor of economic geology, and Dr. Robert Montgomery Bird, to be collegiate professor of chemistry.

Professor J. B. Johnston has resigned the professorship of zoology in the University of West Virginia to accept the position of assistant professor of anatomy of the nervous system in the department of histology and embryology, University of Minnesota.

Professor F. G. Miller, of the chair of forestry in the University of Nebraska, has resigned in order to accept a similar position in the University of Washington. He withdraws from Nebraska on September 1, on which date his connection with the Washington University begins. His successor has already been chosen—Mr. Frank J. Phillips, of the United States Forest Service. Professor Phillips will assume his new duties on September 1, after which his address will be at Lincoln. He is a graduate of the University of Michigan School of Forestry, and has been connected with the U. S. Forest Service for the past four years, during which he has been assigned to forest problems in many places in the western states and territories.

George D. Gable, Ph.D., Hunt professor of mathematics and secretary of the faculty, Parsons College, Fairfield, Iowa, has accepted a call to the Johnson professorship of mathematics in the University of Wooster, Wooster, Ohio.

Dr. George Dreyer, lecturer in pathology in the University of Copenhagen, has been elected professor of pathology in Oxford University.

Dr. Charles Spearman has been appointed reader in experimental psychology in University College, London.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE EARLY SURROUNDINGS OF LIFE[1]

THE American Association in its Plattsburg meeting is close to the shore lines of the first ocean that seems to have contained organic life in variety, or rather a life that had such hard parts that a tolerably complete record of the main groups and families has come down to us. It is then natural to consider what the conditions may have been under which this so varied and complex life had developed, without leaving more trace of its existence.

Reading over Darwin's "Origin of Species," one can readily see that of all the objections to his theory which he so fully and fairly presented, that which he deemed the most serious was the lack of connecting links in the geological record, and in particular the sudden appearance of the varied primordial life.

He conceded that this latter objection was valid so far as one then knew, and ventured only to suggest that while the continents and oceans had been in grand outline fairly permanent since early Paleozoic, during longer eons previous, which he felt must have elapsed, conditions might have been reversed, and the sediments then laid down have been buried beneath the oceans or altered with their life beyond recognition.

At about the same time that Darwin

[1] Vice-presidential address before Section E of the American Association for the Advancement of Science, also complimentary to the Catholic Summer School at the Champlain Assembly near Plattsburg, N. Y.

was pondering his theory, Logan and the New York geologists were studying and giving names to strata antedating the primordial animals and in the fifty years since not only has the theory of the creation of species by generation advocated by Darwin won practically universal scientific acceptance, but many thousand feet of rocks laid down before the Paleozoic have been much studied.[2] One might infer that discoveries in these beds had removed the difficulties. This is not true. The Darwinian theory has won acceptance by its marshaling of facts in other lines. The most serious difficulty still remains most serious. The years have indeed brought so many connecting links to light since Paleozoic time that we may reasonably expect to find more, and in view of the imperfections in our knowledge of the geological record and the fact emphasized by Rice last winter that the record itself is likely to be particularly imperfect just at the critical and exciting parts of the story of life, the lack of more such links seems no longer very serious.

On the other hand, the difficulty at the beginning has in some ways increased. Beds before the primordial, but little altered, such as later preserve ample traces of life—black slates, limestones, dolomites —show only obscure traces.

Nor does the total thickness of such beds suggest a time before the Paleozoic longer than that since. Astronomers and physicists are putting limits to the age of the earth, which though ample for the deposition of all known sediments, curtail the age of the planet as an abode for life to a number of years which the Paleozoic and later beds may easily have taken to form. At the same time the discovery of fishes in the Ordovician shows that the tree of Life had developed all its main branches at that early date. Where then and how did early life manage to do this "90 per cent." of its differentiation so quickly or with so little trace of itself?

Besides the answer suggested by Darwin which seems no longer admissible—it was proposed by him with the greatest reserve —three notable suggestions have been made toward lessening the difficulty. I refer to those of Brooks, Chamberlin and Daly.

Brooks imagines that the early forms of life were free-swimming surface forms of the deep sea, not freely preserved until they discovered the shore as a habitat.

Chamberlin suggests, on the contrary, that the early life was developed in fresh water, in streams and landlocked waters. Dwellers in such locations have rarely left any trace of themselves, in the rocks. Fresh water dissolves their shells, while the deposits themselves are liable to frequent rehandling.

Daly has recently suggested that the chemical character of the water was the determining factor, and that (during Eozoic time) the ocean was limeless so that the animal could not secrete hard parts.

I will not just here go into any elaborate discussion of these theories and the arguments for and against. They are not compatible. Each has almost obvious difficulties, and it is clear that farther light will be very welcome. I wish first to call attention to a ray of light which the geologist might easily overlook, since it is due to a physiologist, one of the assistants at the Collège de France, R. Quinton. He has written a brilliant book of some 500 pages[3] to defend the thesis which he had proposed in 1897 that the higher animals show traces in the vital fluid of their original environment. Let me explain.

[2] The latest fruit being the report of the Adirondack Committee, *Jour. Geol.*, 1907, pp. 191–217.

[3] "L'Eau de Mer Milieù Organique," Masson, Paris, 1904.

For Quinton the higher animals are compound colonies of individual protoplasmic cells, made up: first, of these cells, that is, living matter or protoplasm, red blood corpuscles, phagocytes, etc.; secondly, of secreted dead matter such as coral, bone matter, muscle fiber, etc.; thirdly, of various excretions, and secretions like milk; fourthly, of the vital fluid, the blood serum, free from all corpuscles or extraneous matter, the lymph, the plasm, or "physiological salt solution" which fills the body and bathes the protoplasm, and is the universal circulating fluid.

Now Quinton states that this vital fluid, which is but the water in which they live in the lower sea animals, represents the same thing in the osmotically closed higher animals, and tends to represent the original ocean or, as he formulates it (p. 417), "Animal life, which appeared in the state of a cell under definite physical and chemical conditions tends to maintain through the evolutionary series, in spite of cosmic variations, these conditions of its origin."

Quinton accordingly compares man to a marine aquarium filled, however, not with present-day sea water, but with that of the early ocean. Again he compares him to the culture tube of a bacteriologist—the tube represented by the dead matter, the skin, etc., the culture by the living cell matter, while the vital medium represents the nutrient fluid. These are striking and stimulating comparisons. It is rather a commonplace to say that society is an organism. It is not so common to say the converse: "An organism is a society."

The great value of a scientific theory is in its capacity to marshal and correlate facts, and stimulate lines of investigation. Judging Quinton's hypothesis by this test, I feel safe in classing it as a very valuable addition to science. Quinton's premise that animal life had a marine origin will, I believe, be so readily accepted by geologists that I shall take it for granted and not even sketch the elaborate arguments, embryologic, phylogenetic, and others by which he proves it.

This granted, that there should be some tendency among animals with a closed body cavity like the land animals to retain the ancestral composition of the vital fluid seems reasonable. But Quinton goes on to maintain that it is not a mere tendency, but to a very great degree successful, and that from the composition of the vital fluid one may safely infer that the early ocean had a temperature of about 44° C. (111° F.) a concentration of about seven to eight parts per thousand, and a composition mainly of sodium chloride. Now in this we can not follow him without further consideration, and we are going to ask: first, what actions are now going on which may have changed the ocean from the physical and chemical conditions of the vital fluid to those that it now has, and, secondly, what traces are there of the burial of any such waters? For there are alternatives to Quinton's hypothesis which he hardly seems to fully realize.

That environment produces on the vital fluid some effect is beyond question, and is granted by Quinton, as it is shown by his experiments. Now if by any particular modification conditions more favorable to cell life are produced, why should not this modification be accumulated by the survival of the most vigorous, and so there be a progress from the original oceanic fluid to one determined, not by the original ocean composition, but simply by physical and chemical factors, which make it the best for cell life?

Again, why may not the sea animals have remained open so long as the ocean was growing more favorable in condition for life, and only closed themselves in or struck out for the land when in its change it passed the optimum. We shall, I think, find that this latter hypothesis is the more likely to be true. But it does not seem that we can readily dismiss the second from consideration.

There are other weaknesses in Quinton's theory, one of which we may now mention, leaving the rest until later. That is that his theory does not take in plants, and their circulating medium.

The lower plants and animals are not far apart, and we can hardly suppose a different origin. Yet plants must have existed before animals, just as herbivora must have existed before carnivora, and the cat presupposes the existence of the mouse. Plants as well as animals have protoplasm or living matter, dead matter, and secretions and a vital fluid or sap. But the sap is of much lower concentration and different composition from animals. Quinton's hypothesis needs to be supplemented by some explanation of the relations between plants and animals.

We are then prepared to consider Quinton's valuable law with an open mind, and see how far its inferences as to the surroundings of early life agree with those of dynamic and historical geology.

1. Quinton infers that the early ocean had a temperature not far from 44° C. (111° F.) which is not far from the hottest blood temperature of birds. It is certainly a remarkable fact that from the tropics to the poles, in spite of the tendency of the environment in arctic and temperate climes, the blood heat of the more vigorous and active animals in the various orders of vertebrates falls not over 10° below this temperature.

Quinton's explanation is not the only one, however. The other is that the processes of oxidation and combustion, which furnish the energy for the bodily activity, and the supply of heat to keep the body warm, raise the same to a heat which is best for cell activity, or perhaps even to the temperature which can be stood without serious damage.

A careful investigation of blood temperatures and bodily activity, which are in some ways correlated, might be very significant.

Geologically we can not speak with as much assurance as we might have before radium and the newer theories of cosmogony had undermined all certainties. Glacial periods indeed are reported upon strong evidence from early geological times. Nevertheless, whether we believe in a gradually refrigerating climate, on a cooling globe, warmed by a dying sun, or not, the former wide extent of corals and ferns toward the north pole is undoubted. Van't Hoff finds a hot climate indicated by the Stassfurt salt deposits. We must therefore allow the possibility, and I think most of us would say probability, of a much warmer ocean at least at times in the past, than at present. We may then imagine, and it was to me an illuminating thought, that the early "fish" were not cold-blooded animals at all, but active warm-blooded creatures whose blood temperature was that of the warm ocean around, which has been retained by the higher of their descendants. It seems probable that such a warmer ocean would accelerate all organic activity, including evolution.

Upon the basis of a cooling environment Quinton builds an ingenious genealogical tree. He imagines the secular cooling of the surroundings as depressing also the body temperature of all except a few forms which make special modifications to keep it up. Then a farther fall will lower all except a fraction of the first fraction, who have assumed such farther modification as to resist this farther fall. Thus a high body temperature is a sign of a geologically recent and highly specialized form, while a low body temperature is a sign of a primitive form.

There may be a valuable suggestion here. According to it the keeled birds are more recent than the ostrich tribe, while the carnivora and ruminants belong to families more recent and more specialized than that to which man belongs. Man adapts himself to a cold climate by means of his clothes, and by use of his brains. The marsupials seem to have failed to resist the secular refrigeration at a still earlier date, while the vast bulk of the animal kingdom has submitted to the change in its surroundings and become colder and colder blooded, and all life activities slower as time has gone on. The bearing of this upon the relative rapidity of early evolution is obvious. The rate of evolution in the present cold-blooded forms may be vastly slower than in their hotter-blooded ancestors.

But suppose it to be true that there has been a cosmic refrigeration, why should life have waited for its appearance until 44° C. Many forms thrive at higher temperatures, and algæ and low forms occur and thrive in hot springs up to the temperature of pasteurization (75° C.).

If 44° C. be the temperature at which the line of descent of the birds left the ocean and it has fallen since, there seems to have been no reason why it may not have been falling before, carrying all life with it. Indeed, why should it not, if we assume that 75° C. is but barely endurable, while somewhere about 44° is the best for cell life?

The suggestion seems altogether natural and reasonable that both animal and plant life originated at a temperature above 44°, but that they followed the drop of the ocean or cosmic temperature so long as thereby better and more grateful conditions were secured.

We may remark in passing that the drop from 74° to 44° would not be likely to take as long, perhaps not half as long, as the drop from 44° to 14°, for after a body has once fairly started cooling it cools more and more slowly, the lower the temperature.

2. Again, Quinton infers that the early ocean had a concentration of between 7 and 8 parts per thousand of salts. This is the concentration of the blood serum of the birds, which seem to have kept the temperature most nearly constant, and may be supposed to have most nearly the original concentration also? But beyond this analogy this original concentration of about 7 per thousand is supported by a series of striking and important facts which seem to me to form the strongest of all the arguments, and the convincing one, indeed, for a basis of truth for Quinton's law.

The surroundings of fresh-water fishes would tend to lower the concentration. They have indeed somewhat lower concentrations, between 6 and 7 parts per thousand, but not over 8. Salt-water fishes, on the other hand, have a greater concentration. Quinton cites no figure less than 9.3, but they are always less than the present ocean (35). How can we explain the divergence of the two series from a point otherwise than that the fishes, fresh-water and salt, have been derived from ancestors whose concentration was where the one series ends and the other begins, and that the sharks have had their blood grow gradually more saline while the freshwater fishes have suffered a slight dilution of blood. But this is not all. The concentration is in man just about 8 parts per thousand, while in cattle, whose craving for salt is well known, and whose foods naturally lack sodium, so that they are very likely kept a little short, it sinks to about 7. On the other hand, the dolphin, a relatively recent denizen of the deep, has had his concentration raised to 8.5. There are other facts given by Quinton, regarding fresh and salt-water turtles and crayfish, which I can not give.

But a host of further questions are raised regarding the blood of seals and whales and salmon that breed in fresh-water, and eels that live in fresh water and breed in salt.

We see that this implies that the ocean has grown in concentration. Quinton suggests, as it seems to me rather wildly, that the ocean is losing water into space. Putting this aside, however, we find good reason, in processes now known to go on, to believe that the ocean is accumulating salts and growing more concentrated. The water evaporated from the ocean, carried up into the clouds and rained down again upon the earth, is subject to a natural distillation. It is soft and fresh. On the other hand, the rivers come into the ocean laden with the products of solution. Murray and Dubois have given valuable tables of river composition. The result is that every lake without an outlet, receiving a river, like the Great Salt Lake or the Dead Sea, becomes very salt. And what is the ocean itself but a much vaster lake. So Hunt, Joly, Dubois, Macallum and most of those who have given the subject any especial thought have inferred a concentration of the more soluble salts in the sea. We can not, however, separate a full discussion of concentration from that of the composition of the ocean. I can not see any escape from the general conclusion that there must have been some such concentration, except by supposing that volcanoes from absorbed gases in the interior of the earth are yielding more water than enough to counterbalance the soluble salts brought in by the rivers. This we can hardly disprove, if we assume that there may also be a gradual transudation of these waters from the interior, but it does not seem likely. While, however, Quinton's theory agrees with processes now going on in its suggestion that salts have accumulated in the ocean, we are impelled to ask, as we did in regard to the temperature, why should life have waited to begin until the ocean was already brackish, or why should the ocean have begun with a concentration of 7 parts per thousand?

May it not be that life began in an ocean of much less concentration, but remained open to it, with the body cavity not cut off, until that best for cell life, to wit, a concentration of nearly 7 parts per thousand, was reached?

If we ask this we are led to turn to historical geology, and to the line of enquiry which is, I fear, the most difficult, the least certain, and the most tedious, but to which I feel bound to devote some time, since it happens to be the gateway which led to my interest in the whole subject.

We may ask, what indications are there of any such concentration less than the present in the waters buried in the earlier strata?

Do they come at all, and if so, at the beginning of life, or at that stage in the geological column when the land animals and those who may with some assurance be supposed to have a vital fluid distinct from the sea water are known to have existed? But before we can apply this test we must ask and answer many difficult questions. Can we find analyses of rock waters which can be fairly assumed to represent buried ocean waters? Has not the circulation in strata in the course of millions of years been thorough? Then, again, how can we tell, even supposing that there has been no such circulation that strata were not laid down and filled in the beginning with more or less fresh water? For freshwater springs, as Hitchcock and others have described them, are not uncommon beneath the ocean, and very commonly fresh water may be found by digging in the sand of ocean beaches.

Such an inquiry would have been impossible in Darwin's time. But since his time so many holes have been put down to very great depths by churn or diamond drill, in search of oil, gas, brine, artesian water, etc., that it does seem fair to ask the question. Yet we can hardly separate in the inquiry the composition from the concentration. For in the proportion of the elements, especially of the chlorine, seems to be the surest test of the character of the water. I shall not try to prove this in detail, as it depends on study of many water analyses, but I may give you some idea of the reason. Chlorine (Cl) now exists in ocean water in excess of sodium, and there is, as we shall see, good reason for believing that that excess has been even greater than now in times past.

By an excess of chlorine I mean that after chlorine has been set aside enough to combine with all the sodium that the analysis of a water shows, there is still chlorine left which is usually understood to be combined with the potassium, calcium and magnesium present.

On the other hand, in waters that are mineralized by leaching, whether from granites of New England or the alkali plains of the west, and in all rivers with very few exceptions, explicable often by contamination with manufacturing wastes, there is sodium enough to combine with Cl and then some left. There is hardly any rock, but the unique Stassfurt deposit from which one can imagine chlorides other than sodium chloride to be leached. Nor, on the other hand, is chlorine in solution easy to get out again. The rare and valuable silver ore, hornsilver, a few significant volcanic chlorides, quite soluble, and transient around active volcanoes, and the deposits of dried up oceans and lakes, and a few minerals of no quantitative importance like apatite and sodalite, complete the list of chlorine minerals.

To get results of any value, one must take all the available analyses of a region, see what the surface waters are, how they seem to be affected in composition as one follows them in depth, eliminate waters that may come from desiccated seas, gypsum beds, or salt beds, or may be erroneous and contaminated. Gradually I find myself forming some idea of what the buried water must have been. I must frankly own that from my studies in that state with which I am best acquainted, Michigan, I was first inclined to think that there was no sign of earlier, weaker ocean waters. On the contrary, deep wells from perhaps every geological horizon seem to have stronger brines than the ocean.

Upon taking a wider view I have come to change my mind, and think it is not altogether accidental that the water at Sheboygan, Wisconsin, has at a depth of 1,340 feet 10 parts per thousand of solids, of which 4.3 are Cl; that the deepest well at Cincinnati, 1,245 feet, has 11 parts per thousand, of which 6 are Cl; that Litton's very careful analysis of the water from a well 2,200 feet deep at St. Louis (the water mainly at 1,515 feet in the Magnesian limestone) should give 8.791 per thousand, of which 4.1 are chlorine, and that near us at Montreal in rocks of similar age in a 1,500-foot well (at 1,190 feet) Adams found 7.57 per thousand, of which 2.46 are chlorine. In Europe the only well at all similar I have yet found is one reported by Struve at St. Petersburg (658 feet through Silurian rocks to the granite) with 3.89 per thousand, of which, however, 2.3 are chlorine. Now compare these with the 35 parts per thousand, of which 20 are chlorine, of the present ocean. Consider that in each case this is the saltest water from the district and horizon. Do they not indicate for the open paleozoic ocean a concentration much less than at present, and not far from that of the vital fluid of the land animals, at the very time the first land animals are known to have appeared? The large collection of water analyses made by Blatchley for Indiana yields exceptionally good material for study, since there are a large number from drilled wells, in many cases separated from the surface by sheets of oil or gas. We have to eliminate only two or three whose extra strength appears to be due to brines of the Salina formation, or to solution of sulphides as sulphates on the one hand, and more numerous shallow wells, where the water is dilute, and carbonates, not chlorides, dominant on the other, to get a well-defined and extra abundant group of analyses, characterized by a chlorine excess, and a concentration of 500 to 1,100 grains per gallon, *i. e.,* 7 to 16 parts per thousand, all drawing their strength deep down in Paleozoic rocks.

Norton's collection[4] gives us a chance to study Iowa in similar fashion. Here there seems to have been much circulation from the high western plains toward the Mississippi Valley. Yet, if the rocks had been laid down in water as salt as the present ocean to any great extent, it seems to me hardly likely that that which contains the most chlorine of all those Norton gives would have but 3.356 parts per thousand, of which 1.1 only are chlorine, while there is a large excess of sodium, showing, to be sure, considerable dilution. This water is from 716 to 845 feet down in the Carboniferous.

This is a work in which it is easy to deceive one's self, and many should share in these critical studies.

[4] Vol. VI., Iowa reports.

3. We come now to the third point made by Quinton, the resemblance of the vital medium to the ocean in composition.

Sodium chloride is the leading salt in both. This is the more noteworthy because in the living cell potassium and phosphates are much more important, and this is also true in most of the animal foods.

That is the reason why the craving for salt is so natural, and the salt tax the one tax that the poorest mortal can not evade, if he would live. It is the last screw to be placed on abject poverty.

A second group of constituents in abundance is formed by magnesium, calcium, potassium and sulphur. Carbon, oxygen, nitrogen, hydrogen (carbon dioxide and ammonia), silica and fluorine are also well known to be present in both. Finally, by an elaborate discussion of physiological litterature Quinton shows that all the rarer elements of sea water, with the exception of cobalt, also circulate in our veins, to wit, I, Br, Mn, Cu, Pb, Pt, Zn, Ag, As, B, Ba, Al, Sr, R, Cs, Au, Li.

I do not consider the identity in the presence of traces of relatively rare elements of any very great importance in the present state of analysis. These elements are all widely distributed in nature, even if in minute quantities, and are liable to occur in ocean or vital medium without there being any genetic connection. Moreover, the knowledge of their presence in the one case or the other depends in a number of cases on only one or two determinations, so that there is no assurance of their universal and constant presence.

When we consider the ratio of the different substances, which is what Quinton means by the composition, we find a number of difficulties as well as some striking resemblances between the vital fluid and the ocean. One difficulty is in getting what may be fairly called the composition of the vital fluid. Ordinary analyses of the blood, for instance, show percentages of phosphates and an excess of sodium over chlorine entirely foreign to sea water, present or past. But when the blood cells and organic matter have been most carefully eliminated the proportion of phosphoric acid drops to but 25 parts per million, and though this is more than occurs in sea water now, it is very much less than occurs in the body generally, and Quinton's supposition that it is due to a small amount of organic matter that one can not get rid of, or that it comes from excretions from the organic matter which the blood is carrying off, is not unreasonable. We may even, when we look at the analysis of the Sheboygan water, and consider the phosphatic character of the early brachiopods, imagine that there was in early days more phosphorus than the present ocean contains, and that it had been eliminated by life faster than supplied.

Similar explanations might perhaps be given for the excess of sodium.

The ratio of sodium to potassium is in the vital medium 10 to 1. In the ocean it is nearer the famous 16 to 1. This is a great contrast to living matter in general, in which potassium dominates over sodium.

When we come to compare lime and magnesia, however, we find that both in living matter in general and in the ocean at present magnesium dominates (1.31 : 0.47) over calcium. On the other hand, in the vital medium there is three times as much calcium as magnesium. This fact did not escape Quinton and Macallum, and they both suggest the same explanation—that there has been an accumulation of magnesium in the ocean since it determined the composition of the vital medium.

This is chemically and geologically very likely. The magnesium salts are more soluble than the lime salts. Again deposits from the ocean of lime sulphate and lime carbonate with little or no magnesium, gypsum and limestone, are well known. On the other hand, the only common magnesium deposit known in the rocks, dolomite, has a molecule of calcium for every one of magnesium. Thus a relative increase of magnesium over lime seems probable. Dubois brings reasons to believe that the ocean is now saturated with calcium carbonate, and has as much as it will hold, and that lime is thrown out, largely in coral and shell, as fast as the rivers bring in carbon dioxide. The magnesium which the rivers bring will readily remain as sulphate or chloride and is not so easily reduced or precipitated as calcium sulphate, nor is magnesium so freely taken up and thrown out by organic life.

Thus while the problem is not a simple one, since it depends on the supply of sulphur and carbon as well as magnesium and calcium the accumulation of magnesium seems, to say the least, quite possible. In the present ocean Na:Mg:Ca::10.23:1.31:0.47. As regards the sulphur salts, Daly has suggested that, as in the Black Sea so in the early ocean, until the carnivorous habit was well established and a good scavenger system, the sea would tend to be fouled with dead matter and the sulphates brought down by the rivers be reduced and deposited as sulphides, as we find them in black shales and organic limestones.

No doubt this action has occurred from time to time. It agrees with the customary association of pyrite and black shales, and petroleum and sulphur. But what indications are there of greater frequency of sea-deposited sulphides in the pre-Cambrian rocks?

Anyway if the accumulation of magnesium in the ocean depends on the supply of sulphate we must expect to find it as well as sulphate low in early times.

We are thus brought face to face with a very important problem of historic geology, the chemical evolution of the ocean.

Studying the Paleozoic waters, we find unmistakable indications that they were low in magnesium sulphate, but that they contained relatively large quantities of calcium chloride. This, as long ago noted by Hunt and Goessman, is characteristic of the Paleozoic brines. $CaCl_2$ must have been precipitated little by little by the carbonates and sulphates, forming the calcium carbonate and sulphate of the sedimentary rocks, while the sodium and magnesium remained in solution.

The ratio of calcium to magnesium in the vital fluid is about 0.10 : 0.025, say four to one, while in the Saginaw carboniferous brines it is usually near three to one.

Here for the third time we come to the conclusion that the vital fluid has a composition that the ocean is likely to have had in times past, not at the beginning of its progressive change, but at about the time when we find the first trace of vertebrate life.

4. For the Ottawa meeting of the Geological Society of America I prepared a paper on the chemical evolution of the ocean, and I showed a diagram in which analyses of waters from different strata were arranged according to the ratio of sodium to chlorine, which appeared to have increased in the ocean from something like .20 in Calciferous times to .555 at present. A change in concentration of from 8 to 10 parts up to 35 in the same time would be of the same order, but would imply considerable additions of chlorine in the same time, which we should have to look to the volcanoes and their rocks to furnish. It would also imply, if both changes were uniform, which does not seem likely, that when the concentration by river action began the ratio of sodium to chlorine was somewhat about 0.06. Even in the weakest water and at the beginning the ratio of sodium to chlorine must have had some value, and this is about the ratio in the deep water of the Keweenan copper mines, and may be the ratio which comes from juvenile waters, or those emitted by volcanoes, or may be that due to the leaching of volcanic rocks.

For the fourth time the suggestion is forced upon us that the vital medium does not represent the early ocean, not that which first began to cool, nor that in which the rivers first began to bear their burden of dissolved salts. It does seem quite nearly to correspond to that which we have other reasons to believe existed at the beginning of the Ordovician or end of the Cambrian, not long before the time that the first fishes are known to have existed, but much after life is known to have existed.

The evidence goes then to support Macallum's modification of Quinton's theory (conceived quite independently) that the vital medium represents the ocean water at the time the body cavity in the progress of evolution became osmotically closed.

It thus seems likely that we have found a key by which we may date the development of life and the deposition of beds in terms of the development of the ocean, whenever we can get a sample of the normal ocean water of the time, or approximate to it. I need hardly say that it is not likely that this change in the ocean proceeded at a uniform rate. Changes in climate would affect the great distilling process upon which the development rests. Great uplifts might hasten the supply of salts. Geographic conditions leading to the deposition of enormous salt beds in partially cut-off bays might reduce the concentration of the open ocean. As the area of sedimentary rocks increases relatively to that of igneous rocks the character of the supply of salts furnished by the rivers must change.[5] On the whole accumulation was probably more rapid relatively to the area of land surface, at early dates, when evaporation was more powerful. It is doubtful if the land was so well forest clad and protected from erosion as later. Moreover, salts would be less likely to be thrown out when the ocean was weaker and not so saturated.

The broad conclusion of a gradual accumulation of salt in the sea, particularly sodium, is confirmed by so many independent lines of evidence as to have a very small probable error.

Let us review the arguments for accumulation of sodium before leaving this part of the subject.

1. The argument from the erosion of continents developed by Mackie.

2. The argument from the excess of sodium in river water, worked up recently by Dubois after Murray and Joly.

3. The argument from the shortage of sodium in the average sedimentary rock as compared with the average igneous rocks from which it is derived, as developed by Van Hise, Clarke and Mead.

4. The argument which may be drawn from a study of the early buried waters as suggested by Hunt.

5. And finally the argument which as we have seen follows from the composition of the vital fluid and Quinton's law.

These various arguments depend on various lines of facts, so that one may be fallacious without disproving the other. On the other hand, the stronger lend strength to the weaker. For instance, I doubt if any one from mineral water analyses alone would be likely to feel much assurance. The errors and defects in the chemical work, in the collection of samples, and in the circulation and preservation of the waters, are too great.

The one thing that seems most assured regarding the buried waters is that the early ones were relatively richer in calcium chloride.

The many published, and dozens of yet unpublished, determinations upon our Michigan waters, have put that in my mind beyond question.

The analyses of the coastal plain post-Paleozoic waters deserve farther study. The saltest well of the analyses recently collected by Smith in Alabama from the Tertiary has 30.5 parts per thousand with 11.47 sodium against 18.52 Cl., while the ratio of magnesium to chlorine is .1224: .247.

This is not far from what we might expect from a buried sea water of this age, but on the other hand among the waters from the Cretaceous there is none that appears to be at all unmixed sea water. The saltest, and at the same time one of the deepest (IVa) has only 8.57 per thousand and Na:Cl::2.999:4.538 = 0.66, while Mg: Ca::.0431:.1396.

The analyses collected by Veatch in Louisiana, where we know that rock salt beds occur, show in many cases greater concentration of salt than the present ocean. They also show very little of sulphates, but they show a ratio of magnesium to calcium quite different from the Saginaw brines which mark them as relatively recent.

Leaving now the tedious numerical part of our subject, we may ask ourselves what bearing this has upon the difficulty to which we referred at the beginning.

The vital fluid seems to date or preserve the ocean composition, concentration and

[5] In early times the supply of chlorine seems to have been relatively more rapid, being derived from the leaching of the Keewatin rocks.

temperature of somewhere about Beekmantown eo-Ordovician time, somewhere about the time that the ocean had attained one fifth of its present concentration. This indicates that the pre-Paleozoic was probably not one fourth as long as later time, dating the beginning when the ocean began to get concentrated.

Thus the rapidity of early evolution, to which physical, astronomical and stratigraphic evidence had led us, is confirmed.

But we know that life existed all through Cambrian time, and earlier yet. So while Quinton's investigations indicate certain conditions of the vital circulating fluid from which fresh-water and salt-water vertebrates have diverged, while the more vigorous land animals have retained them nearly unchanged, these conditions are by no means so near the beginning as one might think from a casual reading of his argument. It seems much more probable that life began as soon as was possible, at higher temperatures than 44° C. and at very low concentrations. The water was that leached from basic rocks, the Keewatin schists, and was relatively richer in calcium chloride, and I suspect also ferrous chloride,[6] and was in composition as well as concentration by no means the best for organic life. We may then believe that as the temperature of the water decreased, and the concentration increased, this change was in the direction of the physiological optimum, or salt solution most favorable to protoplasm and cell activity.

According to Meyer's account of the stimulant effect of sodium chloride, calcium and potassium, and the sedative effect of magnesium, the early ocean, as it accumulated salts of sodium and lime, must have been a more and more stimulating medium, up to a point when it became overstimulating and poisonous. Up to this time, which I take to be about the beginning of the Cambrian, there would have been no physiological tendency to secretion or excretion of lime by animals, until and unless the ocean became supersaturated with carbonate. The ocean in the beginning must, like fresh water to-day, have acted as an active solvent if any were formed. But when it passed the optimum then the excretion or precipitation of lime and accumulation of magnesia, which is more sedative, might tend to restore the balance. So long as it could thus be kept in most favorable condition for cell life, there would be no especial reason for osmotic closing or the development of a special vital fluid. Up to this point it would pay animals to accept the beneficial changes which were taking place in the medium in which they lived and moved and had their being.

We do not, understand, suppose that the ocean arrived at the best conditions for cell life in all respects at the same time, but we suggest that one of the first endeavors of the more vigorous animals to keep the vital medium of the best was by means of secretion of superfluous lime. This is supported by the fact that lime is the substance most abundantly brought in by rivers, one in which saturation would soon be reached of the carbonate, and by the fact that lime skeletons and hard parts begin to be abundant in the Cambrian, a geologic period before those animals appeared which we may be sure had a separate vital fluid. However, our general belief in the critical importance in the history of life of the time when the ocean passed through the most favorable conditions for cell life does not depend on any particular theory of the physiological interrelation of various salts.[7]

[6] Compare the richness of iron carbonates in the Huronian. Probably mixed carbonates were precipitated as fast as carbon dioxid was furnished.

[7] But we do suggest that the secretion of hard parts began first as a physiological reaction, like renal calculi, to the increasing hardness of the vital medium.

As the ocean passed more and more decidedly this optimum, the more vigorous organisms resisted this change in various ways. They cut themselves off from it osmotically. They secreted a more or less impervious carapace or shell. Then they got out of it entirely and migrated to the air or the land, perhaps by way of the shore sands and muds. This period when the ocean seems to have passed its best stage for life appears to have been the Cambrian. After this period there was a wealth of forms able to leave hard traces of themselves. Before this period there was no physiological need for skin or shell. But once the skin and shell had been developed, primarily as a physiological reaction against the water, their great advantages for purposes of defense and support no doubt soon made themselves felt.

Before this the early dilute and perhaps acid ocean water would attack shells freely. After the Cambrian time there was an excess of calcium carbonate, which has been steadily thrown out, as the rivers brought the carbon dioxide in, ever since.

In passing I may say that Macallum has suggested that from the composition of the protoplasm itself we may form some idea of that of the early ocean, but as I can not endorse his conclusions, I will not dwell on them here.

We thus attribute the development of hard parts and a separate vital medium, the one occurring at the beginning, and the other at the end of the Cambrian, to the same cause, the endeavor of the societies of cells we call organisms to maintain for the mass of the constituent cells the best possible conditions for their activity.

We have thus, I conceive a fair explanation for the rarity of traces of hard parts in the early rocks. The animals had felt no physiological need of them and had not begun to develop them, and the ocean was relatively fresh, and would more easily dissolve them.

Moreover if thé early ocean was changing in composition and growing more favorable to cell life, while the organisms were bathed in it, we might well expect a rapid evolution, and one not merely superficial.

It is a standard doctrine of biology that the individal in his growth gives a sketch of the history of the race to which he belongs, that embryology and phylogeny run parallel. I do not know that any one has heretofore suggested that the time occupied in passing from one stage to the corresponding stage is in any way proportional in the two series, and that the rapid changes in the egg at the beginning are matched in racial history. It would be indeed foolish to hold this in any rigid way, for the parallelism is in no sense strict. Yet is it not fair to suppose that life as a whole was more plastic at the start even as the individual is, and that as in artificial races there is a cumulative effect of heredity, tending to hold them true after a few generations, so it must be for organic life as a whole?

As we have said, if we may estimate by the concentration of the vital medium relative to that of the present ocean, and suppose the increase to have been uniform, the time prior to the separation of a distinct body fluid, that is, the pre-Ordovician, can be only a quarter of the time which has elapsed since. A discussion of the temperatures and change of ratios of sodium to chlorine and magnesium to calcium, in the present ocean and Paleozoic waters while they do not agree closely, also lead to the conclusion that the ocean at the beginning of concentration by erosion was only a fourth older than the early Paleozoic ocean.

This will give us room for all the sedimentary column of Huronian and Laurentian, I think, for I think the pre-Ordovician column of rocks is hardly more than one fourth of that since.

I presume some will grumble at being curtailed to so short a time before the Trenton, only twenty million years or so (if the time since is eighty million years). As we have said, the progress is probably not exactly uniform. But really twenty million years is quite a while. The following illustration may help us to appreciate this. There has been a change of 15 per cent. to 20 per cent. in the flora of Michigan and Ohio in the past 200 years. If then in each year there was an average deposit of but one two-hundredth of a foot there could be an accumulation of ten thousand feet of strata with a 15 to 20 per cent. change of plants every foot in twenty million years. Have we any facts to make us feel sure that that is not time enough?

The growth of scientific doctrine and theory is like that of some modern invention like the steam engine. Different men contribute, the one this improvement, and one that, until in looking at the perfect machine one wonders and admires and forgets that it is an embodiment of the ideas not merely of one designer, Watt, or Corliss, or Nordberg, but of many, who have each contributed something. So many have discussed the physiological salt solution and the oceanic origin of life, but Bunge, Macallum, and especially Quinton have brought them into relation. Before them Hunt, Goessman, Joly, Mackie, Dubois and others have theorized on the evolution of the composition of the ocean.

From them all we have borrowed, or by them been anticipated. So of previous writers on the conditions of early life, it will be seen that I agree with Chamberlin as to the relatively fresh character of the early medium in which animals appear, that I adopt Daly's suggestion that the scarcity of hard parts of pre-Cambrian animals was physiological and due to the chemical character of the ocean, though we can not at all agree with his conclusion that it was limeless, which seems to be negatived by the composition of the vital fluid, the evidence of fossil brines, and the deposits of the early oceans.

What we bring (besides some detail studies of buried waters) is the correlation, and the suggestion that the development of hard parts, and a relatively permanent vital fluid, were *both* physiological reactions to the chemical evolution of the ocean, as it reached and passed its best conditions for life in the early Paleozoic.

The wider the area of our knowledge the greater the circumference of our ignorance, and the test of a good theory is that it opens up new lines of research. Let me mention a few. Further tests of the composition of the vital medium would be very interesting, especially in salmon, and eels and the like, as well as in seals, whales and insects.

The field which I hope to help cultivate, myself, is the study of waters which may be in part buried sea waters. It would be very interesting to extract the quarry moisture of impervious rocks. I do not know how to do it, without danger of extracting solid constituents at the same time.

To sum up in conclusion, it seems likely that early evolution was very rapid—the history of the race in this respect being like that of the individual—because of some of the following factors:

1. A warmer ocean, and consequent greater activity of life.

2. A constant approach of the same up to early Paleozoic times toward better conditions for life, which caused the organisms not to cut themselves off from it, but remain open, while hard parts were rare, thus

exposing the organisms throughout to the modifying effects of environment.

3. The relative weakness of the stereotyping effects of cumulative heredity at this early date.

4. The fact that as all available spots were not preempted, there were wide fields open to successfully modified forms adapted to some new yet unoccupied station, who could then be very prolific, and thus give large play for further adaptation.

5. The frequency of generations in the lower animals and plants.

6. Probably a relative lack of seasonal rhythm.

7. While new forms of life and the flesh-eating habit were being developed a stimulus was put on various modifications to meet these new conditions.

Since early Paleozoic times animals have existed fitted for land and sea, salt water and fresh, air and mud, herbivorous and carnivorous, with the main methods of attack and defense outlined. So that one could hardly expect so radical or rapid changes thereafter.

I think this audience in this assembly will permit an old pupil of Shaler to indulge in a little philosophy and close on the eve of Sunday with a moral.

Haec fabula docet: that those societies of cells known as animals have not been the mere slaves of environment, nor even of environment and heredity conjointly, but have struggled, with more or less success, to maintain through varying environment that part only of their heredity which conduced to greater protoplasmic activity (or, to put it in every-day English, have striven to surround the great mass of the cells of which they are made up with the conditions best for their health and vigor), and the physical grade of the animal is in the ratio of its success in this struggle for the common weal of the constituent cells.

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SCIENTIFIC BOOKS

Researches on the Affinities of the Elements. By GEOFFREY MARTIN.

The unfortunate part of the book is that any attempt to separate the grain from the chaff is made difficult by the amount of chaff.

The author attempts to represent the affinities of the elements for each other by means of a diagram. This diagram for any particular element is constructed by arranging the elements according to the periodic table. Then over each element erect a perpendicular whose length shall represent the affinity of the chosen element for the element in the table. Joining the points (ends of the perpendiculars) thus obtained, you have a surface which represents at a glance the affinity of the chosen element for all of the elements.

The fact that such a surface could be constructed by any one having a knowledge of the proper lengths of the perpendiculars needs no proof, and the author's mathematics on this subject could, we think, have been omitted with advantage. The real difficulty arises in determining the length of the perpendicular which shall represent the affinity in any given case. Where the heat of formation is large this is taken as measuring the attractive force. Where the heat of formation is small, or the data insufficient, the author determines the proper length by a comparative study of the compound with regard to its stability, etc. The surfaces as given by the author for thirty-one substances are therefore not claimed to be exactly quantitative, but only qualitative. The author points out the readily perceived fact that the form of the surface would be altered should the arrangement of the elements be changed. Also it would be altered by changes in pressure and temperature and would change its form completely with a change in the valence of the element.

We think it hardly probable, even where the heat of formation is large, that it gives any very good idea of the actual size of the attractive forces involved. For the elements reacting are usually previously not monatomic and the heat of formation is the sum of the several reactions involved, to say nothing of a variable amount due to the physical changes. Moreover, T. W. Richards and J. Traube have separately pointed out that the heat of formation is probably largely dependent upon the changes in volume suffered by the reacting elements. When these facts are all considered the affinity surfaces constructed by the author at the expense of so much labor can hardly be taken as more than a guess. Much will have to be learned before any true affinity surface can be constructed.

From various facts cited by the author as collateral evidence bearing upon his point of view some of his conclusions are worthy of note either as being new or because they are derived from a more or less novel standpoint. Thus on page 42:

It seems, in fact, that the force exerted by the bromine atom is always less than the force exerted by the chlorine atom on a given element or radicle, but is always proportional to it.

The chemical attractions which *A* exerts on the various elementary atoms or radicles must be either equal or proportional to the chemical attractions which *B* exerts on the same atoms or radicles.

On page 74:

It is the intensity of internal atomic forces with which the atoms are attracted together in the molecule which determines the intensity of the external attractive force between molecule and molecule, and therefore the volatility of the compound.

On page 99:

Strangely enough, the melting-points of similar compounds does not appear to depend upon the weight of the molecules, but upon their chemical nature, because, as a rule, they melt at temperatures which lie close together in spite of great differences in their molecular weights.

On page 101:

The melting-points and solubility in water can not depend largely upon the magnitude of the molecular weight, but must depend upon the chemical forces.

On page 111:

Consequently we infer that the volatility of compounds is determined almost entirely by the intensity of the forces which bind together the atoms in the molecule.

On page 219:

If this be so, a non-metal is nothing more or less than a substance viewed at a temperature too low for it to assume metallic properties; and conversely, a metal is a substance viewed at a temperature too high for it to assume non-metallic properties.

So that the metallic and non-metallic conditions are simply phases, which all kinds of matter pass through as the temperature increases from zero upwards.

His explanation of osmotic pressure and solubility given in Chapter III. is worthy of note.

There are numerous misprints in the book.

We would end finally by a quotation from the preface and would give warning that the author's speculations are not confined to the preface and the appendices:

> In appendix C is discussed from this point of view the habit of alcohol drinking, and it is suggested that it may be the beginning of an organic tendency that will ultimately lead to the elimination of water in living matter, and its replacement by the more mobile alcohol, in order that as the temperature of the earth and sun falls the aqueous fluid in living matter may be replaced by alcoholic fluids which will remain liquid under conditions which convert water into a solid state.
>
> It is indeed a very curious fact, which has never been adequately explained, that men seem almost instinctively to avoid the use of pure water as a beverage. They drink either tea, beer or alcoholic liquids, but only water when they are either very thirsty or when other liquids can not be obtained. There must be some scientific cause underlying this tendency, and I think that appendix C opens out a very curious possibility as to what this tendency may ultimately lead to.

J. E. Mills

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Experimental Zoology, Vol. IV., No. 2 (June, 1907), contains the following papers: "The Influences of External Factors, Chemical and Physical, on the Development of *Fundulus heteroclitus*," by Chas. R. Stockard. The eggs of *Fundulus* were found to produce definite types of embryos when treated with various salt solutions. The most striking type being the one-eyed monsters resulting from the use of sea-water solutions of $MgCl_2$. Osmotic pressures resulting from the use of sugar solution affected the eggs much more violently when they were being developed in fresh water than in sea-water. The effects of a weak salt solution are augmented by the addition of sugar to the solution. The embryos develop in a perfectly normal manner entirely out of water if kept in a moist amosphere, though they are unable to hatch unless put into water; then they very promptly break through the egg membrane and swim away. "Movement and Problem Solving in *Ophiura brevispina*," by O. C. Glaser. "*O. brevispina* moves in practically all of the ways possible for a pentaradiate animal; exhibits no sign of improvement from practise in the performance of the righting reaction or of freeing its arms of encumbrances. The behavior, in spite of its complexity, can not be considered a sign of intelligence." "Occurreuce of a Sport in *Melasoma (Lina) scripta* and its Behavior in Heredity," by Isabel McCracken. "In this paper the author records the results of a breeding experiment carried through a series of seven generations, under controlled conditions of a dichromatic species of beetle in which a "sport" is of occasional occurrence. The results show that the sport, although inherently stable, as evidenced by its breeding true through selection, is entirely dominated by each of the dichromatic extremes of the species in a first cross, and is gradually eliminated from the lineage of each of these in successive crosses. "The Energy of Segmentation," by E. G. Spaulding. The paper presents the application, by means of experimental methods, and not simply as a postulate, as has heretofore been the case, of the first and second laws of thermodynamics in their generalized form to the event of segmentation. These methods were "compensation" methods; cleavage, in sea-urchin eggs, was inhibited by means of osmotic pressure, and from the values thus obtained and with volumes and surfaces known the energy-change was computed. The conclusion is reached, that, with these laws valid for the organic as well as the inorganic realm, these two realms fall as species within the same "natural classification" in which the principles stated by the two laws form the highest genus. "Experiments in Transplanting Limbs and their Bearing upon the

Problems of the Development of Nerves," by Ross Granville Harrison. When the rudiment of the limb of a tadpole is transplanted it acquires after a time nerves which are connected with the nerves of the region of implantation. The nerves have the same arrangement and distribution as those of the limb in its natural position. This is the case even in limbs taken from individuals which have undergone their development after having been deprived of their nervous system and also in the accessory limbs which sometimes bud out from the transplanted appendages. The nerves in question are not preformed in the transplanted limb but they actually grow into it, their mode of distribution being determined by the structures within the latter. The development of an embryonic nerve ceases and degeneration sets in as soon as the connection with its ganglion is severed.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 193d meeting of the society was held on May 8, 1907, Vice-president Campbell in the chair and sixty-two members present. Under the head of informal communications Mr. F. E. Wright exhibited artificial crystals of silver, copper and diopside produced under various conditions in the Geophysical Laboratory of the Carnegie Institution of Washington and discussed briefly the bearing of the different modes of formation on the general theory of the precipitation of native copper and silver ores. Mr. Lawrence La Forge exhibited a new orthorhombic pyroxene found in a slag at Bingham, Utah. Although this mineral was found by Mr. Wirt Tassin, of the National Museum, to have the chemical composition of a normal calcium iron pyroxene, crystallographically it was found by Mr. La Forge to be orthorhombic but with the same prism angle within the limits of error as ordinary monoclinic pyroxene. Six different crystal forms in all were observed, the prevailing habit being that of an elongated square prism, termination either by the base or by an oscillatory combination of the base and a bracydome. An attempt was made to determine the optical constants but was unsuccessful because of the dark color of the mineral and shattered condition of even very small crystals. Two sections, however, were ground thin enough to determine the extinction, which was found to be parallel and the orthorhombic character thus confirmed.

Regular Program

The New Map of the Yosemite Valley: F. E. Matthes.

This topographic sheet of the U. S. Geological Survey, about to be published, affords a particularly instructive example of modern detail mapping, in that it suggests possible criteria for the guidance of the topographer in the construction of maps which shall embody a scientific interpretation of the relief.

The value of a map as a means of representing land forms depends upon two factors: selection of scale and contour interval, and ability on the part of the map maker to express topographic character. The latter prerequisite will not be considered in this discussion. Thus far the factors which have been determinative in the selection of proper scale and contour interval have, as a rule, been: purpose for which the map is made; degree of cultural development of region mapped; cost per square unit; funds available, etc. Definite physiographic criteria have not yet been considered in this connection although the present state of physiographic knowledge is such that the attempt to apply physiographic principles to the mapping of land forms seems opportune and justified. Most topographic maps give little more than an imperfect, incomplete picture of the relief. Others again are overburdened with unnecessary, irrelevant details. Some actually amount to misrepresentations, even though they be the product of sincere and painstaking effort. The topographer is to-day and always has been more or less uncertain as to the matter of detail. Both in the selection of scale and contour interval, and in the actual field sketching he is at a loss to decide which of the smaller topographic units he must show, and which he must leave out. He needs, in short, criteria to guide him where to draw the line.

The new Yosemite map presents a rather complex problem. Instead of analyzing it and developing the criteria from it, it will be preferable for us to begin by stating the criteria first and then to apply them to the particular case of the Yosemite map.

A topographic map of any kind, because of its small scale, can not undertake to depict the configuration of the land surface complete in all its details. It is essentially in the nature of an abstract, a graphic epitome of the relief. Like any literary abstract, it may be quite brief and confine itself merely to the leading facts; it may be more extended and enter into more or less detail. But whatever its degree of elaborateness, the abridgment of subordinate detail should be evenly maintained throughout, and, above all, its treatment should be *complete so far as it goes.*

The main principle then is that a map must tell a story complete in itself. Its scale and contour interval should be so selected as to admit of the full delineation of every feature essential to the story. No irrelevant subordinate detail should be included if possible.

Some concrete examples may be helpful in illustration.

Let it be required to portray a mountain range in its entirety, with nothing further than its leading characteristics; say a long and narrow block range uplifted along one side, much dissected and enveloped at its base in a broad cloak of waste. These facts may successfully be epitomized by a map on a scale of 1:250,000 with 100 or 200 foot intervals, according to the relief. A smaller scale might leave some of the facts in doubt; a larger scale would introduce superfluous detail.

Again, let it be required to represent the general character of the sculpture of the range. Suppose the range to have been partially glaciated. The new map must be on such a scale as to allow of the distinction between the principal forms of glaciation and those of subaerial erosion. It should be large enough then to admit of the clear delineation of such forms as cirques, arretes, cols, U-canyons, etc., on the one hand, and the characteristic forms of stream and weather erosion on the other. These conditions may be satisfied by a scale of 1:100,000 and 100 or 50 foot intervals. It should be noted that this involves a grouping of the land forms into categories of a new sort. Each group constitutes the record of a certain event in the history of the relief of the range. Together the forms of such a group furnish an index of that event, and collectively they may be conveniently referred to as index forms. The index forms of one event are not necessarily all the product of one and the same process, in fact they seldom are. The index forms of alpine glaciation, for instance, include forms of degradation and of aggradation, and so necessarily do those of subaerial erosion.

If a map then is to tell a complete story, it must aim to show all the essential index forms of one certain event. If it falls short of this it tells the story incompletely; if its scale is such as to admit of subordinate features, the story is unnecessarily encumbered, and the additional cost of mapping is virtually wasted.

Finally, let it be required to make a map of a small portion of the range in question, in order to bring out the local happenings by which a certain feature is differentiated from others of a similar kind. For instance, in the glaciated portion of the range, a certain cirque or canyon may be found possessing decidedly aberrant characteristics. These, being due to local influences, require for their study a map showing the particular index forms in which the incidents due to these local influences may be read. Such a map is the new detail map of the Yosemite Valley (scale 1: 24,000). It aims to represent a glaciated canyon of exceptional form with sufficient detail to shed light on the cause of its aberrant character. Comparison with the standard Yosemite Quadrangle, published several years ago, is interesting in this connection. That sheet, drawn to a scale of 1:125,000, successfully expresses the general character of the sculpturing of the Sierra Nevada. It shows distinctly the glacial sculpture, on the one hand, and the non-glacial, on the other. It shows the Yosemite Valley together with a host of other glaciated canyons and valleys; but besides giving us an inkling of its unusual nature, tells us nothing except that it has glacial characteristics. The new detail map, on the other hand, depicts the Yosemite Valley, not merely as a glaciated canyon, but as a glaciated canyon in a region of unusual rock structure. It is a map giving index forms of differential erosion and cliff recession, and brings out the fact that the aberrant character of the Yosemite topography is intimately linked with the structural vagaries peculiar to the rocks of the Yosemite region.

Geology of the Canal Zone: Ernest Howe.

Passing from the Atlantic to the Pacific, the line of the Panama Canal traverses three well-defined topographic divisions. The first is that of the lower valley of the Chagres and includes the swampy lowlands that extend from Limon Bay nearly to Bohio. This division ends at San Pablo, about six miles below the point where the Rio Obispo enters the Chagres. The second division is that of the summit region and extends from San Pablo to Pedro Miguel, while the third lies between Pedro Miguel and La Boca, and like the first is low and swampy. The relation of these divisions to one another is well shown by the map of the proposed lock canal, the two regions of low relief being marked by artificial lakes while the summit region is traversed by the canal cut.

Although difficult to decipher, on account of the deep covering of red clay and vegetation, the geology is itself quite simple. The oldest rocks of the region are andesitic breccias that occur in the central area between Mamei and Empire and again in the higher hills northeast of Panama. Northward sedimentary rocks occur resting on the older igneous mass and gently inclined toward the Caribbean, so that in passing from the interior toward Colon successively younger beds are encountered. They are well stratified and contain abundant fossils of early Tertiary age. Nearly the same conditions prevail on the Pacific side. On both sides are stratified deposits of acid pyroclastics, the most conspicuous being near the city of Panama. Dikes and large cross-cutting masses of augite-andesite or basalt have invaded all of the older sedimentary rocks, and occur in great abundance in the southern and central parts of the zone; they represent the last phase of active vulcanism in the region.

With the exception of beds of heavy conglomerate in the vicinity of Bohio, all of the sedimentary rocks of the Isthmus consist of argillaceous sandstones, greensands or fine sandy shales; limestones, except high up the Chagres River and in the neighborhood of Empire, are unknown. The rocks are well bedded with moderate northerly dips north of the central region, while the sediments south of the Culebra Cut are inclined in the opposite direction. The oldest beds are Eocene, while the youngest, found near Colon, are late Oligocene. The complete section is preserved only on the northern flanks of the isthmus. Excavation for the locks at Gatun will be in argillaceous sandstones of the early Oligocene throughout, and actual tests on the spot have shown that they are capable of withstanding pressures many times greater than those to which they will be subjected by the lock walls. The earth dam that will be thrown across the valley at Gatun will rest in part upon alluvial material filling a deep gorge cut by the Chagres in Pleistocene time. For more than 100 feet below the surface this alluvium consists very largely of fine blue clay and silt and will be entirely impervious to water. Foundations for the locks at Pedro Miguel will be in the sandy shales and sandstones of the Culebra beds of Eocene age, while the material at the lock site at Sosa at the Pacific end of the canal is massive augite-andesite. The dams at La Boca and Sosa will be of earth and will rest upon alluvial clays of the lower Rio Grande valley.

Recent Changes in the Ice Fields of Glacier Bay, Alaska: Charles Will Wright.

Mr. Wright described in some detail the recent remarkable general recession of the glaciers in Glacier Bay, Alaska. A summary of the geologic history of Muir Glacier was also given and the probable causes of its local advance and recession discussed. In this connection Mr. Wright emphasized particularly the choking and congestion at the valley outlets, as at the mouth of Glacier Bay and locally at Muir Glacier, and the consequent cutting off of warm tidal currents from the ice front. Under such conditions the ice front advanced rapidly, until later on partial removal of the barrier or sinking of the land, the tidal currents regained access to the ice fronts and inaugurated the present period of rapid recession.

Fred E. Wright,
Secretary

DISCUSSION AND CORRESPONDENCE

DOUBLE-ENDED DRUMSTICKS

To the Editor of Science: The impression was received by more than one person who visited the St. Louis Exposition, that one of the Filipino tribes gathered there used a double-ended drumstick, grasping it in the middle and beating alternately with the ends. Professor O. T. Mason, to whom I applied for light, has most kindly informed me that double-ended drumsticks are occasionally employed to produce variations in sound, the two ends being differently constructed. May I ask if any of the readers of Science can furnish me with the name of a Filipino or other tribe, who handles a drum-beater as above described? I may add that I am especially desirous of knowing of the existence of any photograph showing such a grasp.

H. Newell Wardle

ARE BULLS EXCITED BY RED?

To the Editor of Science: Is there any real evidence to the effect that bulls are excited by the color red? And how is it with other animals? According to the newspapers, a bull in Sunbury, Pa., charged a window in a millinery store containing an exhibition of red hats and wrecked the store. Is this merely a newspaper myth?

X.

NOMENCLATURE OF THE CHIRONOMIDÆ

To the Editor of Science: In 1899 Kieffer proposed *Ceratolophus* (*Bull. Soc. Ent. France*, p. 69) as a new genus of Chironomidæ (Midges) with '*femoratus* (Fabr.)' as type. In 1906 the same author reserved this name (Genera Insectorum. Chironomidæ) for a group not containing the type; he also placed '*femorata* Meig.' in two genera at the same time, viz.: *Palpomyia* (p. 63) and *Serromyia* (p. 65). Further, *Ceratolophus* was preoccupied in 1873 (Bocourt, Reptiles).

It is evident that the nomenclature of certain genera of the Chironomidæ is confused and it is a pity that many authors seem to think that thorough unraveling of the nomenclature is unnecessary, when monographing or revising.

G. W. Kirkaldy

SPECIAL ARTICLES

SPECIFICATION OF DIAGRAMS IN APPLIED GEOMETRY

By far the greater amount of weariness in reading geometric discussions comes, I think, from the needless labor of searching for and translating the letters describing a figure, into the symbols of the vectors. I have, therefore, been asking myself, whether a few simple rules might not be devised for drawing conventional diagrams, so as to quite eliminate quantities other than those used in the computation. The following plan has assisted me and may be worth remark.

Every vector or arrow is reckoned from a heavy black dot, which I shall call the *but*, to the barb.

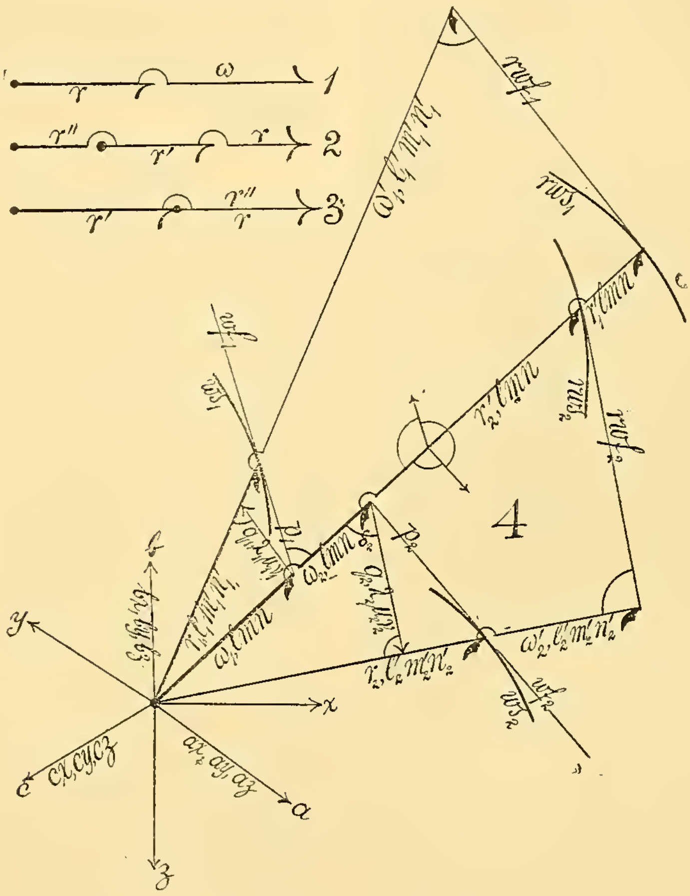
When two vectors from the same origin are collinear, the larger vector should step around the barb of the shorter, in the same way in which electrical engineers represent insulated circuits which cross. Conventionally, therefore, a small semicircle, to be called the step-over, is drawn around the arrow point of the shorter vector, *r*, as in Fig. 1.

The barb is generally to be drawn *on one side* only, as in the harpoon, and the letter or specification of the vector placed near the barb and (when necessary for clearness) on the same side of the shaft with the barb and step-over. Where several vectors coincide the line may be thickened.

Right angles should be indicated by an arc joining the line. Other angles marked.

When two coincident vectors have not the same origin, both the but and barb of one vector must be stepped over, as in Fig. 2. Each letter refers to the whole vector between the next but and the next barb in order, on either side of it. Thus in Fig. 2, r'' and r coincide in r'.

When one collinear vector begins where another ends the case is still definite, if the barb and step-over be on the same side of the specification, as stated. Thus in Fig. 3, $r'' = r + r'$. Complications, however, should be avoided.



As an example of this method, Fig. 4 shows the case of the Fresnellian wave surface with two nappes, together with the reciprocal wave surface also with two nappes. The figure shows the following qualities without ambiguity.

The axes of coordinates, x, y, z.

The axes of elasticity a, b, and c, each with its three directions.

The two wave normals or velocities ω_1 and ω_2 and their direction cosines, l, m, n.

The two wave fronts, wf_1 and wf_2.

The two vectors of the wave surface, or the rays r_1 and r_2, and their direction cosines, l_1', m_1', n_1', and l_2', m_2', n_2'.

The two intersection curves of the wave surfaces ws_1 and ws_2.

The two displacement vectors p_1 and p_2 and their directions, which are the projections of r_1 and r_2 on the respective wave fronts wf_1 and wf_2.

The two force vectors q_1 and q_2, with their direction cosines, λ_1, μ_1, γ_1, and λ_2, μ_2, γ_2.

The two intersection curves rws_1 and rws_2 with the reciprocal wave surface.

The two reciprocal wave fronts rwf_1 and rwf_2.

The two reciprocal wave normals or reciprocal velocities, ω_1', ω_2', and their direction cosines, l_1', m_1', n_1' and l_2', m_2', n_2'.

The two vectors r_1' and r_2' of the reciprocal wave surface and their direction cosines, l, m, n.

All the right angles are indicated and the important angle δ, made by the force vector, is shown in one case.

Clearness is given to the diagram by placing the plane normal to the observer's line of sight. The planes γ_1, ω_1 and ω_2, γ_2 are at right as the auxiliary vectors show.

Naturally the above method is even more pertinent to the modern methods of vector analysis. The diagrams, like the computations, gain in simplicity. And yet it is just here that authors are peculiarly unwilling to fix the ideas of the student to a definite case. Demonstrations in themselves admirably lucid become confused in effect, because the reader is all the while drifting in the haze of the absolute generality of the statement of the premises.

Carl Barus

A PRELIMINARY NOTE ON THE CHROMOSOMES OF ŒNOTHERA LAMARCKIANA AND ONE OF ITS MUTANTS, O. GIGAS

The exceptional opportunities offered at this station for a study of inheritance as manifested in the germ cells of the *Œnotheras* led me to undertake a study of the chromosomes of *Œnothera Lamarckiana*, its mutants and hybrids.

The work was begun after the flowering season had passed, however; therefore only somatic cells from the growing root tips of potted plants in the rosette stage have so far been available for study; and it is the purpose of this note, pending the completion of a more general study of the *Œnotheras*, merely to call attention to a most unexpected contrast found in the number of chromosomes of *O. Lamarckiana* and one of its mutants, *O. gigas*, both pure bred.

Because of the smallness of the chromatic figures and the low percentage of figures studied in which the chromosomes could be counted with certainty, I do not at present feel justified in stating the exact number in either form; but I can state unreservedly what is of more interest, that in all the somatic cells of *O. gigas* arising from *O. Lamarckiana* in which the chromosomes could be counted with precision, *the number has become approximately double that of the parental form, O. Lamarckiana*. This result was unexpected, as a somewhat hasty survey of the tips of

Oenothera Lamarckiana. Oenothera gigas.

several other mutants previous to the study of *gigas* had indicated a number closely approaching or identical with that of the parental form. Gates, in his "Preliminary Note on Pollen Development in *Œnothera lata* de Vries and its Hybrids," published in Science, February 15, 1907, states that in a cross resulting from the pollination of *O. lata* by *O. Lamarckiana*, "the sporophyte count for the *O. Lamarckiana* side of the cross is at least twenty. The conclusion from this is that pure *O. Lamarckiana* itself must have over twenty chromosomes." In his paper on "Pollen Development in Hybrids of *Œnothera lata* × *O. Lamarckiana*, and its Relation to Mutation,"[1] he adds in a foot-note on page 109: "The inference that *O. Lamarckiana* itself has the same number of chromosomes as the dominant *O. Lamarckiana* hybrid is also apparently not borne out by the facts." From my own observations on all

[1] *Botanical Gazette*, February, 1907.

pure-bred *O. Lamarckiana* so far studied I have found no indication of the number ever approaching twenty; but from the evidence of repeated counts it seems to be fourteen or fifteen. I have at least eighteen good clear demonstrations of mitotic figures showing only fourteen chromosomes, all distinctly outlined and clearly defined—with no trace of a chromosome in a preceding or following section; on the other hand, I have encountered a sufficient number of less clearly defined figures, in which there seems to be but thirteen, and in others fifteen chromosomes, to make it necessary to state the number for the present with reserve. Chromosomes frequently lie in such positions as to make it impossible to distinguish between a long-looped form and two so placed as to give a similar appearance; also a looped chromosome may be sectioned at a point to give the two halves the appearance of distinct individuals.

The number of chromosomes characteristic of the somatic cells of *O. gigas* is probably twenty-eight or twenty-nine, although the difficulty in counting is here increased by the large number; however, I have six or seven excellent figures showing twenty-eight sharply-defined chromosomes, and as many more, not so clearly outlined, in which there is a strong indication of twenty-nine. It is hoped that the hundreds of new sections now in process of preparation for study will establish the facts, shortly.

Other points of interest are coming to light, particularly in connection with the hybridization of mutants, and will be mentioned in a later note.

Anne M. Lutz

Station for Experimental Evolution,
Cold Spring Harbor, L. I.,
June 28, 1907

CURRENT NOTES ON LAND FORMS

DIAMOND HEAD AND MOHOKEA

C. H. Hitchcock has recently described a tuff cone and a caldera in the Hawaiian Islands ("Geology of Diamond Head, Oahu," *Bull. G. S. A.*, XVII., 1906, 469–484; "Mohokea Caldera," *ibid.*, 485–496). Diamond Head, on the island of Oahu, is a well-formed tuff cone with a broad and shallow crater, which the author concludes was thrown up explosively from beneath the level of the sea, the volcanic material having been ejected through fossiliferous limestones of Tertiary age. The cone is compared with the Monte Nuovo near Naples. Considerable attention is given the conflicting theory that the cone was built up gradually by the slow accumulation of material ejected at long intervals. The features of the cone are illustrated by several plates.

Mohokea, on the island of Hawaii, is described as a very irregular caldera only partially enclosed, the open side being toward the sea. Two parallel lines of faulted and tilted lava blocks cross the caldera from southeast to northwest, and are believed to be part of the overlying crust which dropped in when the caldera was formed, although the blocks themselves have been in part crowded up until their crests rise higher than the surface without the caldera. Mohokea is compared with the irregular Haleakala caldera, and illustrations of both are given.

D. W. J.

A PENEPLAIN IN EQUATORIAL AFRICA

It is generally accepted among physiographers that a peneplain worn down on crystalline rocks in a humid climate would be heavily cloaked with a deep soil of local weathering; and in favor of this opinion the deeply decayed rocks of the somewhat uplifted and dissected Appalachian Piedmont belt may be instanced. In a subarid climate the case is different.

An excellent account of an extensive peneplain, exposing large areas of bare rock, on the southern border of the French Sahara in latitude 18° to 21° N., northeast of the great bend of the Niger and on the arid outer border of the subequatorial (summer) rains, is given by E. F. Gautier ("A travers le Sahara français," *La Géogr.*, XV., 1907, 1–28). The rocks of the region are for the most part Archean granites and gneisses, broken here and there by less ancient igneous intrusions, and associated with belts of strongly folded and metamorphosed Silurian strata. The Archean area is a smooth platform, a plain of hardly perceptible undulation, its barren surface of bare rock being frightfully desolate; it is interrupted by weathered blocks, often standing in fantastic heaps, and by isolated knobs, which gain an exaggerated appearance of height by reason of the extraordinary flatness of the surrounding plain. The areas of eruptive rocks preserve a greater relief and a more rugged surface; here the trails are at their worst. The Silurian areas possess rounded swells of quartzite between broad shallow depressions; that is, old ridges between old valleys, and thus present a landscape of low, gently modulated forms in contrast with the plain and boulder heaps of the Archean area and with the stronger reliefs of the eruptives. The peneplain as a whole slopes evenly from about 800 m. altitude in the northeast to about 500 m. in the southwest in a distance of 200 kil. It is spoken of as a block, faulted and uplifted in mass. Nevertheless its border on the northeast presents only gentle slopes; there alone are the water courses distinctly enclosed in well-defined valleys beneath the upland surface. Elsewhere the drainage system is highly peculiar, and expresses far-advanced old age, the altitude at which the gently inclined plain now stands being, in the reviewer's opinion, suggestive rather of the inability of the weak, wet-weather, silt-laden streams as yet to have worn their courses closer to normal baselevel, than of elevation in mass after reduction by normal erosion to a lower level. On the Archean area the valleys appear to be so old and the interfluves so completely worn down, that the wadies turn about "sur une pénéplaine rigoureusement horizontale." In the dry season the wadies are not barren stony beds marked by the work of violent floods, like the wadies of the Sahara farther north, but smooth plains of fine alluvium, more or less overgrown with grass and bushes which survive on the ground water stored from the previous wet season.

The alluvium of the wadies is not separated from the bare-rock plains by any distinct border or banks, but the surface of one merges into that of the other; towards the wady border the vegetation thins out and disappears. When the short-lived local rains supply water enough to run from the impermeable rock plains, a wady flows not as a stream, but rather as a sheet of very small depth, great breadth (over a kilometer) and feeble current, soon to be absorbed in the silty alluvium—"une nappe d'épaisseur pelliculaire, très languissament progressive, et bien vite absorbée par l'énorme masse des alluvions." Nowhere else in the world does a single river bear so many names in different parts of its course. A large scale map would show the drainage system of this peculiar region as abnormally, clumsily broadened. Gautier adds pertinent notes on climate, flora, fauna and inhabitants.

W. M. D.

A PREHISTORIC LANDSLIDE IN THE ALPS

Detrital hillocks in various Alpine valleys, formerly interpreted as moraines, have in more recent years been recognized as prehistoric, usually postglacial, landslides. One of the best examples of the kind is that by Kandersteg, south of Lake Thun, first identified as a landslide by Brückner in 1891; and lately described in detail by V. Turnau (Inaug. Dissert., Univ. Bern, 1906). The material came from a huge nitch, still clearly defined, on the northwestern side of the Fissistock, where the strata dip down the slope and outcrop in basset edges on the steepened wall of the glacially overdeepened valley of the Kander. The nitch is about three kilometers long, and nearly one wide; its upper cliffs reach 3,000 m. altitude; its lower edge lies at 1,500 m. The detritus occupies the Kander valley for a length of 8 kil., northward from the point of its oblique entrance, with a width of from a half to one kilometer, the valley floor at the entrance of the slide being 1,200 m., and at its lower end, 800 m. altitude. The highest part of the slide is opposite its source, where the gliding mass was banked up against the opposite valley wall. The thickness of the detritus is seen to vary from 150 to 30 m., but its bottom is not observed. Its form is extremely irregular, and it has greatly obstructed the flow of the valley stream. Its surface is strewn with large blocks of rock. Its volume is estimated at 900,000,000 cu. m. A little farther east, in a branch of the Kander valley, a similar but much smaller slide forms the barrier by which Oeschinen lake is enclosed in a cirque-like valley head.

Turnau quotes estimates of the volumes of other landslides. That of Elm, which happened a score of years ago, is 10,000,000 cu. m.; that of Goldau, a century ago, 15,000,000. Far greater was the prehistoric landslide of Flims in the upper valley of the Rhine, which is estimated at 15,000,000,000 cu. m.; or a thousand times greater than the Goldau slide, and even sixteen times greater than the great slide of the Kander valley.

W. M. D.

PRELIMINARY LIST OF SCIENTIFIC COMMUNICATIONS TO BE PRESENTED AT THE SEVENTH INTERNATIONAL ZOOLOGICAL CONGRESS, BOSTON, AUGUST 19 TO 23, 1907

In response to the invitations of the General Committee and of the various secretaries of the organization a generous number of acceptances to address the congress or to read papers before its sections have been received. The communications thus submitted fall under three heads: addresses, for which the speakers have been invited; voluntary communications to be given before sections; and demonstrations. The number and quality of these contributions presage an unusually successful meeting.

The following speakers have consented to deliver addresses either before the general meetings or the sectional meetings: Professor W. Bateson, Cambridge, England; Professor C. Depéret, Lyons, France; Dr. H. Driesch, Heidelberg, Germany; Dr. T. N. Gill, Washington, D. C.; Professor Richard Hertwig, Munich, Germany; Dr. G. Horváth, Budapest, Hungary; Dr. L. O. Howard, Washington, D. C.; Professor A. A. W. Hubrecht, Utrecht, Holland; Professor J. Loeb, Berkeley, Cal.; Professor C. E. McClung, Lawrence, Kan.; Professor J. P. McMurrich, Ann Arbor, Mich.; Sir John Murray, Edinburgh, Scotland; Dr. R. F. Scharff, Dublin, Ireland; and Professor C. O. Whitman, Chicago, Ill.

For the presentation and discussion of scientific communications fifteen sections have been tentatively named and the organization of each section has been put into the hands of a secretary to whom requests concerning that section should be addressed. The names of the sections and the persons having charge of them are as follows: General Zoology, F. R. Lillie, Chicago, Ill.; Systematic Zoology, D. S. Jordan, Stanford University, Cal.; Entomology, L. O. Howard, Washington, D. C.; Ornithology, Witmer Stone, Philadelphia, Pa.; Palæozoology, H. F. Osborn, New York, N. Y.; Comparative Anatomy, C. S. Minot, Boston, Mass., and J. S. Kingsley, Tufts College, Mass.; Embryology, E. G. Conklin, Philadelphia, Pa.; Cytology, E. B. Wilson, New York, N. Y.; Zoogeography, L. Stejneger, Washington, D. C.; Thalassography, W. E. Ritter, Berkeley, Cal.; Applied Zoology, C. W. Stiles, Washington, D. C.; Comparative Physiology, W. B. Cannon, Boston, Mass.; Experimental Zoology, T. H. Morgan, New York, N. Y.; Heredity, C. B. Davenport, Cold Spring Harbor, N. Y., and Animal Behavior, H. S. Jennings, Baltimore, Md.

The following preliminary list of communications is announced for the sectional meetings:

T. B. Aldrich: Title not yet received.

R. J. Anderson: "Notes on the Movements in Some Animals, with especial reference to their Susceptibility to Training," "A Short Review of the Mammalian Mandible," "Illustrations Suggestive of the Mode of Formation of the Cetacean Flipper."

S. von Apáthy: "New Method of Making Serial Celloidin Sections," "An Unintentional Experiment on Living Nuclei and the Real Structure of the Cell Nucleus," "New Facts and Critical Notes about Neurofibrillæ," "The Presence of Krause's Membrane as a General Feature of Striated Muscles."

S. Awerinzew: "Ueber die Myxosporidien von *Drepanopsetta platessoides*," "Die Marine Biologische Station an der Murman-Küste."

C. R. Bardeen: Title not yet received.

P. Bartsch: "A Study in Distribution based on the Family Pyramidellidæ of the West Coast of America."

W. Bateson: Title not yet received.

C. W. Beebe: "Geographic Variation in Birds, with special reference to Humidity."

R. R. Bensley: "An Analysis of the Salivary Glands of Mammals based on Cellular Characters."

E. A. Birge: Title not yet received.

R. Blanchard: Title not yet received.

Mary Blount: "On the Cleavage and Formation of the Periblast and the Germ Wall in Pigeons."

Kristine Bonnevie: Title not yet received.

G. M. Bowers: "Work of the *Albatross*."

K. Brandt: Title not yet received.

W. S. Bruce: "Life of the Sea in the Antarctic Regions."

H. L. Bruner: "Cephalic Brains of Reptiles."

E. Bugnion: "Fasceux spermatiques doubles (bipolaires) des Ténétrions et des Milabres de Ceylon et d'Egypte."

G. N. Calkins: "Origin and Division of the Maturation Chromosomes in *Paramœcium*."

R. E. Call: "Revision of the North American Unionidæ."

W. B. Cannon: "The Acid Control of the Pylorus."

W. B. Cannon and H. H. Smith: "Some Observations on the Action of the Cardia with reference to a Probable General Law of Motor Activity in the Alimentary Canal."

A. J. Carlson: "On Salivary Secretions."

W. E. Castle: "Reversion and the Fixation of Characters," "The Mendelian Inheritance of Sex."

Frank M. Chapman: "Remarks on the Geographical Origin of North American Birds." (With slides.)

C. M. Child: "Amitosis and Mitosis in Normal and Regular Growth."

T. D. A. Cockerell: "The Miocene Fauna of Florissant, Colorado."

W. R. Coe: Title not yet received.

L. W. Cole: "Behavior of Raccoons under Experimental Conditions."

C. Correns: Title not yet received.

E. R. Corson: "Fusion of Cuneiform and Semilunar Bones."

R. P. Cowles: Title not yet received.

W. C. Curtis: Title not yet received.

W. H. Dall: "Deep-water Distribution of the Molluskan Fauna of the Northwest Coast."

W. Dantchakoff: "Ueber die Entwicklung der Blutelemente beim Huehnerembryo."

A. D. Darbishire: "Mendelian and Sexual Inheritance."

H. B. Davis: "The Behavior of Raccoons."

A. Davison: "Modifications of Structure in a Dog born with Three Legs."

J. Dawson: "The Behavior of Physa."

B. Dean: "'Precocious Segregation' as shown in Series of Vertebrate Embryos and its Significance in Mosaic Development."

K. Derjugin: "Murmansche Biologische Station der K. Naturforscher Gesellschaft St. Petersburg und ihre Untersuchungen im nordischen Eismeere."

H. H. Donaldson: "The Nervous System of *Rana virescens* compared with that of *Rana temporaria* and *R. esculenta*."

Hans Driesch: "The Stimuli of Restitutions."

J. E. Duerden: "The Influence of Domestication on the Behavior of the Ostrich."

H. G. Dyar: "The Distribution of Mosquitoes in North America."

C. L. Edwards: "Variations in the Holothurioidea."

C. H. Eigenmann: "The Ecology of the Cuban Blind Fishes," "Origin and Distribution of South American Fresh-water Fishes."

B. W. Evermann: "The Origin of the Golden Trout of the Southern High Sierra."

E. Fawcett: "The Development and Ossification of Certain Bones in the Human Body."

P. A. Fish: "The Exchange of Air in the Guttural Pouches of the Horse."

O. Folin: "On Protein Metabolism in Fasting."

S. A. Forbes: "A Statistical Study of the Local Distribution and Ecology of Birds."

A. Froriep: "Ueber die Cranio-vertebralgrenze bei den Amphibien, im Vergleich zu Selachier und Amnioten."

S. H. Gage: "Glycogen in the Embryos of *Petromyzon, Amblystoma* and *Gallus*," "Glycogen in the Embryo."

S. P. Gage: "A Four-weeks Human Embryo," "Method of Making Models of Blotting-paper instead of Wax," "Brain of a Six-weeks Human Embryo."

A. Gaudry: Title not yet received.

T. N. Gill: "The Incongruity of Inland and Marine Fauna."

O. C. Glaser: "A Rapid Method of Demonstrating Habit Formation."

J. Goldberger: Title not yet received.

L. von Graff: "Zur Anatomie der nordamerikanischen Turbellarien," "Vergleichung der nordamerikanischen und europaischen Turbellanienfauna."

C. Grave: Title not yet received.

C. C. Guthrie: "Further Results of Transplantation of Ovaries in Chickens."

M. F. Guyer: "Deficiencies of the Chromosome Theory of Heredity," "Results of Injecting Blood and Lymph into Unfertilized Frog Eggs."

P. B. Hadley: "The Behavior of Young Stages of the Lobster."

G. V. Hamilton: "An Experimental Study of an Unusual Type of Reaction in a Dog."

C. W. Hargitt: "The Behavior of Tubicolous Animals," "The Organization and Early Development of Cœlenterate Eggs."

M. Hartog: "Rheotaxy of Copepods and Rotifers."

Y. Henderson: "A Graphic Expression of the Principles Underlying the Normal Variations in the Behavior of the Mammalian Heart."

H. W. Henshaw: "The Zoogeographic Work of the Biological Survey."

W. A. Herdman: Title not yet received.

W. B. Herms: "The Reactions of Sarcophagid Fly Larvæ to Light."

A. L. Herrera: "The Comparative Behavior of Insects and of Winged Seeds," "Plasmogeny, a New Experimental Science."

F. H. Herrick: "Organization of the Gull Community: a Study of the Communal Life of Birds."

M. Herzog: "On the Earliest Stage of Placentation and on the Earliest Development of the Embryo in Man."

L. T. Hobhouse: "The Importance of Animal Psychology for the Theory of Evolution."

G. Horváth: "Relations entre les faunes hémiptérologiques de l'Europe et de l'Amérique du Nord."

L. O. Howard: Title not yet received.

W. E. Hoyle: "The Cephalopoda of the *Albatross* Expedition, 1904–5."

G. S. Huntington and C. F. W. McClure: "The Early Stages in the Development of the Mammalian Lymphatic System and their Correlation to the Embryonic Venous Channels," "Anatomy and Development of the Lymph-sac and Thoracic Duct in the Domestic Cat."

C. C. Hurst: "Unit Characters in Animals and Plants."

H. S. Jennings: Title not yet received.

R. H. Johnson: "Heredity of Color Pattern in Coccinellid Beetles."

J. B. Johnston: "The Phylogenetic History of the Somatic Sensory Column of the Vertebrate Brain."

W. E. Kellicott: "The Degree of Correlation as a Selective Basis."

V. L. Kellogg: "Heredity in Silkworms."

J. S. Kingsley: "A Neglected Point in the Quadrate Problem."

P. Kyes: "The Lecithin Content of the Red-blood Corpuscles and its Relation to the Stroma."

A. Lang: "Hybrids of *H. nemoralis* and *H. hortensis.*"

F. S. Lee: "The Nature and Cause of Muscle Fatigue."

F. T. Lewis: Title not yet received.

E. Linton: "Notes on the Distribution of Entozoa of North American Marine Fishes."

W. A. Locy: "The Fifth and Sixth Aortic Arches in Birds and Mammals," "Injected and Dissected Chick Embryos showing Fifth and Sixth Aortic Arches," "The Nervus Terminalis in Selachians."

A. M. Lutz: "A Study of the Chromosomes of *Œnothera Lamarckiana:* its Mutants and Hybrids."

F. E. Lutz: "Inheritance of Abnormal Wing Venation in *Drosophila.*"

M. W. Lyon, Jr.: "The Distribution of Bats in the Zoogeographical Regions."

O. Maas: "Kaltenziehung und Hunger bei Spongien."

J. P. McMurrich: "Intermembral Homologies."

C. L. Marlatt: Title not yet received.

S. O. Mast: "Light Reaction in *Volvox.*"

W. D. Matthew: Title not yet received.

A. G. Mayer: "The Annual Swarming of the Atlantic Palolo," "A System of the Hydromedusæ," "Vantage Grounds for the Study of the Marine Life of the West Indian Region," "Factors Controlling Rhythmical Pulsation."

A. Maximow: "Ueber die Entwicklung der Blutelemente beim Saeugetierembryo."

W. J. Meek: "On the Selective Action of Certain Drugs."

S. Metalnikoff: "Sur l'immunité de la Galleria mellonella vis à vis des cacilles tuberculeux."

A. Meyer: "The Homologies of the Mesial Wall of the Cerebral Hemisphere of Vertebrates."

C. S. Minot: "Changes in the Nuclei of Vertebrates in Relation to Age."

T. H. Montgomery, Jr.: "Fertility of Egg of *Theridium,*" "The Maturation and Fertilization of the Spider's Egg."

A. Mrázek: Title not yet received.

J. P. Munson: "The Anatomy of *Ophioglypha Sarsii,*" "Observations on the Generation and Degeneration of Sex-cells."

H. F. Nachtrieb: "Lateral Line System of *Polyodon spathula.*"

H. V. Neal: "The Development of the Ventral Cranial Nerves in *Squalus.*"

H. W. Norris: "The Cranial Nerve Components of *Amphiuma*."

J. P. Nuel: "The Reactions of Flatworms to Light."

C. C. Nutting: "The Color of Deep-sea Animals Considered in Connection with Phosphorescence."

A. E. Ortmann: "The Necessity of Survey Work in Zoographical Research," "The Double Origin of Marine Polar Faunas," "Variations and Changes of Environment."

H. F. Osborn: Title not yet received.

W. Patten: "On the Origin of Vertebrates."

S. Pater: "Some of the Earliest Reactions of the Vertebrate Embryo and their Relations to the Nervous System."

J. T. Patterson: "On Gastrulation in Birds."

P. Pelseneer: "Bipolar Theory," "Considérations sur la genèse du névraxe, spécialement sur celle observée chez le Pélobate brun."

A. W. Peters: "The Action of Pure Water on Living Cells," "The Function of the Inorganic Salts of the Protozoan Cell and its Medium."

A. Petrunkevitch: "The Sense of Sight in Spiders."

J. P. Porter: "The Behavior of Birds."

H. Przibram: Title not yet received.

F. H. Pratt: "Vasomotor Reflexes to Isolated Vascular Areas."

H. E. Radasch: "Unilateral Absence of Genito-Urinary System and its Relation to the Development of Wolffian and Muellerian Ducts."

B. H. Ransom: Title not yet received.

A. M. Reese: "Embryology of the Florida Alligator."

W. E. Ritter: "A Point of View with Reference to the Problem of Organic Evolution," "The Problem of Adaptation to Conditions of Life at Great Depths, as exemplified by Simple Ascidians."

L. Rhumbler: "Zellenmechanik und Vererbung."

L. Roule: "L'Origine de la notochorde et du neuraxe chez les larves urodeles des Tuniciers."

C. F. Rousselet: "Improvements in the Method of Preservation of Rotatoria."

W. Roux: Title not yet received.

R. F. Scharff: "On the Evolution of Continents as illustrated by the Geographical Distribution of Existing Animals."

V. E. Shelford: "Behavior of the Tiger Beetles: Its Bearing on Variation and Distribution."

A. E. Shipley: Title not yet received.

C. H. Shull: "Results of Hybridizing *Bursa pastoris* and *Bursa heegeri*."

W. J. Sinclair: "The Santa Cruz Typotheria."

H. M. Smith: Title not yet received.

J. B. Smith: "Ridding a State of Mosquitoes."

A. Steuer: "Seasickness."

N. M. Stevens: "Various Types of Heterochromosomes in the Coleoptera," "The Chromosomes in *Drosophila ampelophila*."

C. W. Stiles: Title not yet received.

F. B. Sumner: "The Effects upon Fishes of Changes in the Chemical or Physical Properties of their Surrounding Medium."

O. P. Terry and E. P. Lyon: "Further Observations on Ferment Activity in Unfertilized and Fertilized Eggs."

J. A. Thomson: "A New Type of Alcyonarian," "As Regards Germinal Selection."

E. L. Thorndike: Title not yet received.

W. L. Tower: "Experimental Evidence Concerning the Existence of 'Unit Characters' and the Relation of this Evidence to the Theory of Mutation," "Experimental Production of Progressive Evolution without Saltation," "Continuity *vs.* Discontinuity in Animal Evolution."

C. H. Turner: "Do Ants form 'Practical Judgments'?"

J. W. van Wijhe: "The Chondrocranium in Birds."

T. W. Vaughan: "Results of a Study of Recent Madreporaria of the Hawaiian Islands and Laysan."

F. Vejdovsky: "Giebt es eine Reduktionsteilung?" "Ueber den Ursprung der Lymphocyten."

H. B. Ward: Title not yet received.

J. Warren: "Epiphysial Region in Reptilia and *Necturus*," "The Paraphysis and Pineal Region in *Lacerta*," "The Paraphysis and Pineal Region in *Chrysemys marginata*."

A. S. Warthin: "Regional Hæmolymph Nodes, a Comparative Study."

E. Wasmann: Title not yet received.

W. M. Wheeler: "Social Insects and the Inheritance of Somatogenic Characters," "The Origin of Slavery among Ants."

B. G. Wilder: "Certain Simplified Terms, with Reasons for their Adoption."

A. Willey: "Lecithality, Oviposition and Viviparity."

E. B. Wilson: "Illustrations of the Morphological and Physiological Individuality of the Chromosomes in the Hemiptera."

N. Yatsu: "An Experimental Study on the Cleavage of the Ctenophore Egg."

R. M. Yerkes: "Behavior of the Dancing Mouse."

E. Yung: "Le sens de l'humide chez les Mollusques," "Structure des tentacules chez *Helix*."

C. Zeleny: Title not yet received.

Notices have also been received that the following demonstrations will be made:

S. von Apáthy: "Certain Instruments for Microtechnique," "Microscopic Preparations."

C. W. Beebe: "Bird Skins."

W. Dantchakoff: "Microscopic Preparations."

G. A. Drew: "Illustrations of a Method to make Series of Anatomical Drawings."

J. H. Emerton: "Demonstration Collection of Spiders."

W. Junk: "Zoological Books."

F. E. Lutz: "Abnormal Wings of *Drosophila*."

O. Maas: "Microscopic Preparations."

A. Maximow: "Microscopic Preparations."

S. Metalnikoff: "Preparations of Blood and of Bacillus tuberculosis."

A. Petrunkevitch: "Images in the Spider's Eyes."

C. F. Rousselet: "Mounted Slides of Rotifera."

J. A. Thomson: "Peculiar Alcyonarians."

Members are reminded that notices of communications, demonstrations, etc., should now be in the hands of the General Committee of the Seventh International Zoological Congress, Cambridge, Mass.

For the Executive Committee,
G. H. Parker, *Chairman*

RADIUM EMANATION[1]

In 1903, it was shown by Mr. Soddy and myself that the spontaneous change of the emanation from radium results in the formation of helium; this observation has been confirmed by Indrikson, by Debierne, by Giesel, by Curie and Dewar, and by Himstedt and G. Meyer. Debierne has shown that actinium chloride and fluoride also develop helium. I have also once detected helium in the gases evolved continuously from a solution of thorium nitrate, and hope soon to confirm this observation.

When the emanation is in contact with, and dissolved in water, the inert gas which is produced by its change consists mainly of neon; only a trace of helium could be detected.

When a saturated solution of copper sulphate is substituted for water, no helium is produced; the main product is argon, possibly containing a trace of neon, for some of the stronger of its lines appeared to be present. The residue, after removal of the copper from this solution, showed the spectra of sodium and of calcium; the red lithium line was also observed, but was very faint. This last observation has been made four times, in two cases with copper sulphate, and in two with copper nitrate; all possible precautions were taken; and similar residues from lead nitrate and from water gave no indication of the presence of lithium; nor was lithium detected in a solution of copper nitrate, similarly treated in every respect except in its not having been in contact with emanation.

These remarkable results appear to indicate the following line of thought: From its inactivity it is probable that radium emanation belongs to the helium series of elements. During its spontaneous change, it parts with a relatively enormous amount of energy. The direction in which that energy is expended may be modified by circumstances. If the emanation is alone, or in contact with hydrogen and oxygen gases, a portion is "decomposed" or "disintegrated" by the energy given off by the rest. The gaseous substauce produced is in this case helium. If, however, the distribution of the energy is modified by the presence of water, that portion of the emanation which is "decomposed" yields neon; if in presence of copper sulphate, argon. Similarly the copper, acted upon by the emanation, is "degraded" to the first member of its group, namely, lithium; it is impossible to prove that sodium or potassium are formed, seeing that they are constituents of the glass vessel in which the solution is contained; but from analogy with the "decomposition-products" of the emanation, they may also be products of the "degradation" of copper.

A full account of this research will shortly be communicated to the Chemical Society.

William Ramsay.

July 11.

[1] From *Nature*, July 18. This letter is apparently the basis of the alleged interview with Sir William Ramsay, cabled to a prominent New York newspaper on July 28 and widely quoted.

SCIENTIFIC NOTES AND NEWS

Sir Henry Roscoe has been elected a foreign member of the Accademia dei Lincei in Rome.

In connection with the celebration of the centenary of the Geological Society, London, Oxford University will, on September 30, confer the degree of doctor of science on Professor Charles Barrois, Lille; Professor A. Heim, Zürich; Professor A. Lacroix, Paris; Professor A. Penck, Berlin; Dr. Hans H. Reusch, Norway; Professor F. Zirkel, Leipzig.

The University of Liverpool has conferred its doctorate of science on Professor A. R. Forsyth, of Cambridge; Professor Francis Gotch and Professor Osler, of Oxford; Sir Oliver Lodge; Sir John Murray, the naturalist; Professor Wilhelm Ostwald, of Leipzig; Professor Sir William Ramsay; and Sir H. E. Roscoe; also Dr. C. L. A. Laveran, of the Pasteur Institute (*in absentia*). The degree of doctor of engineering has been conferred on Sir A. B. W. Kennedy.

Professor Anders Donner, director of the Royal Astronomical Observatory, Helsingfors, Finland, has been elected an Associate of the Royal Astronomical Society.

On the occasion of the last lecture of Professor G. Lunge, whose retirement from the chair of technical chemistry at the Zürich Polytechnic we have noticed, addresses from the teaching staff and from the students were presented by Professor Treadwell.

Professor W. J. van Bebber has retired from his position as departmental head in the Deutsche Seewarte at Hamburg.

The Mississippi Valley Laboratory of the United States Department of Agriculture has been abolished, and the work in forest pathology will from this time be carried on at Washington, D. C. The Laboratory of Forest Pathology, as now organized, is under the charge of Dr. Haven Metcalf. With him are associated Drs. George G. Hedgcock and Perley Spaulding, who were formerly at the Mississippi Valley Laboratory.

The Alvarenga prize of the College of Physicians of Philadelphia, for 1907, has been awarded to William Louis Chapman, M.D., Providence, R. I., for investigations on "Post-operative Phlebitis, Thrombosis and Embolism."

The Mackinnon studentship of the Royal Society in physical science has been awarded for a second year to Mr. W. Geoffrey Duffield, for a research on the influence of pressure on spectra, being conducted at the University of Manchester; and the studentship in biology to Dr. H. M. Woodcock, to aid him in working out the life history of certain hematozoa of birds, an investigation which will be carried on at the Lister Institute of Preventive Medicine. The income of the Gunning fund accrued during the past three years has been placed at the disposal of Dr. F. H. Scott for the continuation of his investigations into the metabolic processes in nerve cells.

Dr. Reid Hunt, of the U. S. Public Health and Marine Hospital Service, will take part in a discussion on the physiological and therapeutic uses of alcohol before the section of physiology of the British Association, now meeting in Leicester.

The British Medical Association is holding its seventy-fifth annual meeting this week at Exeter, under the presidency of Dr. Henry Davy. The address in medicine will be delivered by Dr. William Hale White, the address in surgery by Dr. Henry Trentham Butlin and a popular lecture by Sir John William Moore.

The tercentenary of the death of Ulisse Aldrovandi, the celebrated naturalist, was celebrated at Bologna, from June 11 to 13, in the presence of numerous delegates from foreign countries. A memorial tablet was unveiled, while a medal and several volumes compiled for the occasion were presented to the delegates.

Professor Angelo Heilprin, the eminent naturalist and explorer, died on July 17. He was born in Hungary in 1853 and was brought to this country when he was three years old. Professor Heilprin has been since 1881 professor of palcontology and geology in the Philadelphia Academy of Natural Sciences and had recently been appointed lecturer on physical geography at Yale University.

Dr. August Dupré, F.R.S., chemical adviser to the explosive department of the Home Office of the British government, and the author of papers on chemical and other scientific subjects, died on July 16. He was born in Maintz in 1835, and went to London in 1855.

Admiral John Maclear, of the British navy, commander of the *Challenger* on its scientific voyage from 1872–6 and captain of the *Alert,* and the *Flying Fish,* with which much important hydrographic work was done, died at Niagara Falls on July 17, at the age of sixty-nine years. He was the son of Sir T. Maclear, formerly astronomer royal at the Cape of Good Hope. His wife was a daughter of Sir John Herschel.

Professor Heinrich Kreutz, associate professor of astronomy at Kiel and editor of the *Astronomische Nachrichten,* died on July 16.

Professor J. J. Grancher, an eminent French physician, known especially for his efforts to combat tuberculosis, has died at the age of sixty-four years.

M. André Prosper Paul Crova, professor of physics at Montpellier and known for his researches on radiation and other subjects, has died at the age of seventy-four years.

The French government has recommended a grant of $60,000 for a French expedition to the antarctic regions.

By the will of the late Mr. Mark Stirrup Manchester University has received specimens of volcanic rocks and fossils; £1,000 for the maintenance of a geological and paleontological collection and £1,500 for the foundation of a paleontological scholarship.

A telegram has been received at Harvard College Observatory from Professor Percival Lowell, director of the Lowell Observatory, stating "Martian double canal Gihon photographed double by Lampland and also by me."

Nature states that a small exhibition of scientific apparatus, mostly for chemistry and physics, is being arranged by Mr. R. E. Thwaites, of Wyggeston Grammar School, in connection with the meeting of the British Association, which opened this week at Leicester.

UNIVERSITY AND EDUCATIONAL NEWS

Dr. Geo. L. Streeter, associate professor of neurology at the Wistar Institute of Anatomy, Philadelphia, has been elected professor of anatomy at the University of Michigan.

Dr. J. Heath Bawden, of Vassar College, has accepted the professorship of philosophy at the University of Cincinnati.

Dr. R. P. Stephens, instructor in mathematics in Wesleyan University, has been elected adjunct professor of mathematics in the University of Georgia. Mr. Berton H. Camp has been appointed instructor in mathematics in Wesleyan University.

Appointments at Syracuse University have been made as follows: Joseph E. Kirkwood, professor of botany; W. M. Smallwood, professor of compaiative anatomy; Charles G. Rogers, associate professor of physiology; C. H. Richardson, associate professor of geology and mineralogy; Daniel Pratt, assistant professor of mathematics; Herbert A. Clark, assistant professor of physics; Howard F. Hart, instructor in mathematics; Roger F. Brinell, instructor in chemistry; Burnett Smith, instructor in geology; George D. Babcock, professor of practical mechanics; Forrest E. Cardullo, associate professor of machine design; Carl H. Beach, assistant professor of machine design; James B. Faulks, associate professor of experimental engineering; Dr. Harold D. Senior, professor of anatomy and director of the anatomical laboratory; Dr. L. D. Bristol, instructor iu pathology and bacteriology.

Mr. J. W. Bews has been appointed to a newly-established lectureship of economic botany at Manchester.

Dr. F. R. Noll, of the Agricultural Academy at Poppelsdorff, has been made professor of botany at Halle, and Dr. Gerhard Hassenberg acting professor at Poppelsdorf.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, AUGUST 9, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ARE WE AN INVENTIVE PEOPLE IN THE FIELD OF EDUCATION?[1]

EVERY invention, I suppose, is made up of individual and social elements, and combines them in a way different from that of every other invention. There is no more interesting department of literary criticism, or esthetic criticism generally, than that which seeks to trace out the respective contributions of the race and the individual in any work of art. This is illustrated in a recent discussion of the distinction between the folk-epic and the art-epic,[2] the characteristic difference, for example, between the 'Iliad' and 'Paradise Lost.' Some Homer, in the one instance, whatever his name, gave the final form to a poetic tale that must have been shaping itself in the traditions of his people for many generations. In the other instance, in which we may distinguish the poem from the contemporary materials out of which it was constructed, the work of the poet looms large, and the work of the people back of him is obscured by his personal fame. Yet, when we analyze even Milton's art, with all of its manifestation of a fearless and independent personality, we find it related in the subtlest ways with the literary tradition of his time.

So it is in the history of mechanical invention. We have seen recently a running discussion of the origin of the electric trol-

[1] An address before the chapter of Phi Beta Kappa, at Vassar College, June 10, 1907.

[2] By Professor C. B. Bradley, *The University of California Chronicle*, June, 1906.

ley car. This very modern invention is commonly referred for its beginnings to the electric railway first operated at Richmond, Virginia, in 1888. But it appears that that undertaking had a forerunner, and that forerunner in its turn had a prototype, and the successful American inventor is found to be only the topmost figure of a human pyramid, made up of no one knows how many experimenters in this particular field. The Patent Office has difficulty enough in distinguishing each new invention from its patented predecessors. But when we go aside from the series of formal patents and look to the succession and mingling of motives and ideas, the tangle passes our ability to unravel. We can only see how inextricably the stroke of individual initiative is enmeshed in the movements of a whole people, and that very complication we find it a delight to contemplate.

Now, this social character of all invention appears in a peculiarly vital way in any original work in education. For education in a special sense not only springs from the people, but in turn creates the people from which it springs. Education is its own father. An over-emphasis on individuality in education would quickly carry us away from the line of direct succession. It would give us isolation and sterility instead of recreating the spiritual life of the race.

One can not add too quickly that in the nature of things the danger of a dead lack of individuality is usually a more threatening danger. But let us at once get down to our examples. To begin with, we may take the kindergarten. There has hardly been a more distinct and conspicuous invention in the whole history of schools. It is a thoroughly conscious and modern work of art, in which the personal agency of the inventor comes to the fore. That is the very weakness of the invention. To this day it has not been assimilated. In our educational concert it is a voice that sweetly sings in tune but that refuses to blend with other voices of the chorus. There may be different explanations of this lack of accord. It may be that the individual note is permanently at variance with anything that can be made universal. Or it may be that the kindergarten is merely in advance of the age and will bring the rest of education round into adjustment with itself. It seems pretty clear that both explanations are in part correct. The kindergarten, with certain other forces that have worked toward similar ends, has brought our elementary education a long way toward its type of faith and practise. Yet the emphasis on what is distinctively Froebelian still keeps it a thing apart, and seems likely to set a permanent limit to its ascendency.

It will appear from this reference to the work of Froebel that we are not now concerned simply or chiefly with those inventions which bear the sharp stamp of one man's individuality. It is a minor consideration that the invention should be known at all as the work of a single inventor. Some of the most marked of immediate successes and ultimate failures have had that distinctive imprint. Such, for example, was the monitorial system, in the forms given to it by Joseph Lancaster and Doctor Bell. Such a system may have a large usefulness of its own in the course of educational progress, but it is as scaffolding rather than as part of the permanent structure. Its very insistence upon that which is one man's makes it less fit to serve the great needs of Everyman.

So in varying degrees the educational inventions of the ages combine the distinct contribution of this or that inventor with the broad tendencies of an inventive people. What are some of the other inventions which Europe has contributed to educational history? I mention only a few of them and with little thought for sequence of any sort. There is the educational system of the Jesuits, particularly in its seventeenth and eighteenth century form. There is the English university, made up of federated colleges. There is the seminar, which has been such an instrument in the making of German university instruction. There are two recent contributions of the Swedish people, the Sloyd system of hand-work and the Ling system of educational gymnastics. Let us add the seminary for teachers, the school garden, the Hilfsschule or school for backward children, the system of higher institutions for commercial education, the Gouin method and various other successful methods in the teaching of modern languages, the English system of university extension. And doubtless many others will occur to you. When we come to think over the list, it appears that much has been accomplished; and that European education has not only been greatly widened since the Middle Ages, to reach a manifold larger constituency, but has also been improved to a wonderful degree by the progress of educational invention.

When we would institute a comparison between European and American contributions to such improvement, it is well that we consider first the wider range of invention. The world at large gives to the Americans the credit of being a highly inventive people as regards mechanical devices. The attention of our people was early turned in this direction. Certain conspicuous successes fired the national imagination, and the stress of economic need drove us to the same end. The Patent Office became a center of national pride. To take out a patent or buy the right to sell a patented article or at least to buy something with the magic patent label attached thereto, became a well-nigh universal ambition. And in sober truth our record in the making of useful inventions is really wonderful. At first thought and without an effort you can recall the lightning rod, the steamboat, the cotton gin, the whole series of reaping machines down to the latest combination harvester, the sewing machine, the telegraph, the telephone, the arc and the incandescent electric light, the phonograph, and twenty other things that are now counted among the necessaries of modern life. It is a dazzling list, and may well make us forget the things we have not ourselves invented, but have borrowed from other lands. On second thought, however, we recall those notable creations, the steam engine, the balloon, the power loom, the locomotive engine, the daguerreotype—first-fruit of modern photography—the spectroscope, wireless telegraphy, and many others that the wit of Europe has devised. However much we may lead in the number and variety of our cunning contrivances, there is enough for which we are indebted to other lands to check our conceit and assure us that we have competitors.

On the whole, however, in the domain of mechanism we are undoubtedly in the lead. The fact that the number of patents issued annually in the United States is now only a little less than the whole number issued in all of the rest of the civilized world is not without significance. But when we turn to creative literature and the other arts the case is changed. Here, on the whole, the leadership rests with Europe. We have done good work in this field and are rapidly doing better, but not yet with that confident leadership which we display in mechanical invention. Many of the best short stories are ours. We have a score and more of writers of creditable verse—and even Europe does not seem to be over-productive of great poems in these days. We are producing some virile sculpture that is not merely imitative, and our painters can now command the respect and admiration of the world. The superiority of our illustration-art is recognized. We are erecting many good buildings and are producing some good music. But after all, the preponderance of inventive excellence in these departments is still conceded to Europe. Our architects study at the Beaux Arts, our musicians at Leipsic and Berlin, and our young painters are known to the world when they have exhibited at the Paris Salon.

How, then, does it stand with us in the field of education? I think any one who reads in the German pedagogical literature of our day has now and then a sense of hopelessness of any educational originality. The range of its suggestion is in fact astounding. The new plan and conception of educational procedure which is just dawning above his horizon is very likely to appear in some German pamphlet or even in some 'Handbuch der Pädagogik' as a familiar notion, the boundaries of which have been well marked out and its values weighed in the balance. So any one familiar with the stream of educational influence which has long been crossing the Atlantic in our direction will proceed with caution in naming our American contributions to educational invention. Yet it will be admitted that pedagogic discussion in Germany and in other countries of Europe often outruns by far the practical embodiment of such ideas in working institutions, and even the great reach of German educational doctrine still leaves some things to the educational makers of other lands.

The Europeans themselves are generous in giving us credit for the origination of a variety of educational contrivance. Among the particulars in this bill of credit have been mentioned the American school of library practise, the kitchen garden, the high school laboratory for instruction in natural science, coeducation in secondary schools and colleges, the combination school of the Pratt and the Drexel Institute type. It is difficult for us to form a list of our own. We are too close to the facts to be sensible of their distinguishing characters, and besides we know that Europe has many surprises that might trip us if we claimed too much. But at a venture I would suggest the following as among our original contributions to education, making no claim, however, that the list is all-inclusive or even includes all of the best that we have done.

First, the non-sectarian elementary school for all classes of the community, answering to our democratic social organization and our religious liberty.

Secondly, the American high school, serving at once as a continuation of the elementary school and an introduction to the higher education, with courses meeting a variety of tastes and needs.

Thirdly, the American university, with its combination of instruction and research, of cultural and technological courses, and with liberal and professional departments often dovetailing into each other. To this might be added that notable invention, that new development of personal efficiency, the American university president.

To these institutions, at the core and center of our educational system, we might easily add a number of minor features of that system, no one of them insignificant in itself. The summer school may be mentioned, with its home-study development, as in the Chautauqua type; the text-book in its better forms, and the better type of instruction based on the use of the book; the college gymnasium, for physical education; the consolidated country school, with provision for the transportation of pupils;

the organization of public libraries and museums in close connection with the work of public schools. How many others there are that come crowding on the attention! One is tempted to mention Helen Keller as one of our most admirable educational achievements. The story of her training into normal and honored womanhood is one of the most stimulating passages in our educational history. And Tuskegee is another. Then, too, we recall our schools for the training of nurses, which in a very few years have come to enroll twenty thousand students annually. I may speak of another example, which falls within my own sphere of labor, for as a new invention it was the work of my honored predecessors. I refer to that special type of industrial training which is connected with the introduction of domestic reindeer into Alaska.

In that northern country the necessity of making some better provision by which the natives might clothe and feed themselves, was the mother of this combined industrial and educational invention. Reindeer were imported from Siberia. Teachers were brought from Lapland. And the Eskimo were set to the lesson of caring for the deer, of breaking them to the sled, of using them in profitable service of the incoming white population; and so of adjusting their lives to a new industry, by which they might maintain themselves in the face of new conditions which threatened their very existence. Here was a truly constructive treatment of a most difficult racial problem. A new industry was fitted to new conditions and a new education was based on that new industry. While the arrangement has not yet shown what its full development may be, it has become well established in these more than fifteen years, and already it has made its place and proved its usefulness.

But we can not fairly estimate the measure of our inventiveness unless we turn to the other side, and see what are some of the defects in our system which we have left uncorrected. These are the points where our educational invention has thus far failed to do its work, and they are neither few nor unimportant. I think it will appear that all along the line, from the bottom to the top, our educational system, the object of so great national pride, is still marked by serious inadequacies.

We have not yet made any great improvement in the nurture of children at home, up to the kindergarten age or the age of the primary school.

We have not yet brought the kindergarten into full adjustment to our educational system nor devised any adequate substitute for the kindergarten.

We have found ways of keeping one half of our pupils in school up to the sixth or seventh grade but we have not found ways of keeping all of them to the end of the elementary course.

We have not yet organized nature studies in the schools into any well-knit adjustment to general education.

We have not yet carried our instruction in drawing up into fully effective training for the fine arts, in secondary and higher schools.

We have not yet brought our religious education, as carried on in Sunday-schools, into any effective parallelism with the secular instruction of the public schools.

We have not yet brought our normal schools into satisfactory adjustment with our cherished sequence of schools from the kindergarten to the university.

We have not yet wrought out a satisfactory arrangement for the training of teachers for secondary and higher schools.

We have hardly as yet established a permanent teaching profession.

We have not devised adequate means of

giving needed cultivation, esthetic, intellectual and moral, to the individuals who make up the student body of our mammoth universities.

We have yet to work our way through the gaseous, centrifugal atomism of our college elective courses into an organized and unified national culture.

We have not yet achieved a national standard in our academic and professional education, nor have we organized any effective and economical cooperation among our schools of graduate instruction and research.

We have not yet devised ways by which public education can be definitely and adequately focused upon the improvement of our national morality.

The list, again, is by no means complete, but it is surely long enough for the purposes of this discussion.

I do not take a pessimistic view of the situation in which these defects appear. In every one of the particulars enumerated, serious efforts toward improvement are making even now, and we can not doubt that full success will ultimately be achieved. There have been devoted teachers who have labored long for such improvement, and in some instances their accomplishments have been great and beneficent. But that our triumphs in these particulars have been local and exceptional rather than permanent and national, will be generally agreed, and it is well that we look this unwelcome fact in the face.

We may now attempt a direct answer to the question which was asked at the beginning. Are we an inventive people in the field of education? We are unmistakably, an inventive people in this field. It can hardly be doubted by any one who looks upon the exuberant Americanism of our elementary schools, the great expansion and continued readjustment of our secondary education, the growth of our universities and of university influence in ways that catch so exactly our national characteristics and turn them to academic ends; nor can it be doubted by any one who watches from year to year the spread of our education into new fields by new and untried processes. We are inventive in our education, but it is not yet clear that we are preeminent in this regard, and our educational invention still lags far behind our invention in the domain of mechanism.

We may be easily misled by the flattering reports of foreign visitors. With all of their frankness in pointing out our defects their general criticism of our schools is for the most part extremely favorable. But we must not forget that education with us is in the sweep of a strong tide of popular sentiment. Every invention that we have put forth is carried forward by that current and finds opportunity to do, in full swing, its destined work. Not that individual inventors do their work unhampered and with no discouraging delays. That could never be. But by contrast with Europe, the way of educational improvement here is direct and clear. We cannot yet fairly judge what our education would accomplish under greater difficulties and in the face of closer competition. It is safest for us to take the moderate view, and hold that our educational successes thus far, great and glorious as they are, are only great enough to confirm our hope and confidence, and not yet sufficiently great to insure to us the ultimate leadership.

Our inventiveness in this field is less conspicuous, as has been said, our education shows less of readiness to seize obscure suggestions and carry them through to unlooked-for triumphs of efficiency, than that which we have long disclosed in our Patent Office reports. Yet this field is at least as interesting as the other. It makes intense appeal to widely differing minds, and public attention is often drawn to new educational projects in a measure that is truly astonishing. What is needed is that that public interest should be more sustained and more clearly manifest; that the inventor in education should have the unfailing stimulus which has goaded our mechanical inventors to their most strenuous endeavors. And on the part of the inventor himself there is need of all the patience and resource of the designer of new mechanism; and of other qualities, subtler far than these, which it may be worth our while to consider at this point.

The inventor in education does not bring before the people a new object which they are to look upon and admire and use. The people are the very stuff of his invention, public sentiment is his atmosphere, he is an artificer of human society. Accordingly he must have, many times over, the patience of the mechanical inventor. He must be willing to merge his fame in the larger life of the invention. For if it is a real and living invention he will find that there are many collaborators, and it may take generations to bring the design to its perfection. In education it is generally true that an invention that is only of one man size is not large enough to last. Yet the work calls for zest and courage, and there is ground for individual encouragement. Social changes are accelerated in these days. The single generation has, more than ever, its chance of striking an arc of appreciable advancement; and there was never a time when one man in his one earthly life had a better chance of doing some work of noble note. I believe the spirit of educational invention can be quickened among the men of America, to meet the larger demands that are upon us. And if this language seems to spread out shield and spear in the household of Lycomedes, it is not that I am seeking Achilles at Vassar. It should be said rather that the highly educated women of America are themselves to have a most important part in this educational quickening. Indeed, it is not too much to hope that the time is at hand when our men and women will take share and share alike in this work—alike but different. And we may trust and pray that the great work that our women are already doing in every phase of social improvement may not cause the men of America to dream that their responsibility can be shifted, but may rather remind them that they must not fail in their part.

It may be well to enter here upon some brief discussion of three or four of the problems now calling for constructive leadership. In the first place, let us make note of an unfinished movement, which demands our best skill and will surely reward its exercise. It has been said that the education of the school and education by apprenticeship, after centuries in which they have gone apart, are drawing near together in these days. It seems fair to expect, in fact, that the school of the future will be the result of their union. The combination appears in many forms. Most familiar of these, up to the present time, is the school laboratory in the natural sciences. Here instruction from the book assumes a subordinate place and the pupil learns by what he does. Already, too, the method of the scientific laboratory is permeating other departments of the school. It has influenced the teaching of history and the languages, and we may even see its influence extending to the teaching of law in the professional school. But now the school and the apprentice system are drawing together in other ways. The movement is obvious in manual training and domestic education. The actual contact of the two systems in their organized forms, however, has been especially marked in the past two years. At the Carnegie Technical Schools in Pittsburg arrangements have been entered into by which boys will take a part of their training for certain trades in the ordinary course of apprenticeship, under the control of the trades unions, and another part of their training for the same trades in the technical schools. At the University of Cincinnati the experiment is making of combining work for wages in a regular shop with the studies of an engineering course, two young men counting for one in the shop by alternating on one-week shifts, each taking his university studies in the week that he is not at the bench. The experiment is watched with the liveliest interest by both shopmen and university men and thus far it gives promise of success. In the movement toward the establishment of public trade schools, now under way in Massachusetts and Connecticut and in several other states, the relation of the apprenticeship to the school is a question of the utmost importance, both educationally and in its connection with the problems of trades unionism. From a general pedagogical standpoint the combination of the methods of the literary school with the methods of apprenticeship seems one of the most promising of present opportunities for the exercise of educational invention.

May I venture, in the second place, to speak of the present problem in the higher education of women. I will not say what I think about the subject here and now, when I am so happily indebted to your generous hospitality. I do not think you would care to have me indulge in the language of compliment. But before I came to Vassar, let us say, the question of woman's higher education in America seemed to me to lie about as follows: That, after the great advance we have made in this field, which has commanded the attention of the world and the admiration of a good part of the world, we have come to something like a standstill, and some of the most important steps have not been taken as yet. It has taken a great struggle to establish fully the higher education of woman as a simple human need. But that battle has been won. The integration of woman's education with the general scheme of education has been brought about. But the differentiation of woman's education is yet to be accomplished. Let us admit that the task of integration was by far the greater task. But does it follow that the differentiation is no task at all? Or to put it in other words: the functions of men and women in society are different in many ways. Do those differences lie wholly beyond the range of education? I am confident that they can not permanently be left outside of the range of education; but the task of bringing them under educational treatment is one of the greatest difficulty. It calls for the highest exercise of inventive skill and patience. In coeducational institutions, under a system of free election, the problem tends to solve itself by the gravitation of women toward certain courses and of men toward certain other courses, while still other courses are common ground. But this solution is only partial and unsatisfactory. Some practicable scheme of preparation for mother-work will, we can not doubt, be devised in the course of time. There will be, some day, an education for home making and for woman's leading part in the finer forms of social intercourse, which will do on the higher academic plane what was done in a more petty way, generations ago, in popular finishing schools for girls. But this, too, is only a part. There is to be, further, a serious preparation for woman's part in the economic, the industrial, and even the political world. What the all-round solution of this problem will be, I can not tell nor even guess. But if it meets the need, it will be an educational invention of the highest order of excellence.

In the third place there is the international organization of education. Commissioner Draper has recently called attention to the tremendous number of men and women engaged in teaching throughout the world to-day. There are not far from three and one half million of them, according to his estimates. And for the most part they are engaged in what is essentially the same work, wherever they may be. The full realization of the unity of this great body of teachers, when it is attained, must have profound consequences for the peace and civilization of the world. Already we are working toward such unity in a number of definite and special ways. Many of these ways are already familiar to all: The visits of teachers and other educational leaders of one country among the schools of other peoples; systematic efforts of one people to spread a knowledge of their culture and ideals among other peoples, as exemplified in the Alliance Française; the exchange of university professors; and a variety of other procedure. If the diplomatic relations of nations have passed into an economic stage, it should be added that they are passing into an educational stage. Mr. Barrett, the chief of the Bureau of American Republics, urges, with good show of reason, that if we wish better commercial relations with the proud and sensitive peoples of South America, we must first meet them on higher ground, through an understanding and recognition of their culture and education. Already we can see signs of the emergence of world-standards in school education and university education and particularly in professional education. It is an immediate and practical need that we put our higher education into shape to deserve, and by deserving to compel, recognition, the world over, of our academic and professional degrees. All of these things call for new procedure, new devices, and new coordination of existing agencies. That is, in the language of this discussion, they call for a new exercise of educational invention in its very widest range.

Finally, the international need emphasizes the national need. Such a thing has happened repeatedly in the history of international relations. What we must do to take and keep our place, among the nations of the earth, reveals to us what we must do at home. No one in his senses, I am sure, would propose a centralization of American educational systems. But we need as never before an effective cooperation of our state educational organizations, and of our institutions of learning under more private forms of control. And when education is spoken of here, the meaning is education in its widest reach, from the elementary schools through the colleges and universities, from the most general to the most special of its developments, through the several forms of professional instruction, through organized scientific research, through our provision for libraries and museums and those movements which promise for us the making of a really national art. The organization of what may be called our national education in a manner suited to the spirit of our institutions and in forms commensurate with our standing among the nations—this is an undertaking which must tax the imagination and make demand for administrative originality such as the academic world has seldom seen. But it is a work that is to be done. And it will undoubtedly be the work of many men and women, brought together in intense cooperation, and be extended far beyond the limits of a single generation. It will be a work of national invention.

Such, as it now appears, is some small part of the work of education that lies immediately before us. It is a work that may well call for the most serious consideration of this greatly influential society, which aims to make its philosophy a guide into the larger life. The plea which has been offered amounts in sum to this: That by all means you will give encouragement and stimulus to our already awakened spirit of educational invention; for it takes no second sight to perceive that the times call for the exercise of that spirit in the highest things to which it may aspire.

Elmer Ellsworth Brown

U. S. Bureau of Education

SCIENTIFIC BOOKS

Electrochemistry. By Dr. Heinrich Danneel; translated by Dr. Edmund S. Merriam. Part one. New York: John Wiley & Sons.

This is the first of a series of three volumes which Dr. Danneel proposes to write upon the subject of "Electrochemistry." In this volume the modern theories of electrochemistry, as well as their physicochemical foundations, are discussed. The second volume will contain experimental results and methods of measurement, while the third will be devoted to the technical applications of the subject.

Theoretical electrochemistry is beyond the stage at which any radical innovation in the method of treatment is possible. The author does, however, depart from the more usual procedure in discussing transport numbers after conductivity; and wisely too, we believe. We are not, however, convinced of the advantage of introducing a preliminary chapter on the history of electrochemistry in which much of the subject matter to follow is assumed to be known.

This volume, like its companion volumes in the Sammlung Göschen, contains a surprising amount of fact and information within a very small compass. Whether such condensation is always desirable in a theoretical subject, where abridgment of statement does not necessarily mean a lessening of mental effort, may be questioned. I am reminded of the Abbé Terrassou's remark about a book "that it would be shorter if it were not so short." We are convinced, however, that this very brevity coupled with its clarity will assure it a place of its own among text-books of electrochemistry. We imagine, for instance, that it would be an excellent book to furnish a mature student with a brief, though comprehensive view of the whole subject.

The translation is vigorous and clear. We were sorry to see the familiar expression "migration of the ions" supplanted by the less apt "wandering of the ions."

The physical appearance of the book is better than that of the German original.

Arthur B. Lamb

Researches in Experimental Phonetics; the Study of Speech Curves. By E. W. Scripture. Washington, D. C., published by the Carnegie Institution of Washington, November, 1906. Pp. 204.

Under this title is published the groundwork of the results of Dr. Scripture's recent work abroad, in the laboratories organized at Munich, Berlin and Zurich. Save for illustrative examples from the records, the present volume deals almost exclusively with methods; nearly all of the last fifty pages are taken up with tables, some of which appear for the first time, and should prove most helpful to other investigators along these lines. A discussion of the precise philological and psychological bearings of the results we may await in another volume.

The speech curves studied are obtained from amplified tracings on smoked paper of phonograph (cylinder) and gramophone (disc) records. Dr. Scripture has here employed mainly the disc records, the horizontal movement of the recording point giving a more accurate tracing. The workable portion of the records is practically confined to the vowels. The voiceless sounds as a rule give nothing beyond a straight line. The investigator seems to have brought his method to a high degree of technical perfection. The drawings illustrating the apparatus are unusually clear.

Simple levers have been obtained to amplify the disc records accurately to three hundred times and compound levers to one hundred and twenty-five times. The latter is considered to be capable of much improvement. We are all sadly aware that it is one thing to note a precaution, and quite another to observe it; but so far as the technical side is concerned there are probably few psychological or linguistic problems of equal difficulty that have been approached with greater care.

The first chapter contains some studies of the vibratory movement of the diaphragms, mainly through optical means. The conclusion is reached that the nodal (Chladni) vibrations play an inconsiderable part in the distortion of the wave evident in the familiar "twang."

> The diaphragm of the sound-box, however, bends so that there is more or less yielding and motion of the air behind it . . . in both gramophone and phonograph the wave is distorted in the manner just described (p. 22).

The commercial instruments vary a good deal in quality; about one in a hundred, Dr. Scripture thinks, is suitable for experimental purposes (p. 17). Chapters II., III., IV. discuss the apparatus and methods of immediate analysis. Much of this material will be familiar to one who has followed Dr. Scripture's previous work. On pp. 53–4 is described a control apparatus by which any portion of a curve may be reproduced as a gramophone record so as to afford acoustic analysis for the ear. By this means, any curve possible to sketch may be reproduced in terms of its sound.

The ordinary student of linguistics will find more difficulty in following Dr. Scripture through chapters V.–VII. Their interest must for the present be considered physical and mathematical rather than philological or psychological. They are concerned with problems of harmonic analysis, and a new method for dealing with the disturbing factor of friction in the voice-producing apparatus. The two theories of vowel production are discussed in chapter VIII. The Willis-Hermann theory of the varying intensity of the glottal puffs and the vowel tones as inharmonics to the glottal tone, is confirmed in these studies.

The Helmholtz theory of hearing is interestingly criticized in chapter IX. Simple harmonic analysis is insufficient to give the tones corresponding to the resonating fibers; the inharmonic frictional analysis alone represents the facts of audition, and this is at present possible only for song. Chapter X. describes methods for the synthesis of vowel vibrations, and chapter XI. illustrates the mathematics of vowel analysis; it is intended as a guide to research. Perhaps the main objection to the work is that the correctness of the original gramophone records has been taken too much on faith. There need be no question of the accuracy of Dr. Scripture's reproduction of these curves; but there is room for considerable doubt as to whether the gramophone records themselves are faithful representatives of the spoken sounds they are supposed to record. The mere fact that they resynthesize them into understandable speech is not sufficient. A variant of the method mentioned on page 55 might be employed, a gramophone record *a* making another gramophone record *b* directly from itself. A visual comparison of the two might give an idea of the accuracy of the reproducer of *a* and the recorder of *b*. Otherwise there would seem to be no escape from the tedious method of nonsense syllables, noting whether the errors made in the perception of gramophone speech are analogous to those for normal spoken speech. Until something of this sort is done, there is ground for some caution in the acceptance of this material as representative of actual linguistic facts.

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SCIENTIFIC JOURNALS AND ARTICLES

The American Journal of Science for August contains the following articles: "Radio-Activity of Thorium Salts," B. B. Boltwood; "Wave-lengths and Structural Relation of Certain Bands in the Spectrum of Nitrogen," E. E. Lawton; "Tertiary Peneplain of the Plateau District, and Adjacent Country, in

Arizona and New Mexico," H. H. Robinson; "Heat of Combustion of Silicon and Silicon Carbide," W. G. Mixter; "Vanadium Sulphide, Patronite, and its Mineral Associates from Minasragra, Peru," W. F. Hillebrand; "Mineralogical Notes," W. T. Schaller; "Thermoelectromotive Forces of Potassium and Sodium with Platinum and Mercury," H. C. Barker; "Reaction between Potassium Aluminium Sulphate and a Bromide-Bromate Mixture," F. A. Gooch and R. W. Osborne; "Preparation of Formamide from Ethyl-Formate and Ammonium Hydroxide," I. K. Phelps and C. D. Deming; "Lower Middle Cambrian Transition Fauna from Braintree, Mass.," H. W. Shimer.

We learn from *Nature* that after the current year the *Journal of Anatomy and Physiology* will be issued in two independent parts, one to be devoted to anatomical, histological, morphological, and embryological subjects, and the other to contain papers on subjects of physiological interest (including physiological histology and physiological chemistry). The acting editor of the anatomical part will be Professor D. J. Cunningham, with whom will be associated Sir William Turner, K.C.B., Professor A. Macalister, and Professor G. S. Huntington. The acting editor of the physiological part will be Professor E. A. Schäfer, with whom will be associated Professors F. Gotch, W. D. Halliburton, C. S. Sherrington and E. H. Starling.

SOCIETIES AND ACADEMIES

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

Twenty-first Meeting

The twenty-first meeting of the Society for Experimental Biology and Medicine was held at the College of Physicians and Surgeons, of Columbia University, on Wednesday evening, March 20. The president, Simon Flexner, was in the chair.

Members present—Adler, Beebe, Burton-Opitz, Carrel, Crampton, Crile, Emerson, Ewing, Field, Flexner, Gibson, Gies, Hatcher, Lee, Levene, Levin, Lusk, Mandel (J. A.), Meltzer, Murlin, Noguchi, Opie, Richards, Schwyzer, Shaffer, Torrey, Tyzzer, Wadsworth, Wallace, Wolf.

Abstracts of the Communications[1]

A Study of the Vital Conditions Determining the Distribution and Evolution of Snails in Tahiti, with Illustrations: H. E. Crampton.

It was shown that different valleys of Tahiti contain forms of the genus *Partula* that, on account of their more or less complete isolation, have come to differ in correlation with their geographical proximity or remoteness. Evidence was adduced showing that "mutations" have arisen at various recent times.

The Parathyroid Gland, with Demonstrations of the Effects of Hypodermic Injections of Parathyroid Nucleoproteid after Parathyroidectomy: S. P. Beebe.

It has been found that the symptoms of tetany following parathyroidectomy in dogs can be inhibited by the hypodermic injection of parathyroid nucleoproteid. The globulin from these glands has not been found effective. If the nucleoproteid is heated to boiling in an alkaline medium its inhibitive powers are destroyed.

Further Experimental and Clinical Observations on the Transfusion of Blood: George W. Crile.

Beneficial results were obtained after acute hemorrhage, after pathologic hemorrhage and in the treatment of shock and illuminating gas poisoning. Negative results were obtained in pernicious anemia, leukemia, carcinoma, strychnin poisoning and diphtheria toxemia.

A Preliminary Report on the Direct Transfusion of Blood in Animals given Excessive Doses of Diphtheria Toxins: George W. Crile and D. H. Dolley.

[1] The abstracts presented in this account of the proceedings have been greatly condensed from abstracts prepared by the authors themselves. The latter abstracts of the communications may be found in Number 4 of Volume IV of the society's proceedings, which may be obtained from the secretary.

Transfusion had no beneficial effects on dogs that received lethal doses of the toxin. Exsanguinated normal dogs, that received blood from dogs treated with excessive doses of toxin, were apparently unaffected. Blood letting, as well as blood letting followed by transfusion of physiological salt solution, had no effect upon the action of the toxin.

The Effect on the Normal Dog Heart of Expressed Tissue Juice from Hearts of Dogs Poisoned with Diphtheria Toxin: J. J. R. Macleod and George W. Crile.

Expressed juice from hearts of dogs poisoned with diphtheria toxin, caused cardiac paralysis and fibrillation when perfused through hearts of normal dogs. The same result was obtained, however, with similar juice from normal hearts and with aqueous solutions of the ash obtained from such juice. The paralytic result was attributed to the influence of potassium, although the associated fibrillation requires a different explanation.

Experimental Liver Necrosis: 1. Hexon bases. Holmes C. Jackson and Richard M. Pearce.

In the scattered focal necroses of the livers of dogs and horses the nitrogen precipitable by phosphotungstic acid, after acid hydrolysis, formed 11.3 per cent., and in the diffused necroses 30 per cent., of the total nitrogen, as against 15 per cent. for the normal. The necrotic livers that were allowed to undergo autolysis showed approximately the same percentage loss of phosphotungstic-precipitable nitrogen (hexon) as normal livers, despite the extent of the necrosis. In the focal necrosis the average was 28 per cent., in the diffuse necrosis, 21 per cent.

The Action of Nitric Acid on the Phosphorus of Nucleoproteids and Paranucleoproteids: A. B. Macallum.

Phosphorus is combined in caseinogen in a manner very different from that which obtains in true nucleoproteids. When treated with nitric acid (1.2 sp. gr.) at 35° C. for two weeks, no phosphate is produced. Nucleic acid and true nucleoproteins yield phosphate under such conditions. Nitric acid may therefore be employed to distinguish nucleic acids and the typical nucleoproteids from paranucleic compounds.

Does the Stomach of the Dog contain Free Hydrochloric Acid During Gastric Digestion? Lafayette B. Mendel.

Many positive results were obtained.

On the Nature of the Process of Fertilization: Jacques Loeb.

The author's recent experiments have shown that in the purely osmotic method of producing artificial parthenogenesis, we are in reality dealing with a combination of two different agencies, one being the increase of the osmotic pressure at a comparatively low concentration of hydroxyl ions, and the other, the hydroxyl ions at a comparatively high concentration. The proof for this statement rests upon the following experimental facts.

(*a*) When the concentration of the OH is below a certain limit, namely, $10^{-6}n$, even the maximal increase of osmotic pressure fails to cause the formation of larvas from the unfertilized eggs.

(*b*) When the concentration of hydroxyl ions is high, *e. g.*, $10^{-3}n$, a very slight increase of the osmotic pressure is able to call forth the formation of larvas.

(*c*) The effects of the two agencies can be separated by first putting the eggs for from $1\frac{1}{2}$ to 2 hours into a hypertonic solution with a concentration of hydroxyl ions between 10^{-7} and $10^{-6}n$, and afterwards transferring them for some time to an isotonic solution with a concentration of hydroxyl ions of about 2 or $4 \times 10^{-3}n$. While no egg that has been exposed to the hypertonic solution will develop, many or possibly the majority of the eggs that have in addition been exposed to the hyperalkaline solution will develop into larvas, many of which are perfectly normal and rise to the surface. Eggs which develop into larvas very often (possibly always) have a membrane which, however, differs from the fatty acid membrane or the fertilization membrane in this, that it is not separated by so wide a space from the protoplasm and therefore easily escapes detection.

Comparative Chemical Composition of the Hair of Different Races: Thomas A. Rutherford and Philip B. Hawk.

After subjecting hair obtained from Indian, Negro, Japanese and Caucasian subjects, to the action of digestive juices, and also alcohol and ether, the percentage content of sulphur, nitrogen, carbon and hydrogen in the remaining keratin was found to be nearly the same for each type. The S:N ratio was practically 1:3 in each case.

The Oxidation of Sugars by Cupric Acetate-Acetic Acid Mixtures: A. P. Mathews and Hugh McGuigan.

The addition of acetic acid to cupric acetate diminishes its speed of oxidation. The amount of acid that may be necessary to check the oxidation to any given rate depends on the concentration of the acetate; the more concentrated the acetate the more acid is required.

Solutions of different concentrations of acetate and acetic acid were prepared which would just fail to oxidize levulose to a visible production of cuprous oxide after a half-minute's boiling. Similar solutions were prepared for the different sugars. Each of these solutions for any given sugar of one per cent. concentration had the same speed of oxidation. In all the solutions oxidizing any one sugar with the same speed, the decomposition tension of the cupric oxide in the solutions was a constant. For the different sugars the following data for decomposition tension were obtained in those solutions that just failed to show oxidation to a visible extent after a half-minute's boiling: Levulose, 0.583 volt; galactose, 0.562 volt; glucose, 0.558 volt; maltose, 0.532 volt; lactose, 0.519 volt.

A cupric acetate-acetic acid mixture of proper concentration will show the same selective action toward levulose that many bacteria and other living organisms manifest and will oxidize the levulose almost completely before the glucose is attacked.

Observations on the Effects of Fasting upon the Opsonic Power of the Blood to Staphylococcus aureus: Allan C. Rankin and A. A. Martin (by invitation).

Fasting perceptibly diminished the particular opsonic power studied (from 0.98 to 0.7).

The Automatism of the Respiratory Center: G. N. Stewart and F. H. Pike.

The authors described a method which seems to afford a means of temporarily eliminating all the afferent paths connected with the respiratory center. Since under these conditions the center continues to discharge itself in such a way as to maintain a long and unbroken series of regular, efficient respiratory movements, its normal activity is to be considered an example of physiological automatism, not originated, although influenced, by afferent nervous impulses.

A Series of Spontaneous Tumors in Mice: E. E. Tyzzer.

In the investigation of tumors in mice, attention has been directed, for the most part, to those which develop in the subcutaneous tissue. It is possible that *internal* tumors often occur unnoticed.

The author described tumors of the lungs, kidneys, mammary glands and lymphatic glands, and stated the effects of their inoculation into mice. Silver preparations were made by the method of Levaditti and the results given of an extended examination for spirochetes.

Concerning the Neutrality of Protoplasm: Lawrence J. Henderson (by invitation).

It is desirable, both on account of the normal production of acid during metabolism, and because of the production of acid under pathological circumstances, to study the adjustment of equilibrium in protoplasm whereby neutrality is maintained.

As a result of this investigation it appears that in the presence of both free and combined carbonic acid in measurable amount, mixtures of sodium hydroxid, phosphoric acid and carbonic acid are precisely neutral to rosolic acid, and that the amount of sodium bicarbonate in such mixtures can vary considerably without great variation in the ratio between mono-sodium phosphate and di-sodium phosphate. These results are in accord with the theory, based upon the ionization constant of carbonic acid (3×10^{-7}) and of the ion H_2PO_4 (2×10^{-7}). Although the equilibrium in such a system at 40° C. may be somewhat different, it is evident that this equilibrium will almost perfectly protect protoplasm from variation in neutrality. The variation in hydrogen and hydroxyl ionization can hardly be more than 5×10^{-7}.

The Influence of Adrenalin upon the Venous Blood Flow: RUSSELL BURTON-OPITZ.

The blood flow in the femoral, external jugular and azygos veins was measured by means of the stromuhr previously described by the author. During the experiment, solutions of adrenalin were injected centrally to the stromuhr. The effect of the adrenalin showed itself in a retardation of the venous inflow, which appeared in from fourteen to sixteen seconds after the injection. Considering the velocity of the venous blood stream, it must be assumed that the adrenalin did not produce its characteristic effect until it had reached the arterial side of the circulatory system. The experiments tend to disprove the existence of vaso-motor nerves in the central veins and the pulmonary circuit.

The Viscosity of Laked Blood: RUSSELL BURTON-OPITZ.

It was found that the viscosity of laked blood prepared by the process of freezing is very much less than the viscosity of defibrinated blood. The specific gravity was only slightly lessened. Examples of the experimental data are appended:

Defibrinated Blood		Laked Blood	
Spec. Grav.	Viscosity	Spec. Grav.	Viscosity
1.0566	665.74	1.0563	982.35

The Determination of Ammonia and Urea in Blood: W. MCKIM MARRIOTT and C. G. L. WOLF.

Ammonia is determined by distillation in vacuo. 100 c.c. of blood are treated with 50 c.c. of saturated sodium chlorid solution, and 250 c.c. of methyl alcohol are added to the mixture. The resultant precipitate is finely granular. The residue is filtered off in a filter press, and the filtrate distilled for forty minutes, with the temperature of the water bath at 40–50° C. The receivers are charged with $n/50$ sulphuric acid, and the acid titrated with $n/50$ sodium hydroxid free from carbonate. Sodium alizarin sulphonate is used as the indicator. The results are perfectly accurate.

The residue after distillation is made acid with hydrochloric acid, evaporated and hydrolyzed with 10 grams of glacial phosphoric acid at 150° C. The ammonia formed from the urea is then distilled into $n/50$ acid. The duplicates have shown very satisfactory agreement, but it is quite certain that not all the urea which is added to a sample of blood is recovered. It is probable that the carbohydrates in the residue combine with the urea at the temperature of hydrolysis and prevent the formation of ammonia.

The Resolution of Fibrinous Exudates, with Exhibition of Specimens: EUGENE L. OPIE.

During the early stage of inflammation, a fibrinous exudate, freed from the serum by washing in salt solution, undergoes digestion when suspended in an alkaline (0.2 per cent. sodium carbonate), or in an acid, medium (0.2 per cent. acetic acid). At the end of six days, when fluid has disappeared from the pleural cavity, digestion fails to occur in an alkaline medium, but occurs with great activity in the presence of acid.

During the first stage of the inflammatory reaction, when fluid is abundant and the fibrin which is present digests in the presence of alkali, polynuclear leucocytes are very numerous in the meshes of the fibrin. In the second stage, when fluid has in great part disappeared, and the fibrin contains only one enzyme active in the presence of acid, polynuclear leucocytes have disappeared and only mononuclear cells are embedded in the fibrin.

Since the acids, which, in vitro, favor the action of the enzyme present in the second stage of the process, do not occur in the body, the possibility has suggested itself that carbon dioxide brings this enzyme into action. When carbon dioxide is passed through normal salt solution in which strips of such fibrin are suspended, digestion is very greatly hastened. The normal inhibition exerted by blood serum upon the enzyme is overcome by carbon dioxide; in the presence of a small quantity of blood serum, carbon dioxide causes greater enzymotic activity than in the presence of salt solution alone.

Extirpation of both Kidneys from a Cat and Transplantation of both Kidneys from another Cat, with Exhibition of Specimens: Alexis Carrel.

Both kidneys from a cat were extirpated and immediately replaced by both kidneys from another cat. After this operation the animal urinated abundantly. Urine collected during the first few days contained albumin. On the fourteenth day the cat was operated on for hernia of the small intestine through the abdominal wound. The animal died from general peritonitis one day after this second operation.

The anatomical specimen shows that the kidneys are a little enlarged. There is a slight hydronephrosis on the left side. Nevertheless, both organs appear to be in good condition.

William J. Gies,
Secretary

THE TORREY BOTANICAL CLUB

The club met on May 29, 1907, at the museum building of the New York Botanical Garden at 3:30 o'clock, with an attendance of twenty.

Dr. John Hendley Barnhart was called to the chair.

After the reading and approval of the minutes of the meeting of May 14, the following scientific program was presented:

The Linnæan and Other Early Known Species of Cratægus: Mr. W. W. Eggleston.

The earliest record found of American *Cratægi* is from the Spanish by Caspar Bauhini, in 1623. It is as follows: "*Mespilus virginiana colore rutilo. Mespilus qui colore est rutilo ut cerasa & valde dulcis,* part. I., Ind. occid."

The latter part of this quotation probably refers to Historia Medicinal, by Monardes, in 1569.

Lists of plants raised in the botanical garden at Leiden published by Herman in 1687, by Boerhaave in 1720, and by Royen in 1740; and in the *Schola Botanica,* published at Paris, in 1687; as well as Linnæus's own lists (Hort. Cliffortianus and Hort. Upsaliensis), give short references to American Cratægi; but it is to the English botanist, Plukenet, that we owe our first real knowledge of American thorns. His plates and descriptions are referred to by Linnæus, and these, with his references, are invaluable to us.

Contemporary with Plukenet was Ray, who also added somewhat to our knowledge. John Banister, of Jamestown or Williamsburg, Va., must have contributed much to Plukenet's knowledge, as he was the first English botanist to live in Virginia, and sent many seeds and specimens to England.

This Chesapeake bay region produced all of the Linnæan species, except the one that has been referred to as *C. tomentosa.* This might have been brought from farther back in the country, perhaps by the Indians, as it was one of the earliest thorns raised in England, and is not found in the coastal plain.

In Plukenet's "Phytographia," published in 1691, are five figures of American Cratægi; Plukenet says that he saw the species illustrated in his plate 46, Fig. 1 in the garden of the Hon. Charles Howard, in Surrey. This specimen Linnæus refers to *Cratægus Crus-galli.* A colored plate of it is published in the "List of Plants raised for sale by the English Gardeners about London" (Hort. Brit.), published in 1730. This is the plant labeled in the Linnæus herbarium as *C. tomentosa.* About this Miller was undoubtedly right, for Plukenet's description will cover no other American thorn, certainly none other that was raised in England at that time.

Plukenet's plate 46, Fig. 2, undoubtedly refers to *C. Phœnopyrum* (Linn. f.). There is a good plate of this in Hort. Brit. Linnæus referred this plate to *Cratægus coccinea,* and it has long been incorrectly referred to as *C. cordata* (Miller).

Plukenet's plate 46, Fig. 4, is the first figure referred by Linnæus to *Cratægus coccinea.* This figure and description require a smooth thorn with broad, slightly-lobed leaves, and a red, two-seeded fruit. The only known American thorn that fits this description is *C. Margaretta* Ashe (= *C. Brownii* Brit.). This was not known from the coastal plain region, but there is a specimen in the U. S. National Museum from Maryland. Fig. 5 of plate 99 is a young shoot of *Cratægus Crusgalli* L.

Plate 100, Fig. 1, was referred by Linnæus to *Cratægus tomentosa.* This is the same as *Cratægus uniflora* Muench. or *C. parvifolia* Aiton. It is a common coastal-plain species, which both Banister and Clayton must have collected in Virginia. Clayton mentions but one species with leaves hairy on the lower side, and the reference is doubtless to this species.

That Linnæus did not know well the thorns he was describing, is partially proved by his referring *C. Phænopyrum,* a five-seeded species, to a two-seeded species. Miller's descriptions of the *Cratægi* raised in England is invaluable to us in tracing out these Linnæan species. As Miller says, Linnæus was doubtless misled by Kalm.

Cratægus viridis L. was collected and probably described by Clayton. About this species there can be no question, for there is a Clayton specimen of *C. viridis* in the British Museum.

A colored plate was made by Ehret for "Plantæ Selectæ" between 1750 and 1762. This may be the first illustration of *Cratægus flava* Aiton. It certainly belongs to the *flavæ,* and was raised from seed sent from Carolina by Catesby in 1724. Another American thorn, *C. punctata,* was illustrated by Jacquin in Hort. Vind., 1770.

Further Remarks on the Botanical Exploration of the Bahamas: Dr. N. L. Britton.

Referring to a previous communication made to the club and to others, printed in the *Journal of the New York Botanical Garden,* Dr. Britton gave an account of the recent expeditions of Mr. L. J. K. Brace to Crooked Island, Acklin's Island, Long Cay (Fortune Island), and Andros, and of his own trip in February and March, in company with Dr. C. F. Millspaugh, to Eleuthera, Little San Salvador, Cat Island, Conception Island, Watling's Island, and Long Island. During the progress of this trip Mrs. Britton explored the northern part of Eleuthera, and did some collecting on New Providence. The greater portion of the archipelago has now been visited through the cooperation of the Field Museum of Natural History with the New York Botanical Garden, but the extreme southeastern islands, including Atwood Cay (Samana), Mariguana, and the Caicos Islands are as yet botanically unknown, and the central portion of the large island of Andros is a *terra incognita.* The small islands on the Cay Sal bank also remain unvisited. Dr. Britton exhibited specimens of many of the characteristic species and remarked on their distribution.

The club adjourned at five o'clock until October 8, 1907.

C. Stuart Gager,
Secretary

NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY AND MINERALOGY

At the regular monthly meeting, May 6, 1907, the following papers were presented:

Correlation of the Newark Trap Rocks of New Jersey: Professor J. Volney Lewis.

The disconnected extrusive traps west of the Watchung Mountains may be explained in several ways, but they are probably the results of scant eruptions, the New Vernon crescent being the upturned western edge of the Long Hill trap. The extrusives at Sand Brook and New Germantown are probably outlying remnants of, or at least contemporaneous with, the flows of First and Second mountains.

Darton's dike-and-sheet hypothesis of the Palisades sill is not supported by the facts, the trap being roughly conformable to the strata, so far as known, in all directions. The chance of the fissure of intrusion coinciding with the western flank of the Palisades from Weehawken to Haverstraw is exceedingly small. On the other hand, data now available quite satisfactorily establish the connection between the Palisades and the trap of Rocky Hill to the southwest, and a section along the Delaware River shows a threefold repetition of this by faulting. Thus there is but one intrusive sheet, which gives off numerous dikes and apophyses, in contrast with four extrusives, Second Mountain being double.

The intrusive is considered of later age than the first extrusive, and may be contemporaneous with one of the later extrusives or subsequent to all of them. This conclusion is in harmony with the results of recent studies of the copper deposits, which are intimately connected with the intrusion of the great Palisades sill.

There are many points of resemblance to the Connecticut Valley traps: the same number of extrusives appear in both, grouped in the uppermost strata; in both the second is a double flow; an intrusive sill lies near the base, and dikes cut the intervening strata.

This paper was illustrated with maps and lantern slides.

Recent Investigations of the Potable Water Supplies of New Jersey: Dr. Henry B. Kümmel, State Geologist of New Jersey. The paper was illustrated with maps.

Some Volcanoes of the Western Mediterranean: Dr. Henry S. Washington.

The speaker described briefly the volcanoes of Catalonia, Sardinia, Pantelleria and Linosa, which he visited for the Carnegie Institution in the summer of 1905. The Catalonian eruptions are referred to two phases, a first of extensive lava flows, followed by the formation of numerous small cinder cones, the material being basaltic in every case, nephelite appearing in some types. The Sardinian occurrences consist of extensive sheets of basalt and trachyte of Tertiary age, with the two later large volcanoes of Monte Ferru and Monte Arci, both of which show an interior core of salic rocks (trachytes and phonolites at the former and rhyolite at the latter), covered by extensive mantles of basalt. The last phase of vulcanicity in Sardinia is seen in a long line of small cinder cones of recent date, much resembling those of Catalonia, in both form and material. The island of Pantelleria is quite complex, but here also the earlier eruptions were of trachytes and phonolites, the activity closing with the formation of small, basaltic, cinder cones. The small islet of Linosa, which is almost unknown, shows nine volcanic cones, two phases of eruption being evident: the first producing basalt tuff cones, and the second basaltic cinder cones, similar to those from the other localities. The paper was illustrated by numerous photographs taken by the speaker.

A Contribution to the Geology of Maine: Dr. Ida H. Ogilvie. The paper was read by title.

A Peridotite Dike in Coal-measures of Southwestern Pennsylvania: Professor J. F. Kemp and Mr. J. G. Ross. This paper will be published in the *Annals* of the Academy.

Alexis A. Julien,
Secretary of Section

DISCUSSION AND CORRESPONDENCE

THE ADMINISTRATION OF THE OHIO UNIVERSITY

To the Editor of Science: A remarkable and, it is to be hoped, unique condition of affairs exists at present in the Ohio University. There is at least one spot in this "land of the free and home of the brave" where Russian administrative methods are in vogue. At a recent meeting of the board of trustees a member of the faculty was summarily dismissed. The president seems even to have willfully misled the man, for he discussed with him his work for next year only a few days before commencement. His dismissal was certainly not for incompetence. The charge against him was that he had unfavorably criticized the administration to one of his colleagues. Evidently the delator, who is the natural product of similar conditions everywhere, got in his nefarious work. One member of the board was guilty of the same conduct toward another member of the faculty, although he had always professed to be his special friend. Whether the discharged professor spoke the truth was not considered; he was condemned on ex parte evidence without being given a chance to be heard. Six years ago Alston Ellis, who had formerly been at the head of the Colorado Agricultural College, was chosen president. His career in that state was comparatively brief and would have been briefer had he not voted for himself when he was proposed for reelection. He had hardly been installed at the Ohio University when he gave it to be understood that although there might be committees of the board and of the faculty, his fiat was final; the rest was mere matter of form. One member of the faculty, the oldest in length of service, resigned recently rather than submit any longer to being browbeaten or ignored. When committees of which he was a member were called together he was left out, because once or twice he had had the bad taste to differ with the president. Although a petition signed by about five students out of six was presented against the acceptance of the offered resignation no notice was taken of it officially. Under almost any conceivable conditions one would have supposed that the board might wish to know the cause of such an unusual step.

When names were proposed for honorary degrees the president arbitrarily rejected those of persons whom he thought unlikely to be of any service to him and added those whom he believed or assumed to be in position to requite the favor. Another specimen of the method the president has of making himself felt was the adoption of a resolution by the board—at least he says they did—*requiring* the attendance of the entire faculty at the morning chapel exercises. A request to this effect would have accomplished the same end without producing any ill feeling; but that would not have been a demonstration of his authority. As these exercises consist, for the most part, of a platitudinous speech twenty or thirty minutes long by the president, the performance is highly edifying to at least one person present. The slender attendance on the part of the student body evinces the interesting character of the exercises. For a number of years Albert Douglas, of Chilicothe, has cherished the ambition to succeed General Grosvenor as member of Congress. Being a trustee of the Ohio University, as was also one of his foremost champions, it occurred to them that here was a chance to make the higher (?) education serve some personal ends. With the active aid of the "college crowd" he was nominated by methods that reminded one of those in vogue in Central America except for the absence of fire-arms. What the voters of the district thought of the performance was shown by the ballot cast; for while that of the Democrats remained about the same the Republican vote fell off several thousand. As General Grosvenor had been elected ten times without, in any way, using the college to help him it is evidently not essential to an acceptable candidate. Now behold how things work together for good to them that love a congressman! One after another of Mr. Douglas' henchmen were placed on the college payroll. For the most unscrupulous member of the coterie a special office, that of alumni secretary, was created, although the number of living alumni outside of Athens probably does not exceed five hundred. If they had been consulted this man would not have received one vote in fifty. As neither he nor the president of the college is a graduate of the institution the transaction has a queer look, especially when we take into account the fact that the salary attached to the position is out of all proportion to the service rendered even if it were of the most efficient sort. Albeit, Mr. Douglas is an "honorable man," and declared, when accepting the nomination that he had made no promises of any kind and was under obligations to no one.

Some months ago one of the trustees was sued at law by a member of the faculty on the ground of a misappropriation of a sum of money entrusted to him several years previous for investment. After various delays, the animus of which was plainly evident to those conversant with the local situation, the suit was decided in favor of the plaintiff and the defendant ordered to return the money, including the cost of prosecution. This was done. As the man is absolutely penniless the question naturally arose, Where did the money come from? Later it transpired that a number of members of the faculty had been approached, at the instigation of the president, for a contribution, on the ground that it would be a misfortune to lose the services of so valuable a member of the board. As he has all along been one of the most obsequious supporters of the president, having absolutely no will of his own, the grounds of his value are evident. To the credit of the faculty be it said, that most of them refused to be "grafted" for such a purpose. As the institution was founded to promote "religion, morality and knowledge" it is evident from what appears above and from much additional testimony that might be adduced that these terms are just now somewhat "liberally" interpreted.

Chas. W. Super

Athens, O.,
July 22, 1907

SPECIAL ARTICLES

IMPROVEMENTS IN THE ULTRA-VIOLET MICROSCOPE

The resolving power of a microscope varies directly as the numerical aperture of the objective and inversely as the wave-length of the light employed.[1] In other words, the shorter the wave-length the smaller the objects that can be distinguished. Light of half the usual wave-length will show details one half the size of those seen with ordinary light.

The advantage of using light of extremely short wave-length for microscopic purposes has been known for many years and was given clear expression by Czapski in 1891.[2] For some time, however, little or nothing was done to carry out Czapski's suggestions, for several reasons. First, ultra-violet light is invisible to the eye and though able to affect the photographic plate energetically, can not be focused directly even on a fluorescent screen inserted in the camera in place of ground glass, on account of the weakness and indistinctness of the image when high powers are used. Second, the glass of which ordinary objectives are made is opaque to all but the relatively long waves of ultra-violet light which lie just beyond the visible spectrum, which rays give but slightly increased resolution. So little advantage could be gained that glass objectives corrected for ultra-violet light were never made.

Early in the present century, Köhler began experimenting with lenses of quartz and fluorspar, two substances very transparent to ultra-violet light. Such lenses could be used with ultra-violet of very short wave-length which would give greatly increased resolving power.

While Köhler was in the midst of these experiments von Rohr, in 1902, made a great discovery. He invented a new system of lenses made of only a single substance, yet almost perfectly corrected for spherical aberration for light of a certain definite wave-length.

Herschkowitsch shortly before had learned how to make optically homogenous melted quartz in fragments large enough for the minute lenses of a microscopic objective. Under Köhler's energetic leadership, these discoveries were utilized at once and within two years he was able to describe a complete outfit for using ultra-violet rays in photomicrography and to publish numerous plates showing the remarkable performances of this new ultra-violet microscope.[3]

These new lenses, called monochromats, are corrected for ultra-violet light of one definite wave-length—a bright line in the spark spectrum of cadmium whose wave-length is 0.275 μ, or as more commonly written, 275 $\mu\mu$. With ordinary light composed of many wave-lengths, the images given by the monochromatic objectives are distressingly bad, blurred and fringed with rainbow colors due to chromatic aberration, for which the lenses are not at all corrected. It is out of the question to focus the object with such light, and the statement pub-

[1] This is commonly expressed by the formula $d = \lambda/2A$ where d = size of smallest detail resolved by the microscope, λ = the wave-length of the light employed, and A = the numerical aperture of the objective.

[2] Czapski, S., Die voraussichtlichen Grenzen der Leistungsfähigkeit des Mikroskops, in *Zeitschr. f. wiss. Mikroskopie*, 8: 145–155, 1891.

[3] Köhler, Aug., Mikrophotographische Untersuchungen mit ultra-violettem Licht, in *Zeitschr. f. wiss. Mikroskopie*, 21: 129–165, 273–304, Figs. 1–8, Pls. 1–6, 1904.

lished by the Zeiss firm in announcing the new outfit for sale, seemed to be only too true.[4]

The ultra-violet light of the cadmium spark being absolutely invisible (it can not even enter the human eye owing to the opacity of the lens to rays of so short a wave-length), it was necessary to devise some system for focussing the objects preparatory to photographing them. For this purpose, Köhler has used a very ingenious "seeker" which consists of a simple quartz lens and a fluorescent screen placed over the eyepiece. This screen lights up under the action of the ultra-violet rays. If the objects under the microscope be brought to a focus on this screen the image, when the seeker is removed, will be thrown to a focus on the photographic plate some 30 cm. above.

Ordinary glass being perfectly opaque for the rays from the cadmium spark, it is, of course, necessary to make of quartz not only the prisms for separating the rays used for photographing with this microscope, but also the collector and collimator lenses, the substage condenser, the slide and cover, the objective and the eyepiece. Even the ordinary glass substage mirror can not be used but must be replaced by a totally-reflecting quartz prism.

When high power monochromatic objectives are used (and these alone give resolution superior to that of a good visual objective), it is found to be tedious and difficult to get the object in focus owing to the danger of screwing the objective down too far and breaking the cover glass, if not the objective itself. When finally the object is seen, it is found to be impossible to get a sharp focus on the minute details which it is desired to photograph, because of the dimness of the image shown by the seeker. Very minute or very delicate objects, such as bacteria and small protozoa often can not be seen at all, and the observer must focus on an air bubble or some chance particle of dirt in the hope that some of the objects he seeks may lie in the same plane. Such minute, unstained living cells or the equally small constituent organs of larger cells are, however, of most interest for study with the ultra-violet microscope, not only because of the superior resolving power of the new lenses, but also because, owing to the opacity of many parts of the cell to ultra-violet light, the photographs show such living cells as if they had been fixed and stained, giving a welcome proof of the reality of the structures observed in the cells after killing and staining.

While trying to use one of the new microscopes[5] in April, 1906, on such objects, we hit upon a new and in our opinion much better method of focusing.

Instead of employing a single pair of electrode holders as planned by the makers (Fig. 1), we use a double pair of holders (four in all) arranged so that the cadmium electrodes can be instantly swung out and replaced by a pair of magnesium electrodes by means of the handles shown in Fig. 2. The cadmium electrode holders are longer than those for the magnesium for a purpose to be explained later. There is an automatic stop on the lower pair of holders to insure the spark-gap falling in the axis of the collimator lens.

We were led to devise such a swing-out electrode changer by discovering that the monochromatic lenses, through giving only badly blurred and colored images with ordinary light, *did give very good images that could be focused sharply even to the finest detail, providing strictly monochromatic visible light were used.* The spark spectrum of magnesium shows a well isolated line in the blue that proved to be very well adapted for making exploratory observations and for focusing. The wave-length of this line is 448 $\mu\mu$. It is near the line G (431 $\mu\mu$) of the solar spectrum.

In using the ultra-violet microscope by our method the object is first found and centered with a low power visual lens, using the magnesium blue light. Then the high-power

[4] "With light of considerably different wave-length, more particularly daylight, our Monochromats cannot ever be used." Carl Zeiss, Circular M. 170, Jan., 1905, p. 6.

[5] Kindly loaned by Mr. H. G. Kribs, pending the arrival of the highest power objective ordered from Germany.

monochromat is used and a detailed exploration made of the object, using the blue light all the time in a room lighted as much as desired by incandescent lamps or otherwise (the room should be darkened when the photographic exposure is made). Finally, when a particular spot is found of which a photograph is wanted, the camera is moved into place and then all is ready for the exposure except for a correction of the focus of the objective due to the change in wave-length from 448 $\mu\mu$ to 275 $\mu\mu$. This latter correction must be worked out by trial for each objective, but once determined can in future be made in a moment. The objective when used with ultra-violet light must be racked down a con-

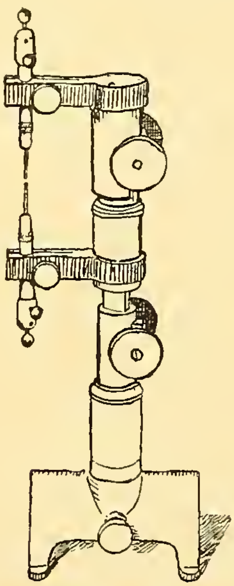

Fig. 1. Electrode holders supplied with the ultra-violet microscope by the maker. Two simple holders with screw clamps to hold the wire (or ribbon) electrodes.

siderable distance below the focal point for the blue rays. This distance that the objective must be lowered is read off on the scale of the fine adjustment screw of the microscope stand. In case of our 1.7 mm. monochromatic objective the focal correction amounts to forty divisions of the fine adjustment screw of the Zeiss Photomicrographic stand (about 0.08 mm.).

By having the arms of the magnesium electrode holders 5.5 mm. shorter than those for the cadmium it was found possible to bring the blue light and the ultra-violet rays to a

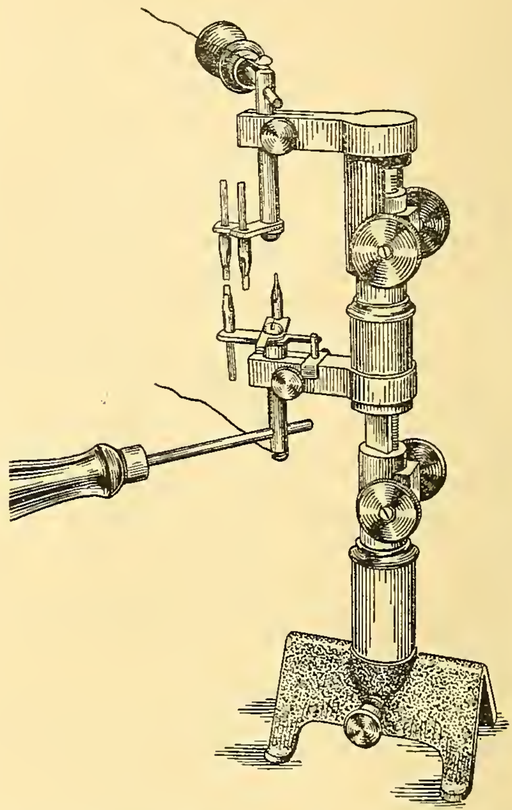

Fig. 2. New swing-out electrode holders. With two pairs of holders; the short ones for magnesium, the long for cadmium. The holders are open above so the electrodes can be removed easily for adjustment. The lower pair have a stop to bring the electrodes automatically in line. Either pair of holders may be thrown into position by turning the handles. About three tenths natural size.

focus at the same distance beyond the prisms and collector lens, though not in the same spot, as the ultra-violet rays are refracted much more than the blue rays in passing through the prisms. The illuminating apparatus is made to swing laterally as a whole, so it is very easy to direct the blue or the cadmium rays upon the face of the totally reflecting prism that throws the light into the substage condenser. By using two stops along the curved way on which it swings the illuminating apparatus can be made to stop automatically at the right place to throw the blue or the ultra-violet light into the microscope.

One great advantage of this system of focusing is that in studying living cells it is possible to do all the exploratory work and to focus exactly on the details to be photographed while using blue light. Only after the adjustments are made is the ultra-violet light thrown on for the few seconds necessary to make the photograph. This prevents injuring the cells with ultra-violet light before they are photographed—an injury to which many delicate cells are very subject, as shown by the investigations of Hertel.[6]

We have made a number of other minor improvements in the ultra-violet microscope, such as a swing-out screen to protect the eye and the microscope from the light of the spark; a pair of insulated rods to hold in place the wires that conduct the high tension electricity from the coil and leyden jars. The strength and the steadiness of the spark have been improved by inserting a few inductance coils in the circuit.

None of the changes are costly and the swing-out electrode holders can be made in a day by any good mechanic for a few dollars. On the other hand, owing to the increased precision in focusing, it will no longer be necessary to buy the whole series of expensive monochromatic lenses. For most biologists, the only one that will be needed is the highest power objective of 1.7 mm. focal length, which alone exceeds the ordinary oil immersion lenses in resolving power.

Finally, it should be noted that the monochromatic blue light of the magnesium spark is very useful for making photographs of microscopic mounts on glass slides with ordinary visual objectives. In fact, no other photomicrographic outfit is so convenient for every day use in a laboratory that is provided with an electric lighting circuit.

The improvements of the ultra-violet microscope here noted were described and exhibited in April, 1907, at the Washington meeting of the National Academy of Sciences and a few days later at the Washington meeting of the American Physical Society. An illustrated account of the ultra-violet microscope and our improvements, together with a few photographs showing its utility in the study of microscopic objects, as well as concise directions for setting up and using the outfit, has been prepared and will shortly be published as a Bulletin of the Bureau of Plant Industry, U. S. Department of Agriculture.

Walter T. Swingle,
Lyman J. Briggs
Bureau of Plant Industry,
U. S. Department of Agriculture,
Washington, D. C.,
July 26, 1907

[6] Hertel, E., Ueber Beeinflussung des Organismus durch Licht, speziell durch die chemisch wirksamen Strahlen, in *Zeitschr. f. allgem. Physiologie*, 4: 1–43, 1904.

CONCERNING THE RELATIONSHIP OF PHYLLOSTICTA SOLITARIA TO THE FRUIT BLOTCH OF APPLES

During the past four years, the writer has been collecting specimens of apple leaves and fruits having spots on them caused by fungi. Recently these specimens were examined to determine what fungi are present in the spots. As a result of this examination, it was found that a fungus which caused spots on the leaves and fruits of a wild crab-apple (*Malus coronaria* (L.) Mill.) also caused spots on the petioles and underside of the midribs of the leaves and of the fruits of the common apple (*Malus Malus* (L.) Britton), a condition that might be anticipated.

The spots on the leaves of the crab-apple are either brown or white, about a millimeter in diameter, and with a distinct, raised, brown or purplish border. In the center of the spots there is a single, minute, black pycnidium (rarely more than one). The white spots may be older than the brown ones, both occurring side by side on the leaf. The spots on the petioles and midribs of the common apple are also brown and sunken and contain one to several pycnidia, the spots occasionally coalescing.

The appearance of the fungus on the fruits of both the crab-apple and the common apple is similar and the effect is much the same. There are brown spots on the fruits, from one fourth to one half an inch in diameter, with a few to as many as fifty black pycnidia near the center of the spots, the spots often coalescing. The fungus prevents the further growth of the fruit in the infected area. The tissue becomes shrunken and firm and cracks are formed around the spots. This spotting of the common apple is the same as the disease described by Clinton[1] in 1902, under the name of "fruit-blotch (*Phyllosticta* sp.)," and, in considerable more detail, by Scott and Quaintance[2] in a bulletin recently issued by the United States Department of Agriculture.

Finding the fungus on the petioles of the common apple suggested the possibility that it might also occur on the branches. A search was at once made for it on a tree where it had previously been found on the petioles and fruits and it was found on both the yearling and older branches. It was more in evidence on the "water sprouts" and on the branches growing in partial shade than on those exposed to the direct sunlight, not only on this tree, but on others in the same orchard. The next day the fungus was found on the branches of the wild crab-apple tree where the first specimens of it were collected on the leaves and fruits.

On the twigs of last year's growth, there are light brown, flat, elliptical spots from one fourth to one half an inch in diameter, containing from a few to twenty to thirty black pycnidia. The bark is usually cracked and raised around the edge of the spot, giving it the appearance of a small canker. On the older branches the fungus grows out from the original spot and forms pycnidia around it. The formation of pycnidia outside of the point of primary infection in successive years indicates that the fungus is perennial and that it winters over on the branches. Pycnidia were developing this spring at about the same time that the apple trees were beginning to show signs of activity. After pieces of the infected twigs had been in a moist chamber a few days, small white masses of spores began to ooze out of the pycnidia. These spores germinated when seeded in a synthetic-agar culture medium and a mycelium developed. Infection of the leaves and fruit during the spring and summer is probably brought about by the spores that develop in the cankers on the branches.

The spots on the petioles, fruits, twigs and branches are much alike in size and general appearance, but they are five to ten or more times larger than the spots on the leaves of the crab-apple and the number of pycnidia in them is many times greater.

Several investigators, including those already referred to, seem to agree that the "fruit-blotch," "apple-blotch," "dry-rot," etc., is caused by a species of *Phyllosticta*, but what species is not indicated. The fungus as it occurs on the leaves of the wild crab-apple furnishes a clue for its determination. In 1895, Ellis and Everhart[3] described and named a fungus occurring on the leaves of the same host as *Phyllosticta solitaria* E. & E., which in all probability was the same as the one under consideration. Both have the "spots minute, 1 mm., round, pale white with a darker border. Perithecia epiphyllous, solitary, one in the center of each spot, 75 μ diam. Sporules sub-globose, hyaline, nucleate, 5–6 μ diam.," and, in addition, those collected by the writer have many of the spots brown and the pycnidia ("perithecia") and spores larger. There is a considerable variation in the size of the pycnidia on the same leaf and of the spores in a pycnidium. The spores found by the writer range from $5–6 \times 6–9\ \mu$, the smallest being about the

[1] Clinton, George P., "Apple Rots of Illinois," Univ. Ill. Bul. **69**: 190–191, February, 1902.

[2] Scott, W. M., and Quaintance, A. L., "Spraying for Apple Diseases and the Coddling Moth in the Ozarks," U. S. Dept. Agr. Bul. **283**: 14–18, April 29, 1907.

[3] Ellis, J. B., and Everhart, B. M., *Proc. Phil. Acad.*, 430, 1895.

same size as those of Ellis and Everhart.[4] Type specimens have not been seen by the writer. The pycnidia are somewhat larger on the fruits and branches, but the spores are about the same size as those on the crab-apple leaves. The following are the spore measurements: From the same crab-apple tree—leaves, 5–6 × 6–9 μ; fruits, 5–6 × 8–9 μ; branches, 6–7 × 9 μ. From the same common apple tree—petioles, 5–6 × 7–9 μ; fruits, 5–6 × 8–10 μ; branches, 5–7.5 × 7.5–10 μ. The largest spore measurements are mostly from fresh spores developed in the moist chamber. These spore measurements agree with those of Clinton's[5] "fruit-blotch" fungus.

From the above, it seems evident that the "fruit-blotch" disease of apples is caused by *Phyllosticta solitaria* E. & E. and that the fungus causing it may occur on either the leaves, fruits, or branches (or on one or more of them at the same time) of the wild crab-apple (*Malus coronaria* (L.) Mill.) and the common apple (*Malus Malus* (L.) Britton).

Specimens of the fungus on branches can be furnished to persons requesting them.

John L. Sheldon

West Virginia Agricultural Experiment Station, Morgantown, W. Va.,
May 25, 1907

[4] Ellis, J. B., and Everhart, B. M., *Proc. Phil. Acad.*, 430, 1895.

[5] *Loc. cit.*

HOLOTHURIAN NAMES

An excellent memoir on "The Holothurians of the Hawaiian Islands" by Dr. Walter K. Fisher, of Stanford University, has just been published "from the Proceedings of the United States National Museum." As I had been informed that Dr. Fisher had fully subscribed to all the nomenclatural rules of the American Ornithologists' Union, I was curious to learn whether he had applied those rules to the nomenclature of the group in question. Years ago, being much interested in the echinoderms, I looked up various questions, with the result of finding unsatisfactory conditions in the naming of the group. The full history of the various episodes has not been given in the current histories by Ludwig (pp. 303–316) and others. I call attention to some here.

Dr. Fisher has referred to "*Holothuria* Linnæus, Systema Naturæ, 10th ed., 1758," as the source for that name. Evidently he had not consulted the volume cited, for there is no mention in it of any animal now called *Holothuria*.

In the tenth edition (I., p. 657) Linnæus defined his genus "260. Holothuria" as follows: "*Corpus* gibbum, nudum, ovale, natans. *Tentacula* sæpius ad alteram extremitatem, inæqualia numero et figura." He referred to it four species, (1) *physalis*, a Physaliid or "Portuguese man-of-war," and three other animals having no resemblance to holothurians. Unquestionably, the type of the genus and description was the first species.

In the twelfth edition (I., p. 1089) Linnæus modified his definition and, while including the four species of the tenth, added five species, (1) *frondosa* (*Cucumaria*), (2) *Phantapus* (*Psolus*), (3) *tremula* (*Holothuria* of moderns), (8) *pentactes* (*Cucumaria*) and (9) *priapus* (a worm). This is the starting point of the ordinary holothurian history.

One naturalist who was aware of these facts would not modify the nomenclature to correspond. It remains to be seen whether Dr. Walter Fisher or Dr. Hubert L. Clark will. The case is clear. If the tenth edition of the Systema is accepted as the starting-point, certainly *Holothuria can not* be retained with its modern limits, since the original was unaccompanied by reference to a single representative and the diagnosis is inapplicable. One of the synonyms of the modern genus must then replace *Holothuria*. *Fistularia*, the oldest, can not be used, as it was preoccupied. There are many later names, more or less applicable, but which one shall be used will depend on the limits given to the genus. If we accept it with the extent given by Ludwig, *Bohadschia* of Jäger (1833) may be taken. If it is limited by the exclusion of the group so named, *Trepang* (Jäger, 1833), *Sporadipus* (Brandt, 1835), *Thelenota* (Brandt, 1835) and several others are available, according to circumstances.

It may be added that *Actinopyga* should not be used for the genus first named *Mülleria* by Jäger, as Brandt had long before published a subgeneric name (*Microthele*) which is applicable.

While on the subject remarks on several family names may be in order. Of late years almost all echinodermists have adopted the quasi-descriptive names given by Brandt (Aspidochirotæ and Dendrochirotæ) instead of Holothuriidæ and Cucumariidæ. The last, however, have been adopted by Dr. Fisher and are in accordance with the custom prevalent among modern zoologists. Both names were attributed to Ludwig (1894), but Holothuridæ was used by Gray as early as 1842 and 1848. Gray also used Cuvieriadæ and Pentactidæ, but, as they were based on obsolete synonyms, they are synonyms of Cucumariidæ. *Holothuria* being discarded, of course *Holothuriidæ* can not be used but may be replaced by *Bohadschiidæ,* based on the earliest generic name.

Theo. Gill

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

MONTHLY WEATHER REVIEW

In Nos. 3 and 4 of the *Monthly Weather Review* (1907) the following articles appeared: "Rainfall and Run-off of the Catskill Mountain Region," by Thaddeus Merriman; a report to the Board of Water Supply of the City of New York, illustrated by a map of the Catskill Mountains and vicinity, showing by isohyetal lines the probable mean annual rainfall; also by cross-sections, showing rainfall values along different critical lines.

"Variation of Precipitation in the Adirondack Region," by Professor A. J. Henry; comments upon a paper by R. E. Horton, in the January *Monthly Weather Review,* pointing out that Mr. Horton's rainfall amounts for the lustrum 1901–5 are not to be taken as average or normal values, this five-year period having been one of heavy precipitation.

"The Temperature in the Front and in the Rear of Anticyclones up to an Altitude of 12 Kilometers, compared with the Temperature in the Central Area," by H. H. Clayton. This summarizes results obtained by means of *ballons-sondes* from St. Louis. Up to about 8 kilometers the temperature was lower in front and higher in the rear than in the central area; between 8 and 10 kilometers the central area was colder than front or rear; and above 10 kilometers the lowest temperature was in the rear of the anticyclone and the highest in front. Mr. Clayton suggests that the cold air in the northern part of the anticyclone is moving faster than the anticyclone towards the southeast and sinks towards the earth's surface on account of its greater specific weight as compared with the surrounding air. The center of the anticyclone is about midway between the northwest and southeast limits of the inclined stratum of cold air. The circulation of air around a central area is confined to a stratum within about 2 kilometers of the earth's surface. The movement of the air at different heights in cyclones and anticyclones is shown by means of diagrams.

"Cooling by Expansion and Warming by Compression," by Professor C. E. Peet, and "Espy's Nepheloscope," by Professor Cleveland Abbe, describe simple apparatus for use in condensation experiments in school meteorological teaching.

"Bells as Barometers," by Professor Cleveland Abbe; note on some erroneous statements which have been going the rounds of the press regarding the so-called "water-bells" near Lebekke, in Belgium.

"A Proposed New Method of Weather Forecasting by an Analysis of Atmospheric Conditions into Waves of Different Lengths." This is a paper of unusual importance by H. H. Clayton which presents, in brief outline, the results of studies extending over many years in connection with long-range forecasting. The author believes that "the discovery of these facts not merely opens the way to a great improvement in the forecasting of weather from day to day, but also . . . furnishes a scientific basis for long-range forecasting." This paper is well illustrated, and merits careful study.

"The Velocity of Centers of High and Low Pressure in the United States," by C. F. von Herrmann; a determination of these velocities for the period 1878–1904, and a comparison with Loomis's results for 1872–84. Substantial agreement is found. The average annual velocity from the Weather Bureau records is slightly higher than the earlier averages. The minimum is found in June (24.0 miles an hour) instead of August (22.6 miles). The highs show a mean annual of 25.6 miles; a maximum of 29.5 in January and a minimum of 22.1 in August.

"The 'Southwest' or 'Wet' Chinook," by H. Buckingham; "The 'Dry' Chinook in British Columbia," by R. T. Grassham; and "The Wet and Dry Chinooks," by Professor Cleveland Abbe.

COAST METEOROLOGICAL STATIONS OF CHILE

The seventh volume of the "Anuario del Servicio Meteorolojico de la Direccion del Territorio Maritimo" of Chile (1905) contains the valuable observations made at sixteen stations along the coast of Chile. In this volume there are given for the first time the records from the port of Punta Arenas, in the Strait of Magellan. The list of stations is an interesting one and includes the island of Juan Fernandez and Punta Dungeness, the latter at the eastern end of the Strait. The southernmost stations, especially Islote de los Evangelistas, Punta Arenas and Punta Dungeness, furnish valuable data which, with those now being recorded by the Argentine Meteorological Service at its far southern stations, will soon fill up one of the gaps in the meteorological charts of the world.

UPPER AIR CURRENTS OVER THE POLAR SEA

The *Beiträge zur Physik der freien Atmosphäre,* Vol. 2, No. 3, contains a brief report by Dr. H. Hergesell of his observations by means of balloons, undertaken during the past summer in the Arctic Ocean on board the *Princess Alice,* with the assistance of the Prince of Monaco. As to wind direction, the meteorological element concerning which there is probably the most interest, it is stated that the direction was variable (July 13–September 8), so that no prevailing direction could be established. The air moved out from the pole as often as it moved poleward. As the observed currents undoubtedly belonged to the great circumpolar whirl, it is probable that the latter must frequently have changed its position within the polar basin.

HUMIDITY CHARTS OF THE UNITED STATES

The first complete series of monthly relative humidity charts for the United States appears in the *Report of the South African Association for the Advancement of Science* for 1906. These charts, based on data for the uniform period of fourteen years (1888–1901), published in the *Report of the Chief of the Weather Bureau* for 1901–02, p. 318, were drawn by Kenneth Johnson, of Harvard University. The lines are drawn for differences of 10 per cent. Relative humidity charts for January, July and the year had already been published, but the present series is complete for all the months, and is therefore a distinct contribution to the climatology of the United States.

CHANGE OF CLIMATE IN DAMARALAND?

In a recent number of *Nature* (Vol. 75, 1907, 536–537), Professor H. H. W. Pearson considers the coniferous plant *Welwitschia,* discovered by Welwitsch in Damaraland. The apparent failure of natural reproduction of this plant in a region well suited to the adult plants suggests to Professor Pearson that the climate is becoming drier, and the conditions necessary to start germination are less frequent than formerly. The species is evidently losing ground, a fact which suggests climatic change.

SNOW GARLANDS

In *Das Wetter* for June, 1907, there are published two views of a very rare phenomenon known in Germany as "Schneegirlanden." These were observed by Dr. C. Kassner, in Berlin, on January 31, 1907. The photographs were taken by him. The first description of snow-garlands was given by Hellmann in the *Met. Zeitschr.* for March, 1889, and the second was given by Assmann, in the June, 1889, number of the same journal. The curious development of these garlands, as reported by Kassner, resulted from the melting of snow on the roof of a building, and a subsequent sliding of the snow down the slope of the roof. Finally a rounded, rope-like roll of snow hung pendant from the edge of the roof, in the shape of a very flat U, the ends remaining fast on the edge of the roof.

NOTE

"The Progress of Science as illustrated by the Development of Meteorology" is the subject of Professor Cleveland Abbe's Presidential Address before the Philosophical Society of Washington, read December 8, 1906, and published in the *Bulletin* of the Society, Vol. XV., pp. 27–56, 1907.

R. DeC. Ward

SCIENTIFIC NOTES AND NEWS

Dr. Rollin Thomas Chamberlin and Dr. Stephen Reid Capps, who received the degree of doctor of philosophy at the summer convocation of the University of Chicago, have been given appointments in the U. S. Geological Survey.

It is announced that Commander R. E. Peary is about to leave New York for the Arctic regions on the *Roosevelt*.

Lieutenant E. H. Schackelton sailed from London on July 30 on the *Endurance* for the Antarctic regions.

Dr. John B. Watson, of the department of psychology at Chicago University, has been spending some time at the Station for Marine Biology of the Carnegie Institution at Dry Tortugas, where he has been studying the habits of the sea-gulls.

Professor F. S. Earle, formerly in charge of the mycological collections at the New York Botanical Garden and later director of the Cuban Agricultural Experiment Station, has spent several weeks at the garden, continuing his investigations of the gill-fungi.

In the issue of Science for July 26 it was stated that Dr. Charles A. White is now the oldest living geologist in North America. Our attention has been called to the fact that Dr. Martin H. Boyé, of Coopersberg, Pa., though best known as a chemist, was from 1838 to 1843 assistant geologist, as well as chemist, to the Pennsylvania Geological Survey. Dr. Boyé was born at Copenhagen ou December 6, 1812. He and Dr. Wolcott Gibbs are the only surviving founders of the American Association for the Advancement of Science, and Dr. Boyé is the only surviving founder of the Association of American Geologists and Naturalists which developed into the association. Lawrence C. Johnson, of Patchuta, Miss., though primarily an attorney and counsellor at law, has also made valuable contributions to geology and was publishing as recently as last year. Mr. Johnson was born at Chester, S. C., on August 18, 1822.

President G. Stanley Hall, Ph.D., LL.D., of Clark University, was announced to give at the summer session of the University of Chicago a series of five lectures on the following subjects: "The Pedagogy of History," "Moral and Religious Education," "The Ideals and Methods of Teaching," "The Claims of Modern versus Ancient Languages," and "The Feelings."

Dr. Lewellys F. Barker, professor of medicine in Johns Hopkins University and formerly head of the department of auatomy in the University of Chicago, gave the doctorate address at the eighty-fifth commencement of Rush Medical College, held in Chicago, on July 12, on "The Psychic Side of Medicine."

Professor Willis Grant Johnson, associate editor of the *American Agriculturist*, has been appointed trustee of the New York State Agricultural Experiment Station at Geneva to succeed Milo H. Owen, deceased. Professor Johnson is a graduate of the Ohio State University and of Cornell University and has been a close student of entomology and allied agricultural branches while instructor at Stanford University and at the University of Illinois. He was for some years entomologist of the Maryland State Agricultural Experiment Station.

Dr. Egon von Oppolzer, associate professor of astronomy at Innsbruck, has died at the age of thirty-seven years.

There will be a civil service examination, on September 4 and 5, to fill existing vacancies in the position of hydrographic surveyor in the navy department at salaries ranging from $1,200 to $2,200 a year. On September 9, there will be an examination to fill vacancies in the position in the Department of Agriculture of assistant crop technologist, at salaries ranging from $1,500 to $2,000 per annum, and of crop technologist, at salaries ranging from $2,000 to $3,000 per annum, depending upon the training and experience shown.

The Minnesota legislature has voted $5,000 a year towards the maintenance of a Pasteur Institute at Minneapolis.

The members of the Liverpool University archeological expedition which left Liverpool at the end of April have reached Aleppo, from the mountains of Arabistan and are returning to England. Interesting discoveries are reported.

The first Congress of Stomatology will be held in Paris from August 1 to 5, under the presidency of Dr. Galippe, of Paris, and Dr. Revier, of Lille. Practitioners of all nationalities will be allowed to take part in the proceedings.

During the first three weeks of July, Mr. S. P. Fergusson conducted a third expedition to Mount Washington, N. H., for the purpose of comparing the meteorological conditions on the summit with those of the free air, employing kites to lift the meteorographs. Continuous records of atmospheric pressure, temperature, humidity and the velocity of the wind have been maintained on the summit (1,916 meters) and at Twin Mountain (426 meters) during a part of each summer in 1905, 1906 and 1907. In cooperation with Professor Rotch, who assumed the cost of the additional experiments, the same instrumental equipment was employed by Mr. Clayton in obtaining kite-flights near Mt. Washington at the time of the international observations on July 22 to 27 inclusive.

Mary W. Whitney, professor of astronomy at Vassar College and president of the Nantucket Maria Mitchell Association, has been for a week at the Maria Mitchell Memorial on Nantucket, giving instructive talks to members and their guests on "Maria Mitchell" and on "Recent Discoveries in the Solar System." Professor Whitney has appointed a building committee to consider plans for an observatory to house properly an equatorial telescope recently donated to the association. Already the sum of $2,138 has been subscribed and the association in charge of the memorial hopes for subscriptions to enable them not only to house the telescope but also to equip the observatory so that it may be available for astronomical classes in the near future.

Reuter's Agency is informed that news has been received at the Scottish Oceanographical Laboratory of the arrival of the Scottish Arctic expedition on board the steamship *Phœnix* at Prince Charles Foreland. Very heavy weather was encountered after leaving the Norwegian coast, and a large quantity of ice exceptionally far to the south and west of Bear Island. This ice continued to Spitzbergen. When Dr. William S. Bruce and his companions arrived at Prince Charles Foreland on June 11 they found the country completely covered with snow. The expedition experienced considerable difficulty in landing the scientific instruments, equipment and stores on account of a perpendicular wall of ice, which fringed the coast. Captain Hjalmar Johansen joins the expedition this month.

We learn from *Nature* that a long excursion, extending from August 15 to August 24, has been arranged by the Geologists' Association. The district selected is Appleby and its surroundings, and the party will be under the direction of Dr. J. E. Marr, F.R.S. Interesting observational work has been allocated for each day, and the arrangements which have been made for visitors will ensure comfort at a moderate expense. The party will leave Euston at 11:30 A.M. on August 14, and geologists who wish to avail themselves of the opportunity offered should communicate with Mr. A. C. Young, 17 Vicar's Hill, Lewisham, S.E. The association has arranged an excursion also in connection with the centenary celebrations of the Geological Society in September next. The excursion will be to Reading on September 28, and will be conducted by

Messrs. H. W. Monckton, O. A. Shrubsole and H. J. Osborne White.

The British Meteorological Office has sent out a circular to the effect that the International Aeronautical Commission, which met at Milan last autumn, decided to obtain from as many stations as possible in the northern hemisphere simultaneous records of the conditions of wind, temperature and humidity prevailing in the upper air during the last week of this month. Most of the continental governments are taking part in this work, and some are sending out special vessels for the purpose of obtaining records from over the sea. England is to be represented by four land stations, one near Portsmouth, one near Manchester, one in Herefordshire and one in Scotland. The plan is to send up small balloons with very light self-recording instruments hanging from them. Often the balloons attain a height of ten or more miles before falling to the ground. A label is attached to the instruments offering a reward and giving instructions to the finder. It is hoped that any person finding one of these instruments will communicate with the address given, and so help to carry out the object of the inquiry. Many meteorologists hope that information may be obtained, which will in time lead to more certainty in the forecasting of the weather.

The first meeting of the International Association of Medical Museums was held at the Army Medical Museum, Washington, D. C., on May 6. According to the *Journal of the American Medical Association*, the committee on organization was empowered to frame a constitution and by-laws and to submit it to the active members. The following officers were elected: President, Major Carroll, Army Medical Museum, Washington, D. C.; vice-presidents, Professor W. G. MacCallum, Johns Hopkins Medical School, Baltimore; Professor J. Ritchie, Oxford University, England; and Professor J. Ludwig Aschoff, University of Freiburg, Germany; secretary-treasurer, Dr. M. E. Abbott, McGill Medical Museum, Montreal, Canada. A bulletin of museum information will be issued to facilitate exchange of specimens. The next meeting is to be held in connection with the Congress of Tuberculosis in Washington, D. C., in October, 1908. The first bulletin of the association contains an introductory statement of the purposes of the association, a full account of the meeting, a list of the organizing members, and an appeal for specimens for the medical museum of McGill University which suffered very serious loss by fire.

The International Council for the Investigation of the Sea met in London for the first time by invitation of the British Government during the week beginning June 10. The *Geographical Journal* states that on the evening of that date they were entertained to dinner by the Royal Geographical Society and the Geographical Club, when about thirty members of the council were present. After dinner a meeting of the society was held, when Dr. Otto Pettersson, acting president of the council, gave a lecture on Oceanic Circulation; after that several representative members of the council gave some account of the varied work which it has been carrying on during the past five years. During the rest of the week the council held its official meetings, and were entertained by the minister of agriculture, the secretary for Scotland, the lord mayor, and the Fishmongers' Company; they were also received at Buckingham Palace by King Edward, and many of them were present at the annual conversazione of the society at the Natural History Museum, at South Kensington.

The British Medical Journal says: Dr. Cabanès, editor of the *Chronique Médicale*, has recently founded a medico-historical society in France. Its object is not the study of the history of medicine, but the study of medicine in relation to general history, literature and art. Dr. Cabanès himself, Galippe, Brachet, Littré and others have shown what light may be thrown on obscure problems of history by a study of the physical constitution and illnesses of rulers. Similar studies have been made of Maupassant, Zola, Flaubert, Alfred de Musset and other writers and poets, and have done much to elucidate their intellectual outlook and to supply the physical grounds for their criticism of life. The committee of the new society includes the names of Drs. Brissaud, Debove, Fournier, Gilbert, Galippe, Grasset, Huchard, Lacassagne Landouzy, Lannelongue, Pinard, Poncet, Pozzi Régis, Charles Richet, and Albert Robin as representatives of medicine, and those of such men as Anatole France, Jules Lemaitre, Victorien Sardou, and Jules Clarétie among representatives of literature. Altogether there are forty members of the Committee of Direction and Patronage, all members of the Institute of France, the Academy of Medicine, or connected with the Collége de France or the University. It begins its existence under the happiest auspices, and we shall look forward with the keenest interest to the results of work in which the most advanced science is combined with all that is best in literature and art.

The London *Times* states that the president of the Liverpool School of Tropical Medicine, Sir Alfred Jones, has received the following telegram from the sleeping sickness expedition of the school, which was sent to Africa early in May last: "Send quantity atoxyl immediately. Cattle experiments indicate success. Montgomery Trypanosomiasis Expedition, Broken Hill, N. W. Rhodesia." Atoxyl is the name of the remedy recommended for therapeutical treatment in cases of sleeping sickness. The sleeping sickness expedition arrived at Kalomo on June 10, where they were the guests of Mr. Codrington, the administrator, who gave every facility for their work. At the end of July it was intended that Dr. Kinghorn, one of the members of the expedition, should proceed direct to Fort Jameson. Mr. Montgomery, the other member, will go west to the River Kafue, and up that river towards the Congo. He will then strike across the country, and meet Dr. Kinghorn on the river Luapala about November, traversing the whole of the time a territory infested by the T'se T'se fly. One of the main objects of the expedition, which is financed by the Liverpool School and supported by the British protectorates concerned and the British South African Company, is to endeavor to prevent the spread of sleeping sickness into districts hitherto uninfested. The expedition will also study the disease on the spot, and will pay special attention to the disease of animals and the distribution of biting flies. It is the fourth expedition of the Liverpool School that has been sent to Africa to study trypanosomiasis.

UNIVERSITY AND EDUCATIONAL NEWS

At the summer convocation of the University of Chicago President Judson stated that Mr. Rockefeller had given during the present year about $3,000,000 for endowment and for other purposes and land on the south side of the Midway valued at $2,000,000. These great gifts have already been reported, but should be repeated now that they have official confirmation. The statement made by the daily papers, but not printed in Science, that Mr. Rockefeller had endowed a pension system in the University of Chicago is not confirmed. The land devoted to the University of Chicago is now a little more than a hundred acres. The gift of Mr. Rockefeller enabled the university to make advances in the salaries of more than eighty members of the faculty.

A College of Education has recently been organized at Ohio State University with the object of preparing educators above the rank of grade teachers and stimulating study and research along educational lines. W. W. Boyd, formerly high school visitor, has been appointed dean and Geo. D. Hubbard, of the department of geology elected secretary. The bulletin of the college, issued in July of this year, announces courses in subject matter in all lines of the College of Arts, Philosophy and Science, in Manual Training and Domestic Science, courses in education, and courses in the teaching of the various subjects. Students may register in September, '07.

Dr. Ludwig Mond has subscribed $15,000 and Dr. Aders Plimmer $10,000 for a building for the department of physiology, University College, London. This will be erected in the south quadrangle, hitherto the playground of the boys' school, and will constitute the first instalment of a building for the accommodation of anatomy, pharmacology, and physiology.

Arthur Crathorne, Ph.D. (Göttingen) and R. L. Börger, Ph.D. (Chicago), have been appointed instructors in mathematics at the University of Illinois. Dr. Crathorne was formerly instructor in the University of Wisconsin, and Dr. Börger has been professor of mathematics in the University of Florida.

G. D. Birkhoff, A.B. (Harvard), Ph.D. (Chicago), has been appointed instructor in mathematics in the University of Wisconsin.

Among recent appointments at the University of Chicago are the following: Charles Scofield Blair, to a research assistantship in geology; J. Claude Jones, to a research assistantship in geology; Arthur Carleton Trowbridge, to a laboratory assistantship in geology; Frank Adolph St. Sure, to an assistantship in anatomy; Stephen Walter Ransom, to an assistantship in experimental therapeutics, department of physiology; Hermann Irving Schlesinger, to an associateship in chemistry; Otis William Caldwell, to an associate professorship in botany and supervisorship of nature study in the School of Education. Promotions have been made as follows: Storrs Barrows Barrett, associate in astronomy, to an instructorship; Philip Fox, associate in astrophysics, to an instructorship; Robert James Wallace, associate in photophysics in the department of astronomy, to an instructorship.

In response to an urgent request from the large Bohemian population of Nebraska provision has been made for the teaching of the Bohemian language in the University of Nebraska, by the appointment of Mr. Jeffrey D. Hrbek, of Cedar Rapids, Iowa, to be instructor in German and Slavonic. Mr. Hrbek is a native of Bohemia, who has fitted himself for teaching in American schools by completing one of the regular courses of study in the Iowa State University. For the present his work is to be under the supervision of the professor of Germanic languages, until it develops sufficiently to warrant giving it a department by itself.

Dr. E. W. Brown, Ph.D. (Yale), has been appointed first assistant in the laboratory for animal physiology, Bureau of Chemistry, U. S. Department of Agriculture.

Mr. Adam Sedgwick, F.R.S., fellow of Trinity College, Cambridge, has been elected professor of zoology and comparative anatomy at Cambridge, in succession to the late Professor Newton. The London *Times* says: Mr. Sedgwick was educated at Marlborough and Trinity College. On the death of the late Professor F. M. Balfour in 1882, Mr. Sedgwick took over the direction of the Morphological Laboratory, and during the last twenty-five years the Cambridge Zoological School has owed much to his energy and his powers as a teacher. Mr. Sedgwick has published numerous scientific memoirs, amongst the most notable of which are those dealing with the development of Peripatus. He is also the author of an exhaustive text-book of zoology, one volume of which has still to appear. For the last ten years he has been tutor of Trinity College.

At the University of Leeds the council has appointed Dr. Walter Garstang to the professorship of zoology, and Mr. V. H. Blackman to the professorship of botany. The two chairs are to take the place of the professorship of biology hitherto held by Professor Miall. Professor Garstang, M.A., D.Sc. (Oxford), is at present chief naturalist to the Marine Biological Association and is in charge of their Lowestoft Laboratory.

At Corpus Christi College, Cambridge, Mr. Herbert Charles Resker, B.A., has been elected to the Hewett research scholarship for natural science.

Dr. Graham Steell has been appointed professor of medicine at the University of Manchester.

Professor W. His, a son of the eminent anatomist, has been appointed to succeed Professor von Leyden in the chair of special pathology and therapeutics in the University of Berlin.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, AUGUST 16, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ADDRESS OF THE PRESIDENT OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

TO-NIGHT, for the first time in its history, the British Association meets in the ancient city of Leicester; and it now becomes my privilege to convey to you, Mr. Mayor, and to the citizens generally, an expression of our thanks for your kind invitation and for the hospitable reception which you have accorded to us.

Here in Leicester and last year in York the association has followed its usual custom of holding its annual meeting somewhere in the United Kingdom; but in 1905 the meeting was, as you know, held in South Africa. Now, having myself only recently come from the Cape, I wish to take this opportunity of saying that this southern visit of the association has, in my opinion, been productive of much good; wider interest in science has been created amongst colonists, juster estimates of the country and its problems have been formed on the part of the visitors, and personal friendships and interchange of ideas between thinking men in South Africa and at home have arisen which can not fail to have a beneficial influence on the social, political and scientific relations between these colonies and the mother country. We may confidently look for like results from the proposed visit of the association to Canada in 1909.

One is tempted to take advantage of the wide publicity given to words from this

[1] Leicester, 1907.

chair to speak at large in the cause of science, to insist upon the necessity for its wider inclusion in the education of our youth and the devotion of a larger measure of the public funds in aid of scientific research; to point to the supreme value of science as a means for the culture of those faculties which in man promote that knowledge which is power; and to show how dependent is the progress of a nation upon its scientific attainment.

But in recent years these truths have been prominently brought before the association from this chair; they have been exhaustively demonstrated by Sir William Huggins from the chair of the Royal Society, and now a special guild[2] exists for their enforcement upon the mind of the nation.

These considerations appear to warrant me in following the healthy custom of so many previous presidents—viz., of confining their remarks mainly to those departments of science with which the labors of their lives have been chiefly associated.

THE SCIENCE OF MEASUREMENT

Lord Kelvin in 1871 made a statement from the presidential chair of the association at Edinburgh as follows:

> Accurate and minute measurement seems to the non-scientific imagination a less lofty and dignified work than the looking for something new. But nearly all the grandest discoveries of science have been the reward of accurate measurement and patient, long-continued labor in the minute sifting of numerical results.

Besides the instances quoted by Lord Kelvin in support of that statement, we have perhaps as remarkable and typical an exemplification as any in Lord Rayleigh's long-continued work on the density of nitrogen which led him to the discovery of argon. We shall see presently that, true as Lord Kelvin's words are in regard to most fields of science, they are specially applicable as a guide in astronomy.

[2] The British Science Guild.

One of Clerk Maxwell's lectures in the Natural Philosophy Class at Marischall College, Aberdeen, when I was a student under him there, in the year 1859, ran somewhat as follows:

> A standard, as it is at present understood in England, is not a real standard at all; it is a rod of metal with lines ruled upon it to mark the yard, and it is kept somewhere in the House of Commons. If the House of Commons catches fire there may be an end of your standard. A copy of a standard can never be a real standard, because all the work of human hands is liable to error. Besides, will your so-called standard remain of a constant length? It certainly will change by temperature, it probably will change by age (that is, by the rearrangement or settling down of its component molecules), and I am not sure if it does not change according to the azimuth in which it is used. At all events, you must see that it is a very impractical standard—impractical because, if, for example, any one of you went to Mars or Jupiter, and the people there asked you what was your standard of measure, you could not tell them, you could not reproduce it, and you would feel very foolish. Whereas, if you told any capable physicist in Mars or Jupiter that you used some natural invariable standard, such as the wave-length of the D-line of sodium vapor, he would be able to reproduce your yard or your inch, provided that you could tell him how many of such wave-lengths there were in your yard or your inch, and your standard would be available anywhere in the universe where sodium is found.

That was the whimsical way in which Clerk Maxwell used to impress great principles upon us. We all laughed before we understood; then some of us understood and remembered.

Now the scientific world has practically adopted Maxwell's form of natural standard. It is true that it names that standard the meter; but that standard is not one millionth of the earth's quadrant in length, as it was intended to be; it is merely a certain piece of metal approximately of that length.

It is true that the length of that piece of metal has been reproduced with more precision, and is known with higher accuracy in terms of many secondary standards, than is the length of any other standard in the world; but it is, after all, liable to destruction and to possible secular change of length. For these reasons it can not be scientifically described otherwise than as a piece of metal whose length at 0° C. at the epoch A.D. 1906 is = 1,553,164 times the wave-length of the red line of the spectrum of cadmium when the latter is observed in dry air at the temperature of 15° C. of the normal hydrogen-scale at a pressure of 760 mm. of mercury at 0° C.

This determination, recently made by methods based on the interference of light-waves and carried out by MM. Perot and Fabry at the International Bureau of Weights and Measures, constitutes a real advance in scientific metrology. The result appears to be reliable within one ten-millionth part of the meter.

The length of the meter, in terms of the wave-length of the red line in the spectrum of cadmium, had been determined in 1892 by Michelson's method, with a mean result in almost exact accordance with that just quoted for the comparisons of 1906; but this agreement (within one part in ten millions) is due in some degree to chance, as the uncertainty of the earlier determination was probably ten times greater than the difference between the two independent results of 1892 and 1906.

We owe to M. Guillaume, of the same International Bureau, the discovery of the remarkable properties of the alloys of nickel and steel, and from the point of view of exact measurement the specially valuable discovery of the properties of that alloy which we now call "invar." He has developed methods for treatment of wires made from this alloy which render more permanent the arrangement of their constituent molecules. Thus these wires, with their attached scales, may, for considerable periods of time and under circumstances of careful treatment, be regarded as nearly invariable standards. With proper precautions, we have found at the Cape of Good Hope that these wires can be used for the measurement of base lines of the highest geodetic precision with all the accuracy attainable by the older and most costly forms of apparatus; whilst with the new apparatus a base of 20 kilometers can be measured in less time and for less cost than one of a single kilometer with the older forms of measurement.

THE GREAT AFRICAN ARC OF MERIDIAN

In connection with the progress of geodesy, time only permits me to say a few words about the Great African arc on the thirtieth meridian, which it is a dream of my life to see completed.

The gap in the arc between the Limpopo and the previously executed triangulation in Rhodesia, which I reported to the Association at the Johannesburg meeting in 1905, has now been filled up. My own efforts, at 6,000 miles distance, had failed to obtain the necessary funds, but at Sir George Darwin's instance contributions were obtained from this association, from the Royal Society and others, to the extent of half the estimated cost; the remaining half was met by the British South Africa Company. But for Darwin's happy intervention, which enabled me to secure the services of Captain Gordon and his party before the Transvaal Survey Organization was entirely broken up, this serious gap in the great work would probably have long remained; for it is one thing to add to an existing undertaking of the kind, it is quite another to create a new organization for a limited piece of work.

Since then Colonel (now Sir William)

Morris has brought to a conclusion the reductions of the geodetic survey of the Transvaal and Orange River Colony, and his report is now in my hands for publication.

Dr. Rubin, under my direction, at the cost of the British South Africa Company, has carried the arc of meridian northwards to south latitude 9° 42′, so that we have now continuous triangulation from Cape L'Agulhas to within fifty miles of the southern end of Lake Tanganyika; that is to say, a continuous geodetic survey extending over twenty-five degrees of latitude.

It happens that, for the adjustment of the international boundary between the British Protectorate and the Congo Free State, a topographic survey is at the present moment being executed northward along the thirtieth meridian from the northern border of German East Africa. A proposal on the part of the Royal Society, the Royal Geographical Society, the British Association and the Royal Astronomical Society has been made to strengthen this work by carrying a geodetic triangulation through it along the thirtieth meridian, and thus adding 2½° to the African arc. These societies together guarantee 1,000*l.* towards the cost of the work, and ask for a like sum from government to complete the estimated cost. The topographic survey will serve as the necessary reconnaisance. The topographic work will be completed by the end of January next, and the four following months offer the best season of the year for geodetic operations in these regions.

There is a staff of skilled officers and men on the spot sufficient to complete the work within the period mentioned, and the Intercolonial Council of the Transvaal and Orange River Colony most generously offers to lend the necessary geodetic instruments. The work will have to be done sooner or later, but if another expedition has to be organized for the purpose the work will then cost from twice to three times the present amount. One can not, therefore, doubt that His Majesty's government will take advantage of the present offer and opportunity to vote the small sum required. This done, we can not doubt that the German government will complete the chain along the eastern side of Lake Tanganyika, which lies entirely within their territory. Indeed, it is no secret that the Berlin Academy of Sciences has already prepared the necessary estimates with a view to recommending action on the part of its government.

Captain Lyons, who is at the head of the survey of Egypt, assures me that preliminary operations towards carrying the arc southwards from Alexandria have been begun, and we have perfect confidence that in his energetic hands the work will be prosecuted with vigor. In any case the completion of the African arc will rest largely in his hands. That arc, if ever my dream is realized, will extend from Cape L'Agulhas to Cairo, thence round the eastern shore of the Mediterranean and the islands of Greece, and there meet the triangulation of Greece itself, the latter being already connected with Struve's great arc, which terminates at the North Cape in lat. 70° N. This will constitute an arc of 105° in length—the longest arc of meridian that is measurable on the earth's surface.

THE SOLAR PARALLAX

Much progress has been made in the exact measurement of the great fundamental unit of astronomy—the solar parallax.

Early in 1877 I ventured to predict[3]

[3] "The Determination of the Solar Parallax," *The Observatory*, Vol. I., p. 280.

that we should not arrive at any certainty as to the true value of the solar parallax from observations of transits of Venus, but that the modern heliometer applied to the measurement of angular distances between stars and the star-like images of minor planets would yield results of far higher precision.

The results of the observations of the minor planets Iris, Victoria and Sappho at their favorable oppositions in the years 1888 and 1889, which were made with the cooperation of the chief heliometer and meridian observatories, fully justified this prediction.[4] The sun's distance is now almost certainly known within one thousandth part of its amount. The same series of observations also yielded a very reliable determination of the mass of the moon.

The more recently discovered planet Eros, which in 1900 approached the earth within one third of the mean distance of the sun, afforded a most unexpected and welcome opportunity for redetermining the solar parallax—an opportunity which was largely taken advantage of by the principal observatories of the northern hemisphere. Unfortunately the high northern declination of the planet prevented its observation at the Cape and other southern observatories. So far as the results have been reduced and published[5] they give an almost exact accordance with the value of the solar parallax derived from the heliometer observations of the minor planets, Iris, Victoria and Sappho in 1888 and 1889.

But in 1931 Eros will approach the earth within one sixth part of the sun's mean distance, and the fault will rest with astronomers of that day if they do not succeed in determining the solar parallax within one ten-thousandth part of its amount.

To some of us who struggled so hard to arrive at a tenth part of this accuracy under the less favorable geometrical conditions that were available before the discovery of Eros, how enviable seems the opportunity!

And yet, if we come to think of it rightly, the true opportunity and the chief responsibility is ours, for *now* and not twenty years hence is the time to begin our preparation; *now* is the time to study the origin of those systematic errors which undoubtedly attach to some of our photographic processes; and then we ought to construct telescopes specially designed for the work. These telescopes should be applied to the charting of the stars near the path which Eros will describe at its opposition in 1931, and the resulting star-coordinates derived from the plates photographed by the different telescopes should be rigorously intercompared. Then, if all the telescopes give identical results for the star-places, we can be certain that they will record without systematic error the position of Eros. If they do not give identical results, the source of the errors must be traced.

The planet will describe such a long path in the sky during the opposition of 1931 that it is already time to begin the meridian observations which are necessary to determine the places of the stars that are to be used for determining the constants of the plates. It is desirable, therefore, that some agreement should be come to with respect to selection of these reference-stars, in order that all the principal meridian observatories in the world may take part in observing them.

I venture to suggest that a Congress of

[4] *Annals of the Cape Observatory*, Vol. VI., part 6, p. 29.

[5] *Monthly Notices R.A.S.*, Hinks, Vol. LXIV., p. 725; Christie, Vol. LXVII., p. 382.

Astronomers should assemble in 1908 to consider what steps should be taken with reference to the important opposition of Eros in 1931.

THE STELLAR UNIVERSE

And now to pass from consideration of the dimensions of our solar system to the study of the stars, or other suns, that surround us.

To the lay mind it is difficult to convey a due appreciation of the value and importance of star-catalogues of precision. As a rule such catalogues have nothing whatever to do with discovery in the ordinary sense of the word, for the existence of the stars which they contain is generally well known beforehand; and yet such catalogues are, in reality, by far the most valuable assets of astronomical research.

If it be desired to demarcate a boundary on the earth's surface by astronomical methods, or to fix the position of any object in the heavens, it is to the accurate star-catalogue that we must refer for the necessary data. In that case the stars may be said to resemble the trigonometrical points of a survey, and we are only concerned to know from accurate catalogues their positions in the heavens at the epoch of observation. But in another and grander sense the stars are not mere landmarks, for each has its own apparent motion in the heavens which may be due in part to the absolute motion of the star itself in space, or in part to the motion of the solar system by which our point of view of surrounding stars is changed.

If we desire to determine these motions and to ascertain something of the general conditions which produce them, if we would learn something of the dynamical conditions of the universe and something of the velocity and direction of our own solar system through space, it is to the accurate star-catalogues of widely separated epochs that we must turn for a chief part of the requisite data.

The value of a star-catalogue of precision for present purposes of cosmic research varies as the square of its age and the square of its accuracy. We can not alter the epoch of our observations, but we can increase their value fourfold by doubling their accuracy. Hence it is that many of our greater astronomers have devoted their lives chiefly to the accumulation of meridian observations of high precision, holding the view that to advance such precision is the most valuable service to science they could undertake, and comforted in their unselfish and laborious work only by the consciousness that they are preparing a solid foundation on which future astronomers may safely raise the superstructure of sound knowledge.

But since the extension of our knowledge of the system of the universe depends quite as much on past as on future research, it may be well, before determining upon a program for the future, to consider briefly the record of meridian observation in the past for both hemispheres.

THE COMPARATIVE STATE OF ASTRONOMY IN THE NORTHERN AND SOUTHERN HEMISPHERES

It seems probable that the first express reference to southern constellations in known literature occurs in the Book of Job (ix. 9): "Which maketh Arcturus, Orion and Pleiades, and the chambers of the south." Schiaparelli's strongly supported conjecture is that the expression "chambers of the south," taken with its context, signifies the brilliant stellar region from Canopus to α Centauri, which includes the Southern Cross and coincides with the most brilliant portion of the Milky Way.

About the year 750 B. C. (the probable date of the Book of Job) all these stars culminated at altitudes between 5° and 16° when viewed from the latitude of Judea; but now, owing to precessional change, they can only be seen in a like striking manner from a latitude about 12° further south.

The words of Dante have unquestionably originated the wonderful net of poetic fancy that has been woven about the asterism, which we now call Crux.

To the right hand I turned, and fixed my mind
On the other pole attentive, where I saw
Four stars ne'er seen before save by the ken
Of our first parents—Heaven of their rays
Seemed joyous. O thou northern site! bereft
Indeed, and widowed, since of these deprived.

All the commentators agree that Dante here referred to the stars of the Southern Cross.

Had Dante any imperfect knowledge of the existence of these stars, any tradition of their visibility from European latitudes in remote centuries, so that he might poetically term them the stars of our first parents?

Ptolemy catalogues them as 31, 32, 33 and 34 Centauri, and they are clearly marked on the Borgian globe described by Assemanus in 1790. This globe was constructed by an Arabian in Egypt: it bears the date 622 Hegira, corresponding with A. D. 1225, and it is possible that Dante may have seen it.

Amerigo Vespucci, as he sailed in tropical seas, apparently recognized in what we now call Crux the four luminous stars of Dante; for in 1501 he claimed to be the first European to have looked upon the stars of our first parents. His fellow-voyager, Andrea Corsali, wrote about the same time to Giuliano di Medici describing "the marvelous cross, the most glorious of all the celestial signs."

Thus much mysticism and romance have been woven about this constellation, with the result that exaggerated notions of its brilliancy have been formed, and to most persons its first appearance, when viewed in southern latitudes, is disappointing.

To those, however, who view it at upper culmination for the first time from a latitude a little south of the Canary Islands, and who at the same time make unconsciously a mental allowance for the absorption of light to which one is accustomed in the less clear skies of northern Europe, the sight of the upright cross, standing as if fixed to the horizon, is a most impressive one. I at least found it so on my first voyage to the Cape of Good Hope. But how much more strongly must it have appealed to the mystic and superstitious minds of the early navigators as they entered the unexplored seas of the northern tropic! To them it must have appeared the revered image of the cross pointing the way on their southward course—a symbol and sign of hope and faith on their entry to the unknown.

The first general knowledge of the brighter stars of the southern hemisphere we owe to Frederick de Hautman, who commanded a fleet sent by the Dutch Government in 1595 to the Far East for the purpose of exploring Japan. Hautman was wrecked and taken prisoner at Sumatra, and whilst there he studied the language of the natives and made observations of the positions and magnitudes of the fixed stars of the southern hemisphere.[6]

Our distinguished countryman Halley visited St. Helena in 1677 for the purpose of cataloguing the stars of the southern hemisphere. He selected a station now marked Halley's Mount on the admiralty

[6] The resulting catalogue of 304 stars is printed as an appendix to Hautman's "Vocabulary of the Malay Language," published at Amsterdam in 1603.

chart of the island. I have visited the site, and the foundations of the observatory still remain. Halley's observations were much hindered by cloud. On his return to England, Halley in 1679 published his "Catalogus Stellarum Australium," containing the magnitudes, latitudes and longitudes of 341 stars, which, with the exception of seven, all belonged to the southern hemisphere.

But the first permanently valuable astronomical work in the southern hemisphere was done in 1751–52 by the Abbé de Lacaille. He selected the Cape of Good Hope as the scene of his labors, because it was then perhaps the only spot in the world situated in a considerable southern latitude which an unprotected astronomer could visit in safety, and where the necessary aid of trained artisans to erect his observatory could be obtained. Lacaille received a cordial welcome at the hands of the Dutch governor Tulbagh: he erected his observatory in Cape Town, made a catalogue of nearly 10,000 stars, observed the opposition of Mars, and measured a short arc of meridian all in the course of a single year. Through his labors the Cape of Good Hope became the birthplace of astronomy and geodesy in the southern hemisphere.

Bradley was laying the foundations of exact astronomy in the northern hemisphere at the time when Lacaille labored at the Cape. But Bradley had superior instruments to those of Lacaille and much longer time at his disposal. Bradley's work is now the basis on which the fair superstructure of modern astronomy of precision rests. His labors were continued by his successors at Greenwich and by a long series of illustrious men like Piazzi, Groombridge, Bessel, Struve and Argelander. But in the southern hemisphere the history of astronomy is a blank for seventy years from the days of Lacaille.

We owe to the establishment of the Royal Observatory at the Cape by an Order in Council of 1820 the first successful step towards the foundation of astronomy of high precision in the southern hemisphere.

Time does not permit me to trace in detail the labors of astronomers in the southern hemisphere down to the present day; and this is the less necessary because in a recent presidential address to the South African Philosophical Society[7] I have given in great part that history in considerable detail. But I have not there made adequate reference to the labors of Dr. Gould and Dr. Thome at Cordoba. To their labors, combined with the work done under Stone at the Cape, we owe the fact that for the epoch 1875 the meridian sidereal astronomy of the southern hemisphere is nearly as well provided for as that of the northern. The point I wish to make is that the facts of exact sidereal astronomy in the southern hemisphere may be regarded as dating nearly a hundred years behind those of the northern hemisphere.

THE CONSTITUTION OF THE UNIVERSE

It was not until 1718, when Edmund Halley, afterwards Astronomer Royal of England, read a paper before the Royal Society,[8] entitled "Considerations on the Change of the Latitudes of Some of the Principal Fixt Stars," that any definite facts were known about the constitution of the universe. In that paper Halley, who had been investigating the precession of the equinoxes, says:

> But while I was upon this enquiry I was surprised to find the latitudes of three of the principal stars in heaven directly to contradict the supposed

[7] *Trans. South African Phil. Soc.*, Vol. XIV., part 2.

[8] *Phil. Trans.*, 1718, p. 738.

greater obliquity of the Ecliptick, which seems confirmed by the latitudes of most of the rest.

This is the first mention in history of an observed change in the relative position of the so-called fixed stars—the first recognition of what we now call "proper motion."

Tobias Mayer, in 1760, seems to have been the first to recognize that if our sun, like other stars, has motion in space, that motion must produce apparent motion amongst the surrounding stars; for in a paper to the Göttingen Academy of Sciences he writes:

> If the sun, and with it the planets and the earth which we inhabit, tended to move directly towards some point in the heavens, all the stars scattered in that region would seem to gradually move apart from each other, whilst those in the opposite quarter would mutually approach each other. In the same manner one who walks in the forest sees the trees which are before him separate, and those that he leaves behind approach each other.

No statement of the matter could be more clear; but Mayer, with the meager data at his disposal, came to the conclusion that "the motions of the stars are not governed by the above or any other common law, but belong to the stars themselves."

Sir William Herschel, in 1783, made the first attempt to apply, with any measure of success, Mayer's principle to a determination of the direction and amount of the solar motion in space.[9] He derived, as well as he could from existing data, the proper motions of fourteen stars, and arrived by estimation at the conclusion that the sun's motion in space is nearly in the direction of the star λ Herculis, and that 80 per cent. of the apparent motions of the fourteen stars in question could be assigned to this common origin.

This conclusion rests in reality upon a very slight basis, but the researches of subsequent astronomers show that it was an amazing accidental approach to truth—indeed, a closer approximation than Herschel's subsequent determinations of 1805 and 1806, which rested on wider and better data.[10]

Consider for a moment the conditions of the problem. If all the stars except our sun were at rest in space, then, in accordance with Mayer's statement, just quoted, all the stars would have apparent motions on great circles of the sphere away from the apex and towards the antapex of the solar motion. That is to say, if the position of each star of which the apparent motion is known was plotted on the surface of a sphere and a line with an arrow-head drawn through each star showing the direction of its motion on the sphere, then it should be possible to find a point on the sphere such that a great circle drawn from this point through any star would coincide with the line of direction of that star's proper motion. The arrow-heads would all point to that intersection of the great circles which is the antapex of the solar motion, and the other point of intersection of the great circles would be the apex, that is to say, the direction of the sun's motion in space.

But as the apparent stellar motions are small and only determinable with a considerable percentage of error, it would be impossible to find any point on the sphere such that every great circle passing through it and any particular star, would in every case be coincident with the observed direction of motion of that star.

Such discordances would, on our original assumption, be due to errors of observation, but in reality much larger discordances will occur, which are due to the fact that the other stars (or suns) have independent motions of their own in space.

[9] *Phil. Trans.*, 1783, p. 247.

[10] *Phil. Trans.*, 1805, p. 233; 1806, p. 205.

This at once creates a new difficulty, viz., that of defining an absolute locus in space. The human mind may exhaust itself in the effort, but it can never solve the problem. We can imagine, for example, the position of the sun at any moment to be defined with reference to any number of surrounding stars, but by no effort of imagination can we devise means of defining the *absolute* position of a body in space without reference to surrounding material objects. If, therefore, the referring objects have unknown motions of their own, the rigor of the definition is lost.

What we call the observed proper motion of a star has three possible sources of origin:

1. The *parallactic motion*, or the effect of our sun's motion through space, whereby our point of view of surrounding celestial objects is changed.

2. The *peculiar* or particular motion of the star, *i. e.*, its own *absolute* motion in space.

3. That part of the observed or tabular motion which is due to inevitable error of observation.

In all discussions of the solar motion in space, from that of Herschel down till a recent date, it has been assumed that the peculiar motions of the stars are arranged at random, and may therefore be considered zero in the mean of a considerable number of them. It is then possible to find such a value for the precession, and such a common apex for the solar motion as shall leave the residual peculiar motions of the stars under discussion to be in the mean = zero. That is to say, we refer the motion of the sun in space to the center of gravity of all the stars considered in the discussion, and regard that center of gravity as immovable in space.

In order to proceed rigorously, and especially to determine the amount as well as the direction of the sun's motion in space, we ought to know the parallax of every star employed in the discussion, as well as its proper motion. In the absence of such data it has been usual to start from some such assumption as the following: the stars of a particular magnitude are roughly at the same distance; those of different classes of magnitude may be derived from the hypothesis that on the average they have all equal absolute luminosity.

The assumption is not a legitimate one—

1. Because of the extreme difference in the absolute luminosity of stars.

2. Because it implies that the average absolute luminosity of stars is the same in all regions of space.

The investigation has been carried out by many successive astronomers on these lines with fairly accordant results as to the position of the solar apex, but with very unsatisfactory results as to the distances of the fixed stars.[11] In order to judge how far the magnitude (or brightness) of a star is an index of its probable distance, we must have evidence from direct determinations of stellar parallax.

STELLAR PARALLAX

To extend exact measurement from our own solar system to that of other suns

[11] Argelander, *Mém. présentés à l'Acad. Imp. des Sciences St. Pétersbourg*, tome III.; Lundahl, *Astron. Nachrichten*, **398**, 209; Argelander, *Astron. Nachrichten*, **398**, 210; Otto Struve, *Mém. Acad. des Sciences St. Pétersbourg*, VI^{e} série, Math. et Phys., tome III., p. 17; Galloway, *Phil. Trans.*, 1847, p. 79; Mädler, *Dorpat Observations*, Vol. XIV., and *Ast. Nach.*, **566**, 213; Airy, *Mém. R.A.S.*, Vol. XXVIII., p. 143; Dunkin, *Mem. R.A.S.*, Vol. XXXII., p. 19; Stone, *Monthly Notices R.A.S.*, Vol. XXIV., p. 36; De Ball, inaugural dissertation, Bonn, 1877; Rancken, *Astron. Nachrichten*, **2482**, 149; Bischoff, inaugural dissertation, Bonn, 1884; Ludwig Struve, *Mém. Acad. St. Pétersbourg*, VII^{e} série, tome XXXV., No. 3.

and other systems may be regarded as the supreme achievement of practical astronomy. So great are the difficulties of the problem, so minute the angles involved, that it is but in comparatively recent years that any approximate estimate could be formed of the true parallax of any fixed star. Bradley felt sure that if the star γ Draconis had a parallax of 1″ he would have detected it. Henderson by "the minute sifting of the numerical results" of his own meridian observations of α Centauri, made at the Cape of Good Hope in 1832–33, first obtained certain evidence of the measurable parallax of any fixed star. He was favored in this discovery by the fact that the object he selected happened to be, so far as we yet know, the nearest sun to our own. Shortly afterwards Struve obtained evidence of a measurable parallax for α Lyræ and Bessel for 61 Cygni. Astronomers hailed with delight this bursting of the constraints which our imperfect means imposed on research. But for the great purposes of cosmical astronomy what we are chiefly concerned to know is not what is the parallax of this or that particular star, but rather what is the average parallax of a star having a particular magnitude and proper motion. The prospect of even an ultimate approximate attainment of this knowledge seemed remote. The star α Lyræ is one of the brightest in the heavens; the star 61 Cygni one that had the largest proper motion known at the time; whilst α_2 Centauri is not only a very bright star, but it has also a large proper motion. The parallaxes of these stars must therefore in all probability be large compared with the parallax of the average star; but yet to determine them with approximate accuracy long series of observations by the greatest astronomers and with the finest instruments of the day seemed necessary.

Subsequently various astronomers investigated the parallaxes of other stars having large proper motions, but it was only in 1881, at the Cape of Good Hope, that general research on stellar parallax was instituted.[12] Subsequently at Yale and at the Cape of Good Hope the work was continued on cosmical lines with larger and improved heliometers.[13] By the introduction of the reversing prism and by other practical refinements the possibilities of systematic error were eliminated, and the accidental errors of observation reduced within very small limits.

These researches brought to light the immense diversity in the absolute luminosity and velocity of motion of different stars. Take the following by way of example:

Our nearest neighbor amongst the stars, α_2 Centauri, has a parallax of 0″.76, or is distant about 4⅓ light-years. Its mass is independently known to be almost exactly equal to that of our sun; and its spectrum being also identical with that of our sun, we may reasonably assume that it appears to us of the same magnitude as would our sun if removed to the distance of α_2 Centauri.

But the average star of the same apparent magnitude as α_2 Centauri was found to have a parallax of only 0″.10, so that either α_2 Centauri or our sun, if removed to a distance equal to that of the average fixed star of the first magnitude, would appear to us but little brighter than a star of the fifth magnitude.

Again, there is a star of only 8½ magnitude[14] which has the remarkable annual proper motion of nearly 8¾ seconds of arc —one of those so-called runaway stars—

[12] *Mem. R.A.S.*, Vol. XLVIII.

[13] *Annals of the Cape Observatory*, Vol. VIII., part 2, and *Trans. Astron. Observatory of Yale University*, Vol. I.

[14] Gould's Zones, V$^{\mathrm{h}}$ 243.

which moves with a velocity of 80 miles per second at right angles to the line of sight (we do not know with what velocity in the line of sight). It is at about the same distance from us as Sirius, but it emits but one ten-thousandth part of the light-energy of that brilliant star. Sirius itself emits about thirty times the light-energy of our sun, but it in turn sinks into insignificance when compared with the giant Canopus, which emits at least 10,000 times the light-energy of our sun.

Truly "one star differs from another star in glory." Proper motion rather than apparent brightness is the truer indication of a star's probable proximity to the sun. Every star of considerable proper motion yet examined has proved to have a measurable parallax.

This fact at once suggests the idea, Why should not the apparent parallactic motions of the stars, as produced by the sun's motion in space, be utilized as a means of determining stellar parallax?

SECULAR PARALLACTIC MOTION OF STARS

The strength of such determinations, unlike those made by the method of annual parallax, would grow with time. It is true that the process can not be applied to the determination of the parallax of individual stars, because the peculiar motion of a particular star can not be separated from that part of its apparent motion which is due to parallactic displacement. But what we specially want is not to ascertain the parallax of the individual star, but the mean parallax of a particular group or class of stars, and for this research the method is specially applicable, provided we may assume that the peculiar motions are distributed at random, so that they have no systematic tendency in any direction; in other words, that the center of gravity of any extensive group of stars will remain fixed in space.

This assumption is, of course, but a working hypothesis, and one which from the paper on star-streaming communicated by Professor Kapteyn, of Groningen, to the Johannesburg meeting of the Association two years ago we already know to be inexact.[15] Kapteyn's results were quite recently confirmed in a remarkable way by Eddington,[16] using independent material discussed by a new and elegant method. Both results showed that, at least for extensive parts of space, there are a nearly equal number of stars moving in exactly opposite directions. The assumption, then, that the mean of the peculiar motions is zero may, at least for these parts of space, be still regarded as a good working hypothesis.

Adopting an approximate position of the apex of the solar motion, Kapteyn resolved the observed proper motions of the Bradley stars into two components, viz., one in the plane of the great circle passing through the star and the apex, the other at right angles to that plane.[17] The former component obviously includes the whole of the parallactic motion; the latter is independent of it, and is due entirely to the real motions of the stars themselves. From the former the mean parallactic motion of the group is derived, and from the combination of the two components, the relation of velocity of the sun's motion to that of the mean velocity of the stars of the group.

As the distance of any group of stars found by the parallactic motion is expressed as a unit in terms of the sun's yearly motion through space, the velocity

[15] *Rep. Brit. Assoc.*, 1905, p. 257.

[16] *Monthly Notices R.A.S.*, Vol. LXVII., p. 34.

[17] *Publications Astron. Laboratory Groningen*, Nos. 7 and 9.

of this motion is one of the fundamental quantities to be determined. If the mean parallax of any sufficiently extensive group or class of stars was known we should have at once means for a direct determination of the velocity of the sun's motion in space; or if, on the other hand, we can by independent methods determine the sun's velocity, then the mean parallax of any group of stars can be determined.

DETERMINATION OF STELLAR MOTION IN THE LINE OF SIGHT

Science owes to Sir William Huggins the application of Doppler's principle to the determination of the velocity of star-motion in the line of sight. The method is now so well known, and such an admirable account of its theory and practical development was given by its distinguished inventor from this chair at the Cardiff meeting in 1891, that further mention of that part of the matter seems unnecessary.

THE VELOCITY OF THE SUN'S MOTION IN SPACE

If by this method the velocities in the line of sight of a sufficient number of stars situated near the apex and antapex of the solar motion could be determined, so that in the mean it could be assumed that their peculiar motions would disappear, we have at once a direct determination of the required velocity of the sun's motion.

The material for this determination is gradually accumulating, and indeed much of it, already accumulated, is not yet published. But even with the comparatively scant material available, it now seems almost certain that the true value of the sun's velocity lies between 18 and 20 kilometers per second;[18] or, if we adopt the mean value, 19 kilometers per second, this would correspond almost exactly with a yearly motion of the sun through space equal to four times the distance of the sun from the earth.

Thus the sun's yearly motion being four times the sun's distance, the parallactic motion of stars in which this motion is unforeshortened must be four times their parallax. How this number varies with the amount of foreshortening is of course readily calculated. The point is that from the mean parallactic motion of a group of stars we are now enabled to derive at once its mean parallax.

This research has been carried out by Kapteyn for stars of different magnitudes. It leads to the result that the parallax of stars differing *five* magnitudes does *not* differ in the proportion of one to ten, as would follow from the supposition of equal luminosity of stars throughout the universe, but only in the proportion of about one to five.[19]

The same method can not be applied to groups of stars of different proper motions, and it is only by a somewhat indirect proof, and by calling in the aid of such reliable results of direct parallax determination as we possess, that the variation of parallax with proper motion could be satisfactorily dealt with.

THE MEAN PARALLAXES OF STARS OF DIFFERENT MAGNITUDE AND PROPER MOTION

As a final result Kapteyn derived an empirical formula giving the average parallax for stars of different spectral types, and of any given magnitude and proper motion. This formula was published at Groningen in 1901.[20] Within the

[18] *Kapteyn Ast. Nach.*, No. 3487, p. 108; and Campbell, *Astrophys. Journ.*, XIII., p. 80.

[19] *Astron. Nachrichten*, No. 3487, Table III.; and *Ast. Journ.*, p. 566.

[20] *Publications Astron. Laboratory Groningen*, No. 8, p. 24.

past few months the results of researches on stellar parallax, made under the direction of Dr. Elkin, at the Astronomical Observatory of Yale University, during the past thirteen years,[21] have been published, and they afford a most crucial and entirely independent check on the soundness of Kapteyn's conclusions.

COMPARISON GROUPS ARRANGED IN ORDER OF PROPER MOTION

No. of Stars	Proper Motion	Magnitude	Parallax		Yale-Kapteyn
			Yale	Kapteyn	
21	0".14	3.8	0".028	0".026	+0".002
39	0.49	6.3	.042	.055	− .013
45	0.59	6.7	.068	.060	+ .008
46	0.77	6.5	.047	.074	− .027
22	1.50	6.2	.118	.124	− .006

GROUPS ARRANGED IN ORDER OF MAGNITUDE

No. of Stars	Proper Motion	Magnitude	Parallax		Yale-Kapteyn
			Yale	Kapteyn	
10	0".61	0.8	0".103	0".110	−0".007
29	.53	3.8	.076	.075	+ .001
33	.63	5.6	.064	.070	− .006
34	.73	6.7	.055	.070	− .017
31	.68	7.6	.025	.061	− .036
36	.80	8.3	.056	.062	− .006

	No. of Stars	Proper Motion	Magnitude	Parallax		Yale-Kapteyn
				Yale	Kapteyn	
Spectral Type I.	13	0".42	4.0	0".076	0".076	0".000
Spectral Type II.	81	0.67	5.3	0.067	0.074	−0.007

In considering the comparison between the more or less theoretical results of Kapteyn and the practical determinations of Yale, we have to remember that Kapteyn's tables refer only to the means of groups of a large number of stars having on the average a specified magnitude and proper motion, whilst the latter are direct determinations affected by the accidental errors of the separate determinations and by such uncertainty as attaches to the unknown parallaxes of the comparison stars—parallaxes which we have supplied from Kapteyn's general tables.

[21] *Trans. Astron. Observatory of Yale Univ.*, Vol. II., part 1.

The Yale results consist of the determination of the parallax of 173 stars, of which only ten had been previously known to Kapteyn and had been utilized by him. Dividing these results into groups we get the comparison given above.

These results agree in a surprisingly satisfactory way, having regard to the comparatively small number of stars in each group and the great range of parallax which we know to exist amongst individual stars having the same magnitude and proper motion. In the mean perhaps the tabular parallaxes are in a minute degree too large, but we have unquestionable proof from this comparison that our knowledge of stellar distances now rests on a solid foundation.

THE DISTRIBUTION OF VARIETIES OF LUMINOSITY OF STARS

But, besides the mean parallax of stars of a particular magnitude and proper motion, it is essential that we should know approximately what percentage of the stars of such a group have twice, three times, etc., the mean parallax of the group, and what percentage only one half, one third of that parallax, and so on. In principle, at least, this frequency-law may be obtained by means of the directly determined parallaxes. For the stars of which we have reliable determinations we can compare these true parallaxes with the *mean* parallax of stars having corresponding magnitude and proper motion, and this comparison will lead to a knowledge of the frequency-law required. It is true that, owing to the scarcity of material at present available, the determination of the frequency-law is not so strong as may be desirable, but further improvement is simply a question of time and the augmentation of parallax-determination.

Adopting provisionally the frequency-law found in this way by Kapteyn,[22] we can localize all the stars in space down to about the ninth magnitude.

Take, for example, the stars of magnitude 5.5 to 6.5. There are about 4,800 of these stars in the whole sky. According to Auwers-Bradley, about 9½ per cent. of these stars, or some 460 in all, have proper motions between 0″.04 and 0″.05. Now, according to Kapteyn's empiric formula, whose satisfactory agreement with the Yale results has just been shown, the mean parallax of such stars is almost exactly 0″.01. Further, according to his frequency-law, 29 per cent. of the stars have parallaxes between the *mean* value and double the mean value; 6 per cent. have parallaxes between twice and three times the mean value; 1½ per cent. between three and four times the mean value. Therefore of our 460 stars 133 will have parallaxes between 0″.01 and 0″.02, twenty-eight between 0″.02 and 0″.03, seven between 0″.03 and 0″.04, and so on.

Localizing in the same way the stars of the sixth magnitude having other proper motions, and then treating the stars of the first magnitude, second magnitude, third magnitude, and so on to the ninth magnitude in the same way, we finally locate all these stars in space.[23]

It is true we have not localized the individual stars, but we know approximately and within certain limits of magnitude the number of stars at each distance from the sun.

Thus the apparent brightness and the distance being known we have the means of determining the light-energy or absolute *luminosity* of the stars, *provided it can be assumed that light does not suffer any extinction in its passage through interstellar space.*

On this assumption Kapteyn was led to the following results, viz., that within a sphere the radius of which is 560 light-years (a distance which corresponds with that of the average star of the ninth magnitude) there will be found:

1	star giving from	100,000	to	10,000	times the light of our sun.
26	stars "	10,000	"	1,000	" " "
1,300	" "	1,000	"	100	" " "
22,000	" "	100	"	10	" " "
140,000	" "	10	"	1	" " "
430,000	" "	1	"	0.1	" " "
650,000	" "	0.1	"	0.01	" " "

THE DENSITY OF STELLAR DISTRIBUTION AT DIFFERENT DISTANCES FROM OUR SUN

Consider, lastly, the distribution of stellar density, that is, the number of stars contained in the unit of volume.

We can not determine *absolute* star-density, because, for example, some of the stars which we know from their measured parallaxes to be comparatively near to us are in themselves so little luminous that if removed to even a few light-years greater distance they would appear fainter than the ninth magnitude, and so fall below the magnitude at which our data at present stop.

But if we assume that intrinsically faint and bright stars are distributed in the

[22] *Publications Astron. Lab. Groningen*, No. 8, p. 23.

[23] *Ibid.*, No. 11, Table II.

same proportion in space, it will be evident that the comparative richness of stars in any part of the system will be the same as the comparative richness of the same part of the system in stars of a particular luminosity. Therefore, as we have already found the arrangement in space of the stars of different degrees of luminosity, and consequently their number at different distances from the sun, we must also be able to determine their relative density for these different distances.

Kapteyn finds in this way that, starting from the sun, the star-density (*i. e.*, the number of stars per unit volume of space) is pretty constant till we reach a distance of some 200 light-years. Thence the density gradually diminishes till, at about 2,500 light-years, it is only about *one fifth* of the density in the neighborhood of the sun.[24] This conclusion must, however, be regarded as uncertain until we have by independent means been enabled to estimate the absorption of light in its course through interstellar space, and obtained proof that the ratio of intrinsically faint to bright stars is constant throughout the universe.

Thus far Kapteyn's researches deal with the stellar universe as a whole; the results, therefore, represent only the *mean* conditions of the system. The further development of our knowledge demands a like study applied to the several portions of the universe separately. This will require much more extensive material than we at present possess.

As a first further approximation the investigation will have to be applied separately to the Milky Way and the parts of the sky of higher galactic latitude. The velocity and direction of the sun's motion in space may certainly be treated as constants for many centuries to come, and these constants may be separately determined from groups of stars of various regions, various magnitudes, various proper motions, and various spectral types. If these constants as thus separately determined are different, the differences which are not attributable to errors of observation must be due to a common velocity or direction of motion of the group or class of star to which the sun's velocity or direction is referred. Thus, for example, the sun's velocity as determined by spectroscopic observations of motion in the line of sight, appears to be sensibly smaller than that derived from fainter stars. The explanation appears to be that certain of the brighter stars form part of a cluster or group of which the sun is a member, and these stars tend to some extent to travel together. For these researches the existing material, especially that of the determination of velocities in the line of sight, is far too scanty.

Kapteyn has found that stars whose proper motions exceed 0″.05 are not more numerous in the Milky Way than in other parts of the sky;[25] in other words, if only the stars having proper motions of 0″.05 or upwards were mapped there would be no aggregation of stars showing the existence of a Milky Way.

The proper motions of stars of the second spectral type are, as a rule, considerably larger than those of the first type; but Kapteyn comes to the conclusion that this difference does not mean a real difference of velocity, but only that the second-type stars have a smaller luminosity, the mean difference between the two types amounting to 2½ magnitudes.[26]

THE FUTURE COURSE OF RESEARCH

In the last address delivered from this chair on an astronomical subject, Sir Wil-

[24] *Publications Astron. Lab. Groningen*, No. 11.

[25] *Verl. Kn. Akad. Amsterdam*, January, 1893.

[26] *Ibid.*, April, 1892.

liam Huggins, in 1891, dealt so fully with the chemistry of the stars that it seemed fitting on the present occasion to consider more especially the problem of their motion and distribution in space, as it is in this direction that the most striking advances in our knowledge have recently been made. It is true that since 1891 great advances have also been made in our detailed knowledge of the chemistry of the sun and stars. The methods of astro-spectrography have been greatly improved, the precision of the determination of motion in the line of sight greatly enhanced, and many discoveries made of those close double stars, ordinarily termed spectroscopic doubles, the study of which seems destined to throw illustrative light upon the probable history of the development of systems from the original nebular condition to that of more permanent systems.

But the limitations of available time prevent me from entering more fully into this tempting field, more especially as it seems desirable, in the light of what has been said, to indicate the directions in which some of the astronomical work of the future may be most properly systematized. There are two aspects from which this question may be viewed. The first is the more or less immediate extension of knowledge or discovery; the second the fulfilment of our duty, as astronomers, to future generations. These two aspects should never be entirely separated. The first, as it opens out new vistas of research and improved methods of work, must often serve as a guide to the objects of the second. But the second is to the astronomer the supreme duty, viz., to secure for future generations those data the value of which grows by time.

As the result of the Congress of Astronomers held at Paris in 1887 some sixteen of the principal observatories in the world are engaged, as is well known, in the laborious task, not only of photographing the heavens, but of measuring these photographs and publishing the *relative* positions of the stars on the plates down to the eleventh magnitude. A century hence this great work will have to be repeated, and then, if we of the present day have done our duty thoroughly, our successors will have the data for an infinitely more complete and thorough discussion of the motions of the sidereal system than any that can be attempted to-day. But there is still needed the accurate meridian observation of some eight or ten stars on each photographic plate, so as to permit the conversion of the *relative* star-places on the plate into *absolute* star-places in the heavens. It is true that some of the astronomers have already made these observations for the reference stars of the zones which they have undertaken. But this seems to be hardly enough. In order to coordinate these zones, as well as to give an accuracy to the *absolute* positions of the reference stars corresponding with that of the *relative* positions, it is desirable that this should be done for *all* the reference stars in the sky by several observatories. The observations of well-distributed stars by Kustner at Bonn present an admirable instance of the manner in which the work should be done. Several observatories in each hemisphere should devote themselves to this work, employing the same or other equally efficient means for the elimination of sources of systematic error depending on magnitude, etc., and it is of far more importance that we should have, say, two or three observations of each star at three different observatories than two or three times as many observations of each star made at a single observatory.

The southern can not boast of a richness of instrumental and personal equipment comparable with that of the northern hemisphere, and consequently one welcomes with enthusiasm the proposal on the part of the Carnegie Institution to establish a meridian observatory in a suitable situation in the southern hemisphere. Such an observatory, energetically worked, with due attention to all necessary precautions for the exclusion of systematic errors, would conduce more than anything else to remedy in some degree that want of balance of astronomical effort in the two hemispheres to which allusion has already been made. But in designing the program of the work it should be borne in mind that the proper duty of the meridian instrument in the present day is no longer to determine the positions of all stars down to a given order of magnitude, but to determine the positions of stars which are geometrically best situated and of the most suitable magnitude for measurement on photographic plates, and to connect these with the fundamental stars. For this purpose the working list of such an observatory should include only the fundamental stars and the stars which have been used as reference stars for the photographic plates.

Such a task undertaken by the Carnegie Observatory, by the Cape, and if possible by another observatory in the southern hemisphere, and by three observatories in the northern, would be regarded by astronomers of the future as the most valuable contribution that could be made to astronomy of the present day. Taken in conjunction with the astrographic survey of the heavens now so far advanced, it is an opportunity that if lost can never be made good; a work that would grow in value year by year as time rolls on, and one that would ever be remembered with gratitude by the astronomers of the future.

But for the solution of the riddle of the universe much more is required. Besides the proper motions, which would be derived from the data just described, we need for an ideal solution to know the velocity in the line of sight, the parallax, the magnitude, and the spectrum-type of every star.

The broad distinction between these latter data and the determination of proper motion is this, that whereas the observations for proper motion increase in value as the square of their age, those for velocity in the line of sight, parallax, magnitude, and type of spectrum may, for the broader purposes of cosmical research, be made at any time without loss of value. We should therefore be most careful not to sacrifice the interests of the future by immediate neglect of the former for the latter lines of research. The point is that those observatories which undertake this meridian work should set about it with the least possible delay, and prosecute the program to the end with all possible zeal. Three observatories in each hemisphere should be sufficient; the quality of the work should be of the best, and quality should not be sacrificed for speed of work.

But the sole prosecution of routine labor, however high the ultimate object, would hardly be a healthy condition for the astronomy of the immediate future. The sense of progress is essential to healthy growth, the desire to know must in some measure be gratified. We have to test the work that we have done in order to be sure that we are working on the right lines, and new facts, new discoveries, are the best incentives to work.

For these reasons Kapteyn, in consultation with his colleagues in different parts of the world, has proposed a scheme of research which is designed to afford within a comparatively limited time a great augmentation of our knowledge. The principle on which his program is based is that adequate data as to the proper motions, parallaxes, magnitudes, and the type of spectrum of stars situated in limited but symmetrically distributed areas of the sky, will suffice to determine many of the broader facts of the constitution of the universe. His proposals and methods are known to astronomers and need not therefore be here repeated. In all respects save one these proposals are practical and adequate, and the required cooperation may be said to be already secured—the exception is that of the determination of motion in the line of sight.

All present experience goes to show that there is no known satisfactory method of determining radial velocity of stars by wholesale methods, but that such velocities must be determined star by star. For the fainter stars huge telescopes and spectroscopes of comparatively low dispersion must be employed. On this account there is great need in both hemispheres of a huge reflecting telescope—six to eight feet in aperture—devoted almost exclusively to this research. Such a telescope is already in preparation at Mount Wilson, in America, for use in the northern hemisphere. Let us hope that Professor Pickering's appeal for a large reflector to be mounted in the southern hemisphere will meet with an adequate response, and that it will be devoted there to this all-important work.

CONCLUSION

The ancient philosophers were confident in the adequacy of their intellectual powers alone to determine the laws of human thought and regulate the actions of their fellow men, and they did not hesitate to employ the same unsupported means for the solution of the riddle of the universe. Every school of philosophy was agreed that some object which they could see was a fixed center of the universe, and the battle was fought as to what that center was. The absence of facts, their entire ignorance of methods of exact measurement, did not daunt them, and the question furnished them a subject of dispute and fruitless occupation for twenty-five centuries.

But astronomers now recognize that Bradley's meridian observations at Greenwich, made only one hundred and fifty years ago, have contributed more to the advancement of sidereal astronomy than all the speculations of preceding centuries. They have learned the lesson that human knowledge in the slowly developing phenomena of sidereal astronomy must be content to progress by the accumulating labors of successive generations of men; that progress will be measured for generations yet to come more by the amount of honest, well-directed, and systematically discussed observation than by the most brilliant speculation; and that, in observation, concentrated systematic effort on a special thoughtfully selected problem will be of more avail than the most brilliant but disconnected work.

By these means we shall learn more and more of the wonders that surround us, and recognize our limitations when measurement and facts fail us.

Huggins's spectroscope has shown that many nebulæ are not stars at all; that many well-condensed nebulæ, as well as vast patches of nebulous light in the sky, are but inchoate masses of luminous gas. Evidence upon evidence has accumulated to show that such nebulæ consist of the matter out of which stars (*i. e.*, suns) have been and are being evolved. The different types of star spectra form such a complete and gradual sequence (from simple spectra resembling those of nebulæ onwards through types of gradually increasing complexity) as to suggest that we have before us, written in the cryptograms of these spectra, the complete story of the evolution of suns from the inchoate nebula onwards to the most active sun (like our own), and then downward to the almost heatless and invisible ball. The period during which human life has existed on our globe is probably too short—even if our first parents had begun the work—to afford observational proof of such a cycle of change in any particular star; but the fact of such evolution, with the evidence before us, can hardly be doubted. I most fully believe that, when the modifications of terrestrial spectra under sufficiently varied conditions of temperature, pressure, and environment have been further studied, this conclusion will be greatly strengthened. But in this study we must have regard also to the spectra of the stars themselves. The stars are the crucibles of the Creator. There we see matter under conditions of temperature and pressure and environment, the variety of which we can not hope to emulate in our laboratories, and on a scale of magnitude beside which the proportion of our greatest experiment is less than that of the drop to the ocean. The spectroscopic astronomer has to thank the physicist and the chemist for the foundation of his science, but the time is coming—we almost see it now—when the astronomer will repay the debt by wide-reaching contributions to the very fundamenta of chemical science.

By patient, long-continued labor in the minute sifting of numerical results, the grand discovery has been made that a great part of space, so far as we have visible knowledge of it, is occupied by two majestic streams of stars traveling in opposite directions. Accurate and minute measurement has given us some certain knowledge as to the distances of the stars within a certain limited portion of space, and in the cryptograms of their spectra has been deciphered the amazing truth that the stars of both streams are alike in design, alike in chemical constitution, and alike in process of development.

But whence have come the two vast streams of matter out of which have been evolved these stars that now move through space in such majestic procession?

The hundreds of millions of stars that comprise these streams, are they the sole ponderable occupants of space? However vast may be the system to which they belong, that system itself is but a speck in illimitable space; may it not be but one of millions of such systems that pervade the infinite?

We do not know.

"Canst thou by searching find out God? canst thou find out the Almighty unto perfection?"

David Gill

SCIENTIFIC BOOKS

A Text-book of Electro-Chemistry. By Max Le Blanc, Professor in the University of Leipzig. Translated from the Fourth German Edition by W. R. Whitney, Ph.D., Director of the Research Laboratory of the General Electric Company, and John W. Brown, Director of the Research and Battery Laboratory of the National Carbon Company. 8vo, pp. xiv + 338. Price, $2.60 net. New York: The Macmillan Company.

That two busy men, immersed to their eyes in solving the commercial problems of two great industrial corporations, should have the courage of their convictions to the extent of themselves translating this splendid text-book, is a most hopeful sign of the times, whichever way it is regarded. What more could be wished, than that a text-book should originate within the classic precincts of a university, and be translated and sponsored by the heads of two commercial laboratories? And the book is worthy of its origin.

The earlier editions of Le Blanc's book are so well known to electro-chemists, that but a brief allusion to the contents as a whole is necessary here. The well-balanced chapters deal with the fundamental principles, historical development, theory of electrolytic dissociation, migration of ions, conductance of electrolytes, electrical endosmose and electrostenolysis, electromotive force, electrolysis and polarization, a supplement on accumulators and an appendix describing the scheme of notation employed.

As to the way in which these are handled, the English is above criticism and the presentation is lucid and comprehensible to the last degree. There is nowhere the slightest chance for misunderstanding the writer's ideas, whether one accepts them as a finality or not. As a presentation of the fundamental facts and the prevalent theories of electrochemistry, the work is probably without an equal, certainly without a superior. As prices go, the book is much cheaper than usual—an additional recommendation, probably ascribable to the broad views and sound commercial instincts of the translators and publishers.

As to the plan of the work, the theory of electrolytic dissociation is followed consistently throughout. We regret to say, however, that although so praiseworthy in other respects, the form of statement in terms of the theory is not always free from objection, and to give the student an unbiased, absolutely unobjectionable idea, would need revision by the teacher. To illustrate: "*The value 13,700 calories then really represents the heat of dissociation of water*" (p. 134). The statement should certainly have been qualified by saying *electrolytic dissociation,* or even *ionization,* for *dissociation;* otherwise, the statement as it stands, is certainly incorrect.

A series of inconsistencies is caused by following in too uncritical a spirit the teachings of the dissociation theory. Thus, on page 94 we have:

The degree of dissociation of a substance in solution is equal to the ratio of its equivalent conductance in that solution to its equivalent conductance in a solution of infinite volume.

But on page 148, discussing the di-electric constants of solvents, we have:

From this fact it follows that it is inadmissible to draw a conclusion, as often has been done, regarding the degree of dissociation from the value of the equivalent conductance alone.

Such inconsistencies (and there are others of analogous character) are the chief defects of the book. The tenets of the dissociation theory are laid down with emphasis, usually in italics, as above, and then later the experimental facts which negative some of those statements are either not mentioned, or mentioned with very slight emphasis, or else freely admitted, and yet their full import and effect glossed over. There is in many cases an apparent willingness to admit facts contrary to the tenets of the dissociation theory, and yet such facts are not pushed to their full, legitimate conclusion.

All of this shows that the theories of electrochemistry are in a state of transition; even the teachers with the best of purposes to see all sides are sometimes staring at one side and blinking at the other. The perfectly judicial attitude of mind is, at present, difficult if not impossible to preserve. A few years will see a new era of electrochemical theory and teaching, wherein the student is nurtured as a plain eclectic, keen to see and quick to admit the truth wherever and in whatever guise he finds it.

Are we speaking of an unattainable millennium? We hope not.

JOSEPH W. RICHARDS

Tropical Medicine. By THOMAS W. JACKSON, M.D.

The acquisition by this government within the last few years of the Philippine Islands, Puerto Rico and the Panama Canal District, and its necessary sanitary supervision over Cuba in its relation to yellow fever, have made the study of tropical diseases one of great interest and, especially for the physicians of the southern states, one of practical necessity, for as our knowledge of these so-called tropical diseases increases, we find that not only are they to be found in the tropics, but also to a greater or less extent in our own country.

The book is divided into several parts, beginning, of course, with the usual introduction, but in this case including a discussion of tropical hygiene. The treatment of this subject denotes a familiarity with conditions as found in the tropics obtained only by experience, and if the advice given were followed, it would materially decrease the amount of sickness and the number of deaths occurring among those living there.

That portion of the book which treats of mosquitoes, though brief, is well worth studying for those likely to be brought into contact with either malaria or yellow fever.

The book is written in a narrative style, the usual text-book description of the subjects being given, but with sufficient personal experiences interspersed to lend an added interest to the subject uuder discussion.

The book is divided into three parts, the first part dealing with "Systemic Diseases (Chiefly Bacterial in Origin)." This section is mainly concerned with a discussion of the infectious diseases.

Under the heading of Cholera, the description of bacteriologic technic to be used for diagnostic purposes is faulty and not clear, and leaves the impression that a mere novice could make a diagnosis, whereas, as is well known, cases arise which offer great difficulty, from the presence of other spirilla giving similar reactions and only differentiated by agglutination or animal experiments. The author lays considerable stress on the use of the anti-cholera serum prepared by the Japanese, which, he says, has an anti-toxic action.

It is surprising to note, as is stated, that Haffkine's prophylactic had never been used as a curative agent for plague; its use for such a purpose would certainly seem contra-indicated. Under the same heading, the author recommends for the agglutination test that "the serum be diluted with normal salt solution to a proportion of 1:3." It is very doubtful whether agglutination obtained with such a dilution would be of any value.

The chapter on malaria is written in a more detailed way than those on the other diseases.

The author apparently believes in the infectious nature of beri-beri, accepting the work of Wright, though giving rather full abstracts of the report of Baron Takaki of the Japanese navy, who ascribes the marked decrease in the number of cases in the Japanese navy to a change of diet consisting of the addition of barley and an increased amount of meat to the usual rice diet.

In the chapter on yellow fever, considerable space is justly given to the work of Reed, Carroll, Agramonte and Lazear, composing the board appointed by the government for the study of yellow fever.

The second part is taken up with a discussion of diseases produced by animal parasites. The chapter on ankylostomiasis is excellent, the author here again detailing his own experiences. The remainder of this section is taken up with a discussion of filariasis, trypanosomiasis and those diseases produced by parasites peculiar to the tropics.

The third part treats of diseases of undetermined causation and of the skin. Under this heading is to be found a brief description of such diseases as acute febrile icterus, mycetoma, tropical splenomegaly and of some of the parasitic skin diseases.

At the end is a list of articles recommended for diagnostic purposes which would undoubtedly be of great value for any practising physician.

A perusal of the book would be of benefit to any one likely to come into relation with tropical diseases.

James W. Jobling
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DISCUSSION AND CORRESPONDENCE

ON THE EFFECTS OF MAGNESIUM SULPHATE ON THE GROWTH OF SEEDLINGS

A recent issue of Science contains a letter from Professor Oscar Loew, which, for some unaccountable reason, is entitled "a correction." I have read the letter carefully several times in an endeavor to find in it the promised "rectification," but without success. It is obvious, however, that, in the letter referred to, Professor Loew announced a particular text, then read into it miscellaneous matters that were off the subject and next proceeded to belabor the men of straw his imagination introduced to the reader.

Professor Loew began the letter as follows:

A statement on page 452 of Science of March 22 requires a rectification in the interest of the unprejudiced reader.

The sentence in question reads as follows:

"These results show conclusively that magnesium sulphate in proper dilution is beneficial to the growth of seedlings, and that any inhibitory effects are due to the presence of excessive amounts, thus controverting Loew's theory that magnesium salts when alone in solution are always injurious to plant growth."

This quotation from the abstract of Miss Burlingham's communication at the last meeting of the Biological Section of the American Chemical Society was followed, in Professor Loew's letter, by the remarks quoted below (1–6), to each of which I have appended a brief reply from our own standpoint, the pertinence of which the reader, having the above quoted sentence before him, will have no difficulty in determining:

"Permit me," Professor Loew went on, "the following remarks regarding this remarkable sentence" (the one quoted above):

1. It is not a *theory* that magnesium salts act poisonously on plants; it is a *fact*.

Miss Burlingham did not say it is a "*theory* that magnesium salts act poisonously on plants"; she herself witnessed such poisonous action repeatedly, and wrote as follows about this very "*fact*" in her abstract, although Professor Loew has not seen fit to quote it: "Magnesium sulphate . . . is usually toxic in strengths greater than $m/8{,}192$ (0.003 per cent.)"; anhydrous, 0.00147 per cent.

2. Not only Loew, but also others have observed the same fact. Loew has merely furnished an explanation well in accord with certain observations.

Miss Burlingham did not intimate that Professor Loew was the only investigator who had "observed the same fact," *i. e.*, that "magnesium salts act poisonously on plants." She knew quite well there were others, among them herself, as is indicated in the above quotation from her abstract that Professor Loew failed to notice. She did not allude to Professor Loew's "explanation that is well in accord with certain observations." She referred, however, in the words indicated, to "Loew's theory that magnesium salts when alone in solution are *always* injurious to plant growth." Professor Loew did not discuss the latter point in his letter, however, although he might well have done so to the exclusion of the matters he introduced without warrant. Why did he refrain from correcting the essential point in his quotation? *Are* "magnesium salts when alone in solution *always* injurious to plant growth"?

3. The doses at which magnesium salts, applied alone, are poisonous for plants can *impossibly* be called *excessive*, since even at 0.02 per cent. a poisonous action of magnesium salts on algæ can be observed, while calcium nitrate is not in the least injurious for algæ at even 1 per cent.

"*Excessive*" is, of course, a relative term and Miss Burlingham used it as such. In the abstract from which Professor Loew quoted the "remarkable sentence" which, according to him, "*requires* rectification in the interest of the unprejudiced reader," but which he proceeded aggressively to misconstrue, regardless of what the "interest of the unprejudiced reader *required*," Miss Burlingham wrote as follows: "It was found that while magnesium sulphate is usually toxic in strengths greater than $m/8{,}192$ (0.003 per cent.), it produces decided stimulation in $m/16{,}384$, reaches a maximum stimulation at dilutions from $m/32{,}768$ to $m/131{,}072$ (0.00075 per cent. to 0.00018 per cent.), then beyond this point gradually diminishes in action. . . . Seedlings allowed to grow for several weeks in a dilution of magnesium sulphate which was at first slightly toxic finally developed strong lateral roots and attained a root growth far beyond the control." It is obvious that Miss Burlingham used the term "excessive" to apply to "strengths greater than $m/8{,}192$

(0.003 per cent.)," *i. e.*, of magnesium sulphate (anhydrous, 0.00147 per cent.).

4. It is a well-known fact that many compounds that act poisonously at a certain concentration can act in very high dilution as stimulants of growth.

Miss Burlingham said nothing to the contrary. She found nothing in opposition to it. There is nothing in her abstract to warrant the inference that she was not aware of this "well-known fact."

5. It is erroneous to attribute this stimulating action to any nutritive quality of the poison.

Miss Burlingham did not "attribute this stimulating action to any *nutritive* quality of the poison." She said her results "show conclusively that magnesium sulphate in *proper* dilution is *beneficial* to the growth of seedlings." She did not offer any explanation of her preliminary results, merely stated them.

It is ridiculous for Professor Loew to assume that Miss Burlingham exhibited prejudice in her abstract, for neither she nor I had any preconceived notions to establish, nor any theories to maintain. Her conclusions were drawn impartially from her results.

Professor Loew concluded his letter with the following unbiased allusion:

6. The unprejudiced reader who desires some information as to the nutritive rôle of magnesium salts in plants and to the conditions under which this function can be performed, is kindly requested to consult Bulletin No. 45 of the Bureau of Plant Industry, "The Physiological Rôle of Mineral Nutrients in Plants," Washington, 1903.

I cheerfully commend "Bulletin No. 45," of which Professor Loew is the author, to the attention of any one wishing "information as to the nutritive rôle of magnesium salts in plants and to the conditions under which this function can be performed." The said bulletin is the most valuable single contribution to our knowledge of the questions discussed in it, and reflects brightly the flood of light that Professor Loew has thrown upon the subject since he undertook its investigation. Nevertheless the "unprejudiced reader" of it will certainly conclude, after studying "Bulletin No. 45," that there is probably very much more for all of us, including Professor Loew, to learn about the "nutritive rôle of magnesium salts in plants" and "on the conditions under which this function can be performed." The "unprejudiced reader" will also surely welcome such earnest attempts as Miss Burlingham's to extend our information on details of the subject.

Miss Burlingham's preliminary paper appeared in the July number of the Journal of the American Chemical Society. It gives the data upon which were based the remarks in her abstract that Professor Loew has misinterpreted for the "unprejudiced reader." It makes further comment here unnecessary.

William J. Gies
New York Botanical Garden

A NOTE ON CERTAIN WIDELY DISTRIBUTED LEAFHOPPERS (HEMIPTERA)

Certain leafhoppers have more or less recently become notorious for the damage they occasion to various cereals, such as sugar-cane and sorghum. *Perkinsiella saccharicida* (Kirkaldy) has done much damage in Hawaii, having been introduced from Queensland, where, however, it is not native. It is to be found wherever sugar-cane is grown in Australia and Hawaii, and I have recently received it from Java. *Peregrinus maidis* (Ashmead) was described from maize in Florida and is now widely distributed over the southern United States; it has an even wider range now than *Perkinsiella saccharicida*, for it is all through eastern Australia, Hawaii, Viti and, I think, Java, while Mr. Distant has recently redescribed it as *Pundaluoya simplicia* from Ceylon.

G. W. Kirkaldy

SPECIAL ARTICLES

COLOR INHERITANCE AND SEX INHERITANCE IN CERTAIN APHIDS

The color changes that occur in the sexual generation of certain aphids, and the correlation of a definite color with each sex, have suggested that these insects may furnish favorable material for testing the possibility that the male and female sex characters form an allelomorphic pair and undergo segregation in gametogenesis.

In one of the goldenrod aphids all of the parthenogenetic individuals are a deep reddish brown, the males are green and the females brown, both males and females being produced by the same mother. Assuming that sex may be regarded as an inheritable character, the indications are that the parthenogenetic individual is both a sex-hybrid and a color-hybrid, green color and male sex being recessive. In the sexual generation green color becomes dominant with the male sex, brown with the female. Here correlation of color with sex, and selective fertilization, *i. e.*, only gametes containing opposite sex characters forming fertile unions, would account for the conditions observed.

In another aphid found on the star cucumber, the parthenogenetic generations consist of green and red individuals. Both red males and green females are produced by the same parthenogenetic mother which may be either green or red. Here again it appears that all of the parthenogenetic individuals must be both sex-hybrids and color-hybrids, but either color may be dominant during the parthenogenetic generations with no evident determining factor.

In an aphid which is abundant on the flower clusters and upper leaves of *Œnothera biennis,* we find more complicated conditions. In the parthenogenetic generations there are two colors, a dark red and a bright green. In autumn certain red-winged mothers produce red apterous females, and other apterous red individuals produce greenish-brown males, while red females and green males come from the green mothers. The winged males are produced only by apterous mothers, the apterous females only by winged mothers. In this case all may or may not be sex-hybrids and color-hybrids.

In November, 1905, I placed sexual forms of these *Œnothera* aphids on *Œnothera* rosettes in the greenhouse and an abundance of eggs were laid. The eggs hatched early in March, giving both red and green young. Individuals of the two colors were isolated on *Œnothera* plants protected with fine tarletan, and the several families were kept under observation in the greenhouse until June 14, about three months from hatching. All of the members of each family remained true to the color of their egg-ancestor. The plants with the aphids were then taken to Cold Spring Harbor and planted out under tarletan screens. Syrphid larvæ killed many of the aphids. The last of the green ones disappeared in August, while some of the red ones lived until the last of September. In no case did any individual of any one of the families deviate in color from its egg-ancestor. Sexual forms did not appear before I left Cold Spring Harbor on September 28. After returning to Bryn Mawr, about October 1, I collected both green and red parthenogenetic aphids from wild *Œnotheras* and raised the males and females of the sexual generation from these. The males of green parentage are bright green like their mothers, while the females are pale green when born and gradually grow more and more reddish until, when mature, they are a bright red, not quite so deep a red, however, as that of the red females from red mothers. The males of red parentage are red when born, but change gradually to a greenish brown, while the females are deep red like the mothers, the red being a little brighter at maturity than that of the parthenogenetic generations, but easily distinguishable from the brighter and more transparent red of the females of green parentage.

It will thus be seen that the color which comes from the winter egg holds for all of the parthenogenetic descendants, but when the sexual forms appear the males are green or greenish brown, and the females red, indicating some relation between color dominance and sex. That this relation can not be associated with different metabolic conditions in the two sexes is shown by the fact that in the star cucumber aphid, where there are both green and red parthenogenetic strains, the color conditions in the sexual generation are reversed,—the males are red and the females green.

A few preliminary experiments were made in November, 1906, in mating males and females raised from isolated mothers in the greenhouse. The matings and results were as follows, the letters showing the color characters which were visible:

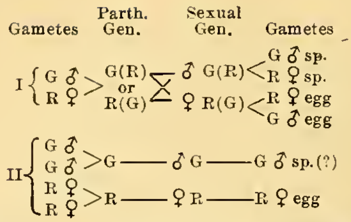
1. ♀ R (red par.) × ♂ RG (red par.) { *a.* All red. *b.* Red and green.
2. ♀ GR (green par.) × ♂ G (green par.) { All green.
3. ♀ R (red par.) × ♂ G (green par.) { No eggs hatched.
4. ♀ GR (green par.) × ♂ RG (red par) { *a.* One red. *b.* Several green.

Only a small proportion of the eggs hatched, but the results, though meager, indicate the possibility that color inheritance may here be Mendelian, and that a further study of it may throw light on the problem of sex inheritance.

The coloration of the sexual generation, however, shows that either one or the other of two conditions must probably exist: (1) All of the egg-ancestors and therefore all of the parthenogenetic individuals, as well as the males and females, are sex-hybrids as well as color-hybrids, and the factors which determine sex dominance also determine color dominance, possibly by virtue of some structural correlation of the two characters. (2) There are green hybrid strains which produce red females and red hybrid strains which produce greenish-brown males, while the red strains which produce red females may be pure reds and the green strains which produce green males may be pure greens.

The first of these suppositions, which alone could account for the conditions found in the star cucumber aphid, where parthenogenetic mothers of either color produce both red males and green females, and in the goldenrod aphid where the brown parthenogenetic mothers produce both green males and brown females, seems much more likely to be true for all.

In the following table the possibilities for the star cucumber aphid are shown under I., and those for the *Œnothera* aphid under I. and II. combined. (The color scheme must be reversed for the star cucumber aphid, G♀, R♂.) In both, the dominance of sometimes one color, sometimes the other in the parthenogenetic generations is a subject for investigation. It may be conditioned by the immediate ancestry of the gametes.



In the goldenrod aphid, if we consider the parthenogenetic forms as essentially female, correlation of color with sex (B♀ and G♂), and selective fertilization would account for the observed relation of color to sex.

The second, and less likely but nevertheless interesting, possibility for the *Œnothera* aphid involves the question whether a zygote can be pure as to the sex character, or unisexual. The chief point to be investigated by experiment, in addition to the study of color inheritance in cross-breeding, is whether in this aphid both males and females come from the parthenogenetic progeny of each egg-ancestor, or in some cases (G♂) only males, and in others (R♀) only females. To test this possibility it would be necessary to carry many families through from the egg to the following sexual generation, and very likely to repeat the experiment several times.

A large series of experiments in cross-breeding to test the color inheritance has been planned by the author for next year, and this note is published in the hope that some one may be interested to undertake experiments along the same line.

N. M. Stevens
Bryn Mawr College,
Bryn Mawr, Pa.,
June 8, 1907

A COLOR SPORT AMONG THE LOCUSTIDÆ

There are various sports among animals that are so rarely observed and so little understood as to seem to render it desirable that every occurrence should be recorded. One of these is the occasional substitution of pink for green color among the Locustidæ, which has been recorded perhaps a dozen times. It is to be hoped that repeated notices of their capture may call the attention of physiologists to them, and in time elicit a satisfactory explanation of the phenomenon. A specimen of one of these pink katydids, a male of the species *Amblycorypha oblongifolia* (De Geer), identified by Jas. A. G. Rehn, was sent to the Museum of the University of Michigan some months ago, by Mr. A. S. Austin. He captured the insect on Grosse Isle, in the Detroit River, some twelve or fifteen miles below Detroit, on August 12, 1906. This specimen is of duller colors than the ones figured by Scudder,[1] but is still a decided pink. The brown spots on the tegmina are fainter, twelve or thirteen in number, and less scattered than in Scudder's specimens, and are roughly arranged in two rows on the lower two thirds of the wings. The yellow flecks mentioned by Scudder are wanting.

The stridulating area, like that of Scudder's specimen, is brown except a small trapeziform area at the angle of the wing, which is pink. The eyes are brownish red, margined with yellow. The antennæ are yellow, inclined to brown in the distal half. The sides of the thorax, all of the coxæ, and the proximal fourth of the hind femora are tinged with green.

Besides this specimen there is also in the University Museum a female of the same species, without data, which has also duller colors than the female of Scudder's plate. This dullness can hardly be attributed to a fading in the preserved specimen, for the male was received alive, and up to the present time has preserved its colors perfectly.

Folsom[2] has been led to remark that these pink specimens are found in late summer, as if to suggest that the change may be at least in part due to seasonal influence. If this statement is meant to apply to adults only, the earlier dates, August 9 for one of Scudder's specimens and August 12 for Austin's, can hardly be considered late records. If the replacement occurs also in nymphs, of which I find no record in the accessible literature, then the earliest records are comparatively late, and Folsom's suggestion is of some force. It would be gratifying to learn the dates of other unrecorded specimens.

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[1] Scudder, S. H., 'Pink Grasshoppers,' *Entomological News*, Vol. XII., No. 5, May, 1901, pp. 129–131, and Pl. VI.

[2] Folsom, J. W., 'Entomology with Reference to its Biological and Economic Aspects,' p. 215.

GYMNOSPORANGIUM MACROPUS

During the last few years the cedar rust has increased in abundance and severity in Nebraska and adjacent states. The disease has been so severe that it has threatened the life of the cedars in many places where they have been employed as wind-breaks around orchards or where they were adjacent to apple trees that were susceptible to infection.

Spraying experiments have shown that the disease may be at least partially controlled on the apple, but those who have cedars—and there are many in this section who value them as much as they do their apple trees—have been clamoring for assistance in saving them from the inroads of this fungus.

As a result of this demand careful observations have been made on the life history of this rust and spraying experiments are in progress. The work was started with the supposition that the spores of the cluster-cups on the apple leaves and fruit produced the cedar apples which matured in the autumn of the same season, but observations and experiments have not confirmed this assumption.

Observations made during the summer of 1906 showed that the first cluster-cups matured on the apple about the first of July in the vicinity of Lincoln. At this date only a very few cluster-cups were open and these were mostly on the fruit where two or more apples were in contact. A few days later young cedar apples as large as radish seeds were found to be present on the cedars. At Broken Bow, Custer County, the first mature cluster-cups were not observed until the eighth of July, and at that time cedar apples were found in abundance varying in size from one twelfth to one fourth inch in diameter.

Careful watch has been kept of the cedars during the present season. The first indication of the presence of the young cedar apples was noted on the seventeenth of June. At this time the scale leaves at the points of origin of the apples were slightly lifted. On June 26, the young apples had increased in size so that they could be easily detected with the hand lens or even with the naked eye. All apple trees and other possible hosts were carefully examined and the rust spots showed at that date nothing but the spermogonia. They did not even show the characteristic hypertrophy of the under surface which precedes the formation of the cluster-cups, and the stage of development at present indicates that no mature æcidiospores will be formed until near the middle of July. This apparent retardation of the development over that of last year is to be explained by the general backwardness of vegetation due to the cold spring.

In addition to these observations I should mention that some small cedars were enclosed in glass houses during the spring of 1906. These houses were ventilated by means of windows provided with cotton screens to prevent infection from the outside. The first part of July they were examined and a few cedar apples were found, the small number being due presumably to the fact that conditions in the houses were very unfavorable for growth.

Considering these observations here recorded, two explanations suggest themselves:

1. The fungus is either perennial in the cedar, or

2. The æcidiospores of one season produce the cedar apples which appear in June of the next year and reach maturity in the autumn.

We have some evidence of a perennial character, especially in trees that are badly infected. In such cases it is quite easy to find new apples growing out from the side of old ones, or even from the middle of old ones. It is, however, quite possible that such cases represent new infections rather than the persistence of an old mycelium. The second explanation however seems more probable to the writer. If this is true the cedar is probably infected in the summer and autumn, but no evidence of the resulting cedar apples can be noted until the next season when growth has been resumed. It would then require two full years for a cedar apple to develop. It remains for further observations to completely substantiate this view.

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A BLIGHT DISEASE OF YOUNG CONIFERS[1]

During the past spring there occurred in the large conifer nursery at Halsey, Nebraska, a very serious outbreak of "blight" of the needles of two-year-old seedlings of *Pinus ponderosa* and *P. divaricata*. The damage was very considerable, there being several hundred thousand of the trees affected. What is of more moment than the actual damage sustained, however, is the threatened danger to the many nurseries of the country which are engaged wholly or in part in the growing of young conifers for reforesting purposes. The present outbreak shows that the fungus causing it is capable of very serious and extensive attacks wherever it may happen to be present. The disease is characterized by a gradual dying back of the needles from the tip to the base. The fungus very evidently then proceeds into the stem of the affected tree and finally kills the entire plant. In the specimens of diseased trees examined by the writer no fungous fruiting bodies could at first be detected; upon remaining in a moist chamber for a few days abundant black pustules broke out upon all of the dead tissues of the attacked needles. These were found to be exuding masses of spores of a species of *Pestalozzia*. The pustules occurred universally upon all dead parts and no other organism thus accompanied the disease; it seemed apparent at once that the *Pestalozzia* was closely connected with the trouble. Pure cultures of the fungus were made and then used in making inoculations upon healthy seedlings of *Pinus ponderosa* in the greenhouse, which were about one month old. The inoculations succeeded, causing the typical disease in plants which

[1] Published with permission of the Secretary of Agriculture.

had been previously healthy in every respect.

The various species of *Pestalozzia* have been known as parasites in Europe, causing disease of conifers of one to several years' age. The same fungus was found in 1903 in Texas and also upon young pine trees from North Carolina and New York in 1906 by the writer. There can be little doubt that it occurs generally in the United States, and sometimes at least, as a true parasite. The fact that it occurs as a parasite upon young conifers seems not to have been proved in this country by other workers. The present article may be taken as a warning to managers of conifer nurseries, as it is more than likely that similar outbreaks of this disease will be noted in the near future. Removing the diseased trees and burning them, accompanied by thorough spraying of the remainder with Bordeaux mixture containing some adhesive substance to make it cover the smooth needles, should completely control the trouble and stop its spread into unaffected seed beds.

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NORMAL FAULTING IN THE BULLFROG DISTRICT

The Bullfrog Mining District is situated in southern Nevada, about ten miles from the California line, and sixty miles south-southeast of Goldfield. The towns within the district are Rhyolite, Beatty and Bullfrog. In 1906 Mr. G. H. Garrey and the speaker mapped the general geology of a strip across the district, seven miles long and three miles wide. The country is a desert, the rocks are bare and exposures are exceptionally good. The relief is about 2,500 feet. Mining exploration has added greatly to the natural exposures, and conditions for field work are unusual.

The oldest rocks form a crystalline complex, consisting in the main of quartz-biotite schists, quartzites, limestone, pegmatite, injection schists and gneisses, which surround small areas of sheared diorites. This complex is the equivalent of a series of sedimentary rocks which has been greatly metamorphosed. Above the schists is a massive limestone, about 100 feet thick, probably Silurian. In faulted contact with the limestone and older rocks is a great series of Tertiary lava flows with subordinate beds of sedimentary tuffs, limestone and shale, altogether about 7,000 feet thick. Of the lava flows there are sixteen separable divisions of rhyolite, five basalt flows, one flow of dacite, and one of quartz basalt. Stratified tuffs of sedimentary origin occur at two horizons, with numerous lava flows between. The Tertiary rocks are approximately conformable one with another in dip, though there are slight erosional unconformities at several places. Basalt dikes, most of which are along fault fissures, cut the older lavas. There was much faulting after the dikes were intruded, and the rhyolite-basalt contacts afforded planes of weakness which were taken advantage of in nearly every instance. Dikes and other intrusive masses of rhyolite also cut the lavas. At three places there are small outcrops of leucite basanite.

The bedded rocks dip eastward at angles averaging 27° and are traversed by faults, most of which strike northeast and dip west. Most of the faults are nearly perpendicular to the beds and all are normal, that is, the down-throw appears to have been down the dip of fault planes and consequently the west block is, in most cases, depressed, or the block east of the fault plane is elevated with respect to the down-thrown or hanging-wall side. Since the dip of the beds is to the east and the dip of the faults to the west, the same beds occur repeatedly. Before deformation the beds were approximately horizontal. In the deformation two processes operated; faulting, which tended to lower the beds to the west or raise them to the east; and monoclinal folding or tilting, which tended to raise the beds towards the west or lower them to the east. A seven-mile east and west section across the area shows that the eastward depression due to tilting is 12,400 feet, which is only 1,300 feet more than the westward depression due to faulting, or that the result of both processes was to leave the beds at about the same elevation at the east and at the west borders of the area. The throw of the faults varies from a few feet to 5,000 feet. There are two systems or groups, one of which strikes nearly north and the other about 35° east of north. The Tertiary rocks are not closely folded, but the dip of the beds in any single block is nearly uniform.

It is improbable that any considerable amount of tilting or faulting occurred before all of the Tertiary lavas were extravasated, for the dip of early and of late flows is nearly uniform, and lavas do not overlap faults. The tilting occurred before or after faulting, or else the two processes went on together. If all of the tilting had occurred before the faulting then a given bed at the east border of the area should at that time have been 12,400 feet lower than the same bed at the west border. Evidence of such relief should be preserved if the period between the deformation by the two processes had been sufficient for a considerable amount of erosion, and a large thickness of derived sedimentary rocks should probably have resulted from the erosion of this series. On the other hand, if the faulting had occurred first and the interval was considerable, the relief and consequent intervening erosion would have been equally great. Since there are no faulted rocks not tilted, or tilted rocks not faulted, it is presumed that faulting and tilting operated at the same time or close together.

Tilting before faulting implies a vertical movement of parts of the earth's surface of more than two miles, followed by another vertical movement equally great and of a different character. Faulting before tilting implies equivalent movements in reverse order. Since the processes operated close together, this is regarded as improbable. It is, therefore, assumed that faulting and tilting occurred at the same time, and that the movement was largely rotational, each block moving independently, being tilted as it was faulted. The result is like the fall of a row of books when some are removed from the shelf. It is to be noted that when the books fall and become inclined 27° from an upright position, there is an extension of a line drawn horizontally through them equal to 12 per cent.; that is, some books must be removed if the remainder fall. Unless there was extension due to revolution some of the blocks must move out laterally in order that the other blocks may settle. The faults are not quite parallel in strike, but two systems make 35° angles with each other. Accordingly, some of the blocks would present wedge-shaped edges to any section and these during deformation could easily move laterally outward. That lateral movement did take place is abundantly recorded by nearly flat striæ on horizontal surfaces. The effect of all deformation was to greatly extend the surface east and west in the direction of the dip of the beds.

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QUOTATIONS

THE NOBEL PRIZES

Regret has already been expressed here that the confidence placed by Nobel in his native land has not been justified. His large fortune was made in Great Britain by the discovery and manufacture of dynamite, and it seems likely that the instructions of his will would have been more adequately carried out if their execution had been entrusted to the Royal Society and the British courts. Nobel doubtless believed that the international obligations would be fully met by the Scandinavian countries, and it is truly sad and discouraging that there should be lack of good faith in the administration of a fund intended, as the testator states, "to benefit mankind."

Nobel's will is perfectly clear and explicit. It directs that the interest from the fund "shall be divided into five equal parts," which shall be annually awarded in prizes to those persons who shall have contributed most materially to benefit mankind during the year immediately preceding. "One share to the person who shall have made the most important discovery or invention in the domain of physics; one share to the person who shall have made the most important chemical discovery or improvement; one share to the person who shall have made the most important discovery in the domain of physiology or medicine; one share to the person who shall have produced in the field of literature the most distinguished work of an idealistic tendency, and, finally, one share to the person who shall have most or best promoted the fraternity of nations and the abolishment or diminution of standing armies and the formation and increase of peace congresses."

In face of these explicit directions statutes have been drawn up, apparently with the sanction of the King of Sweden and others high in authority, providing that only sixty per cent. of the income need be used for the prizes and that they need be awarded only once in five years. The balance of the income—except perhaps in the case of the prize for the promotion of peace, regarding which information is lacking—is now used for the support of certain laboratories and libraries at Stockholm. These are doubtless needed, possibly more than the prizes established by Nobel, but they have been founded in dishonor. The clause establishing the laboratory of physics and chemistry is unpleasantly disingenuous. It says that it is to be "established primarily for the purpose of carrying out, where the respective Nobel committees shall deem requisite, scientific investigation as to the value of those discoveries in the domains of physics and chemistry which shall have been proposed as meriting the award of Nobel prize to their authors. The institute shall, moreover, as far as its means allow, promote such researches in the domains of the sciences named as promise to result in salient advantage." The prizes have so far been awarded annually, but it is to be feared that when the money is needed in Sweden, it will be kept there in accordance with the provision of the statutes that when a prize is not awarded the money may be used for funds "to promote the objects which the testator ultimately had in view in making his bequest in other ways than by means of prizes."

The administrators of the Nobel foundation have violated the conditions of the bequest in other ways which, though not so discreditable as the conveying of the money to local purposes and men, can not be regarded as justifiable. Nobel expressly stipulates that the prizes shall be awarded to those "who shall have contributed most materially to benefit mankind during the year immediately preceding." The statutes hedge, as follows: "By the proviso in the will to the effect that for the prize competition only such works or inventions shall be eligible as have appeared "during the preceding year" is to be understood that a work or invention for which a reward under the terms of the will is contemplated shall set forth the most modern results of work being done in that of the departments, as defined in the will, to which it belongs; works or inventions of older standing to be taken into consideration only in case their importance has not previously been demonstrated."

In no single case has the award been made for work accomplished or published during the preceding year. The prizes have been given to men of eminence, most of whom accomplished their important work long ago. It would certainly be difficult to select each year the work most beneficial to mankind, and mistakes would undoubtedly be made; but the effort to make such a selection and to award the prize without regard to nationality, age or eminence would be a great stimulus to research, far greater probably than the methods adopted. But the question is not which method is the better, but for what purposes Nobel made his bequest. The terms of the will have also been violated by dividing the prizes and by awarding them to institutions, and its spirit has been especially ignored by giving the power of nomination and determination chiefly to Swedes. It does not of course follow that the dead hand should forever control. But Nobel died only ten years ago. He might be given his will for a little while at least, and under the special circumstances of the case it would seem only just to submit any provisions which proved impracticable or unwise to international consideration.

There is a certain lack of courtesy in thus criticizing actions sanctioned by the Swedish government and by those Swedish men of science at least who are accepting gratuities from the fund. Neither can we as a nation regard ourselves as fit to cast stones when we remember the histories of the Stewart, Tilden and other bequests, or when we consider that the Smithsonian Institution, established by a foreigner "for the increase and diffusion of knowledge among men" has been used largely for the promotion of local interests. But it is only by frankly considering these things that we may learn that honor is more than great riches.—*The Popular Science Monthly*, January, 1907.

We agree with Mr. Lange when he says, on page 1060 of this issue, that Dr. Alfred Nobel was a man of remarkable originality, as is shown by his bequest of his fortune to Scandinavia to reward the benefactors of mankind. But we fear that his originality will never be allowed much scope by those who have charge of the administration of the fund, for they have from the beginning shown a flagrant disregard of the intentions of the founder. This, of course, is no new thing. Many philanthropic testators, if they could rise from their graves fifty or a hundred years after they had been laid in them, would repudiate the work that is being carried on in their names. This is sometimes the fault of the trustees and sometimes their wisdom. The provisions of a will may prove to be impracticable, or in the course of time the changed conditions may make it useless or detrimental to the cause it was intended to promote.

But Nobel's plan has been proved neither unpractical nor unwise, because it has never been tried. In his will of November 27, 1895, he directs that his property "shall constitute a fund, the interest accruing from which shall be annually awarded in prizes to those persons who shall have contributed most materially to benefit mankind *during the year immediately preceding.*"

The clause we have italicized has been disregarded from the start by the five Nobel committees, although it is the most original and promising feature of the plan. Great discoveries in science and innovations in literature are often the work of young men, unappreciated by their colleagues and superiors, overburdened by drudgery and inadequately provided with the means of study and research. To men like this the free gift of $40,000 and the public recognition of the value of their work would be a godsend. They would be stimulated to greater exertions and would be able to devote themselves to the work for which they had already proved themselves exceptionally fitted.

But the Nobel committees, instead of this, have chosen to bestow their awards in many cases on men who, long before the Nobel Fund was established, had done the work for which the world is their debtor, and were resting on their laurels. The money, however much needed, will not enable them to do more than they have; the honor, however much deserved, will not add to their fame. The Nobel prizes have been given only six years, yet six of the recipients—Carducci, Moissan, Dunant, Mommsen, Finsen, Curie—have died since they were so honored, three of them from old age. The following table shows how far the Nobel committees have departed from the intention of the founder in rewarding contemporary achievement:

Name	Achievement	Age of Achievement	Age of Award	Years of Delay
Dunant	Geneva Convention	36	73	37
Sully-Prudhomme	"Justice"	39	62	23
Mommsen	"History of Rome"	37	85	48
Fischer	Sugar synthesis	33	50	17
Björnson	"Arne"	26	71	45
Mistral	"Miréio"	29	74	45
Echegaray	"O Locura ô Santidad"	45	71	26
Passy	French Arbitration Society	45	79	34
Arrhenius	Electrolytic theory	25	44	19
Becquerel	Uranium rays	44	51	7
Behring	Diphtheria antitoxin	38	47	9
Ramsay	Helium	43	52	9
Finsen	Light cure	34	41	7
Cremer.	Interparliamentary conference	50	65	15
Rayleigh	Argon	52	62	10
M Curie	Radium	39	44	5
Madame Curie	Radium.	31	36	5
Röntgen	X-rays	50	56	6
Ross	Malaria parasite	40	45	5
Carducci	"Odi Barbare"	44	71	27
Ramon y Cajal	Neurology	41	56	15
Moissan	Isolation of fluorine	35	44	9
Baeyer	Artificial indigo	45	70	25
Koch	Tuberculosis bacillus	41	64	23
Sienkiewicz	"With Fire and Sword"	38	59	21
Lenard	Lenard rays	32	43	11
Suttner	"Die Waffen nieder"	47	63	16
Golgi.	Nerve staining	25	58	33

The Code of Statutes of the Nobel Foundation, issued in the name of the King, June 29, 1900, contains the following section:

The proviso in the Will to the effect that for the prize competition only such works or inventions shall be eligible as have appeared "during the preceding year" is to be so understood, that a work or an invention for which a reward under the terms of the Will is contemplated, shall set forth the most modern results of work being done in that of the departments, as defined in the Will, to which it belongs; works or inventions of older standing to be taken into consideration only in case their importance have not been previously demonstrated.

This action loosened up the stringency of the phrase used by Nobel, but the committees have not even kept within the elastic limits that they imposed upon themselves, as a glance at the table shows. What we have put down as the "age of achievement" is the year of the man's life when he produced his first work of superlative importance, the excellence of which was either recognized at once by the world or would have been discernible by a learned and well-equipped body like the Nobel Committee. But in many cases, nothing had occurred to "demonstrate the importance" of their achievements during "the preceding year," or even during the time the Nobel Foundation has been in existence. Carducci was too weak to rise from his chair when the emissaries of the Nobel Committee brought him his medal and too feeble in mind to answer them. He had not published a book for nine years, and his position as the foremost of Italian poets had been established for over thirty years. The fame of Sully-Prudhomme, Echegaray and Mistral has declined rather than risen in the last six years, because they have become more historic monuments than leaders of modern thought.

Mr. Lange defends the appropriation of 25 per cent. of the income for administrative expenses on the ground that it is necessary in order to insure that the prizes are worthily bestowed. This might be justifiable if the money were spent for this purpose. If the committees used the laboratories and libraries they have established out of the Nobel Fund for the purpose of testing the real value of alleged inventions it would do much to promote science and assist in the discovery of struggling genius. But no man is allowed to present his own claims. He must first have the endorsement of scholars occupying certain narrowly specified official positions in his own land.

As a matter of fact, the selections of the Nobel Committees have not been such as required special ability or expenditure for investigation. Any college student in chemistry, physics or medicine, if asked offhand to name the greatest living men in his branch of science would have hit upon at least fifteen out of the twenty-two names on the list of the Nobel prize men. In the choice of those who had done most for the promotion of peace or produced the greatest work in idealistic literature there would have been greater diversity of opinion, but not because the names chosen were not well known. Did it require an $80,000 laboratory to test the reality of the X-rays? How much of the "rather more than $12,000" appropriated for that purpose last year did the committee expend in repeating Baeyer's synthesis of indigo, first made a quarter of a century ago, and now accomplished at the rate of thousands of tons a year? Did the Caroline Medical-Chirurgical Institute of Stockholm have to spend much time in ascertaining that Golgi's method of nerve staining, which has been in common use for over twenty years, is practical and valuable? How large a reference library was needed to discover that Mommsen was a great historian?

The Nobel bequest was reported to be more than $8,000,000. This, if invested in safe securities, as Nobel directed, should produce about $64,000 for each of the five annual prizes. So much of the income has been spent for other purposes, in salaries, traveling expenses, ceremonials and purchases of books and apparatus, that the amount of the money prize has now shrunk to $37,000. And still the local administrators are not satisfied with what they get out of it. Mr. Lange suggests that they may take advantage of the clause allowing them to suspend the award for not longer than four years in the absence of suitable candidates in order to get money for the "constructive" work of the Nobel Peace Institute, for the maintenance of a library and reading-room in Christiania, for a complete catalogue of the literature of internationalism, a school, the printing of books and periodicals and the establishment of another arbitration court. These are highly creditable projects, but the Nobel Fund was given for another purpose. All the countries of the world have the same interest in it as Norway and Sweden, and they have a right to protest against its misappropriation.—*The Independent*, May 9, 1907.

CURRENT NOTES ON LAND FORMS

PIT CRATERS IN MEXICO

Among the many basins of the Central Plateau of Mexico, bordered by volcanoes in various stages of growth and dissection, and smoothly floored with aggraded layers of volcanic ashes and dust, of fluviatile and lacustrine desposits, and of occasional lava flows, there is one of typical development in the state of Puebla, east of the city of Mexico and separated by the volcano of Orizaba and its neighbors from the dissected escarpment by which the descent is made from the highland to the coastal lowlands. Ordoñez gives a good account of this basin-plain and of the pit craters that have been formed in it by explosion ("Los Xalapascos del Estado de Puebla," Inst. Geol. Mex., Parerg., i, 1906, no. 9). The plain is like all its fellows in having risen on the irregular flanks of the larger and smaller, younger and older volcanic masses that enclose it, and in being interrupted by more or less completely isolated volcanic knobs and ridges which rise here and there through its smooth surface. The gentle ascent by which one ordinarily approaches the border of an explosion crater is an insignificant element of relief in comparison with the much larger volcanic forms on all sides; indeed, the slope is sometimes hardly perceptible, and the depression of the crater, 1,000 to 1,800 met. in diameter, and 50 or more met. deep, is come upon as a surprise for which there is no warning at a little distance. A shallow blue lake usually occupies the floor; the walls are frequently steep and expose good sections of the layers by which the plain has been built up; special interest attaching to such items as buried stream channels and occasional thin lava sheets. Paths lead down in zigzags on the steep face or more directly by centripetal ravines; for the poor natives in neighboring villages have long been accustomed to carry water up from the lakes for domestic uses. Ordoñez regards these craters as among the latest manifestations of volcanic activity, and characterizes them as seeming unduly large for the feebleness of the explosive force which produced them.

BATOKA GORGE OF THE ZAMBESI

Among the results of the British Association visit to South Africa in 1907 is an account of "The Geology of the Zambesi Basin around the Batoka Gorge," by G. W. Lamplugh (*Quart. Journ. Geol. Soc.*, LXIII., 1907, 162–316), which includes an excellent description of a plateau in a youthful stage of dissection. In the region of Victoria Falls, the South African highland is built up of basalt sheets; older rocks, including a fundamental complex of gneiss, schists and granite, appear to the northeast and southeast. The relief is small; occasional residual knobs—*Inselberge* of the German explorers—rise here and there in the crystalline areas; low escarpments traverse the belts of inclined strata bordering the crystallines; broad swells of sand, supposed to be wind deposits of an earlier and more arid period, are spread over the basalts. The present altitude of the plateau is 3,000 feet or more. The upper Zambesi is a wide, placid river flowing through a shallow valley, bordered by low slopes of greatly decomposed basalt; its branches are of gentle fall and their valleys (called "channels" by Lamplugh) are but little below the general highland level. At Victoria Falls, the river plunges down 360 feet into a narrow gorge with nearly vertical walls, in which the peculiar zigzag turns have been well explained by Molyneaux ("The Physical History of Victoria Falls," *Geogr. Journ.*, XXV., 1905, 40–55) as the result of groups of obliquely transverse joints. In 60 miles below the falls, the river descends about 400 feet, and the walls of the gorge become more and more open. At the same time, the side gorges increase in length, so that a widening area of sharply dissected country, very difficult to traverse, extends eastward from the falls, on each side of the main gorge. Some 300 miles east of the falls, the Kafue river, coming from the north, flows in a broad shallow valley for several hundred miles across the undulating plateau country, then plunges down through a succession of cataracts in a rugged gorge, descending 1,000 feet in two miles, after which it has a sluggish course of 20 miles to its confluence with the Zambesi.

The systematic manner in which the forms appropriate to old age on the plateau are replaced by those appropriate to youth in the gorge and its branches gives new warrant—if any new warrant is needed—for the use of a systematic terminology in the explanatory description of land forms. The structure of the region being stated in the first place, it suffices to say that the old features of the plateau are replaced by young features of strong relief below the falls; all the more characteristic forms may then be easily inferred. The space saved by the adoption of this concise style of description may then be used to advantage for accounts of individual features. For the highland area, "shallow valley," "shallow trough" and "channel sunk very slightly below the general level of the plateau" are the paraphrases which Lamplugh uses instead of the systematic term, "old valley"; the fact that three different descriptive phrases are thus used in a single article for one and the same class of forms only emphasizes the need of the adoption of a single, definite, technical term.

A PENEPLAIN IN SOUTH AFRICA

During the excursion of the British Association to South Africa in 1905, the undersigned had opportunity of traversing the High Veld of the interior on several different lines, and thus of gaining a general impression of its leading features (see "Observations in South Africa." *Bull. Geol. Soc. Amer.*, XVII., 1906, 377–450). As to structure, the region is broadly covered with a heavy series of nearly horizontal Mesozoic continental formations, resting unconformably on a complicated series of much older rocks, which appear to have been reduced in pre-Mesozoic time to the state of subdued mountains or hills, and which have since suffered still further reduction in the long continued cycle of erosion by which a vast body of material has been swept away. The present nearly-level highland of the treeless plains bevels across the Mesozoic strata at very gentle angles, and except for the scattered strong reliefs in the form of stony ridges and mesas maintained by resistant dolerite dikes and sheets, the surface has truly reached an expression of penultimate erosion. The low swells between the water courses have a thin soil; they are often of very faint convexity, nicely indicated by the faint arching of the long railway tangents. The water courses, unlike the broad and ill-defined wadies in the peneplain in equatorial Africa described in Science for August 2, 1907, are deep, well-defined channels, bordered by 20 or 30 feet of alluvium which cloaks the wide-open old-valley floors. The channels were nearly dry at the time of our visit, but bore the marks of having carried heavy floods in previous wet seasons (southern summer) when heavy local downpours occur. A curious minor item was the occurrence of rapids in the dwindled streams of the dry season, where rock sills occurred in the deep channel beds: this at first suggested a recent revival of erosion; but it was afterwards better understood that the long established grade of these old drainage lines is indicated by the even slope of their alluvial flood-levels and not by the small inequalities in their flood-scoured beds. Where the water courses lead through notches in the dolerite ridges, the channels are encumbered with boulders and their fall is more rapid than elsewhere; thus the Veld is divided into compartments of slightly different altitudes.

The Veld stands at altitudes of from 6,000 to 8,000 feet, with a gentle slope to the west, which turns a large drainage area to the Orange River system. The eastern border of the Veld is suffering invasion by the head ravines of actively retrogressive streams that descend rapidly to the coastal lowlands of the Indian ocean; and this feature, along with certain other indications, led to the belief that the peneplain of the Veld had probably been worn down with reference to the normal base-level of the ocean when the region stood several thousand feet lower than now; and that its uplift is so recent that, over most of the surface, the long, west-flowing rivers have not yet had time to deepen their valleys in their upper and middle courses. Farther towards the Atlantic, it is to be expected that a beginning of incision must already have been made; but critical observations are lacking in that direction.

Further physiographic results of the same excursion are presented in an article on "The Mountains of Southernmost Africa" (*Bull. Amer. Geogr. Soc.*, XXXVIII., 1906, 593–623), where the heavy Mesozoic series and a conformably underlying Paleozoic series are folded in well-defined east-west anticlines and synclines, apparently peneplained in one cycle and greatly eroded in a second, with the result of developing a remarkably well-adjusted drainage system, containing excellent examples of subsequent and resequent streams, as well as of deep-cut transverse water gaps in the ridges. Many of the ridges are anticlines, and serve admirably to correct the prevailing misapprehension that the ridges of long-eroded mountains should be of synclinal structure.

W. M. D.

DEDICATION OF THE ALDROVANDI MUSEUM OF THE UNIVERSITY OF BOLOGNA, ITALY

With felicitous ceremonies, extending through June 11–13, the University of Bologna has dedicated to the memory of the illustrious seventeenth century Bolognese naturalist, Aldrovandus, a new geological museum. Amongst the foreign universities represented were Glasgow, Oxford, Cambridge, Berlin, Königsberg, Breslau, Halle, Vienna, Paris, Upsala, Christiania, Pennsylvania, Yale, Michigan, Cornell, etc.

The addresses on the principal day were delivered before a distinguished audience in the Archgymnasium, Senator Capellini, president of the University of Bologna, presiding. Following his eloquent address, a study of the *motif* of the occasion was given by Professor Costa. Responses from foreign countries were given by Professors Brusina, of Agram; Pélissier, of Montpellier; Ferguson, of Glasgow; Schück, of Upsala; Borcea, of Rumania; Richter, of Hungary, and Dr. Wieland, of the Carnegie Institution of Washington. The celebration was finally concluded by a dinner tendered the delegates by the mayor of Bologna.

The University of Bologna enjoys the proud distinction of being the oldest university in Europe, and possesses in addition to fine zoological collections, paleontological collections of great importance, as well remembered by Americans, due, largely, to the indefatigable efforts of Senator Capellini, now extending through a period of fifty years. This ancient university, so thoroughly imbued with the spirit of modern research and enterprise, is indeed to be congratulated on thus coupling the deep historical interest of the vast and wonderful pioneer labors of Aldrovandus, whom Capellini happily compares with Aristotle, with twentieth century science.

G. R. W.

CENTENARY OF THE GEOLOGICAL SOCIETY[1]

In September next the Geological Society will celebrate its hundredth birthday. In honor of this interesting occasion preparations have for some time been in progress. Invitations to the celebration have been issued to all the foreign members and foreign correspondents of the society; the various geological surveys all over the globe, universities having chairs of geology or mineralogy, scientific academies, societies and museums at home and abroad have been invited to send delegates to London. The large number of acceptances already received include the names of many of the most distinguished geologists of the present day, both in the old and the new world.

It has been arranged that a series of excursions to various parts of this country shall take place before the centennial meeting,

[1] From *Nature*.

under the conduct of fellows of the society conversant with the geology of the several selected districts. These excursions will begin on Wednesday, September 18, and the excursionists will all be back in London by the evening of September 25. The celebration of the centenary, which will extend over three days, will begin on Thursday, September 26, at 11 o'clock, in the Hall of the Institution of Civil Engineers, when the chair will be taken by Sir Archibald Geikie, who has been elected president of the society for the second time in order that he may preside on this occasion. The foreign members and foreign correspondents, and the delegates from institutions at home and abroad, will then be received by him, and will present their addresses. In the afternoon, at 3 o'clock, in the same hall, the president will deliver an address, while in the evening a banquet will be given by the society to its colonial and foreign guests.

Friday, September 27, will be chiefly devoted to visits to museums, galleries, etc., concluding with an evening reception. On Saturday, September 28, short excursions have been projected to places of geological interest within easy reach of London. On Monday, September 30, the visitors will be divided into two sections, one of which will go to Oxford, the other to Cambridge. It is understood that the universities will confer honorary degrees on some of the more distinguished geologists from beyond the seas, and that college hospitality will be as abundant and hearty as usual, while those visitors who may still have energy enough left for field-work will be taken on geological excursions from both the university towns. This well-planned combination of scientific intercourse with social pleasure can hardly fail to have a lasting effect in forming and confirming friendships by bringing the geologists of many different countries into close personal relations with each other.

SIR JOSEPH HOOKER'S NINETIETH BIRTHDAY

Sir Joseph Hooker has addressed the following letter to Sir Trevor Lawrence in reply to the congratulations of the Royal Horticultural Society on the occasion of his ninetieth birthday:

The Camp, Sunningdale,
July 15, 1907.

My Dear Sir Trevor: Your letter of the 25th June conveying the hearty congratulations of the President, Council, and Fellows of the Royal Horticultural Society on the approach of my 90th birthday has gratified me more than I can express.

It is not by many times the first instance I have experienced of the friendly and all too liberal estimate of my labors in the cause of horticulture that the society has entertained.

It has been a source of great regret that I was obliged, when resigning my post of chairman of the Scientific Committee, to abandon all hope of attending our meetings on account of having to devote my energies to the Directorship of Kew, and to the completion of labors on botanical works I have in progress.

I had also to endeavor to overtake arrears of work extending over many years, which are still far from being overtaken. As a botanist I have hereby lost much, for since the days of David Douglas, the Royal Horticultural Society has contributed more botanical science, as represented by collections, publications and experimental research, than any other establishment in Europe.

I have now to request you as their president to accept yourself, and convey to the council and to my fellow-members, my pride and gratitude for this most welcome evidence of their friendship and esteem.

With every good wish for the continued welfare and renown of the society,

Believe me, dear Sir Trevor, sincerely yours,
Jos. D. Hooker

SCIENTIFIC NOTES AND NEWS

The seventh International Zoological Congress opens its meeting under the presidency of Mr. Alexander Agassiz at Boston on August 19. An account of the general features of the program, including the visits to New York, Philadelphia and Washington, will be found in the issue of Science for May 17. The full program, so far as papers were announced up to that time, will be found in the issue of Science for August 2.

The British Association for the Advancement of Science opened its annual meeting at Leicester on July 31, when Sir E. Ray Lankester resigned the chair to Sir David Gill, who gave the address published in this issue of Science. The nomination of Mr. Francis Darwin to be president next year was confirmed.

Dr. J. S. Murat has been appointed director of the Meteorological Institute of Bucharest in the place of Dr. S. C. Herpites, who has retired from active service.

Dr. Otto Wallach, professor of chemistry at Göttingen, and Dr. Karl Graebe, professor of chemistry at Frankfort, have been elected corresponding members of the Berlin Academy of Sciences.

Professor Eugene S. Talbot, professor of stomatology in the Woman's Medical School of Northwestern University, is one of the honorary presidents of the International Stomatological Congress that met in Paris last week.

Dr. Hugo Bücking, professor of mineralogy and petrography at the University of Strassburg, has celebrated the twenty-fifth jubilee of his university professorship.

Dr. Friedrich Hildebrand, professor of botany at Freiburg, has retired from active service.

Professor J. S. Kingsley, of Tufts College, spends next year in Europe on leave of absence, sailing on August 31. His address for letters will be in care of Baring Brothers, Bishopsgate, London, England. Separata, etc., may be sent as usual to him at Tufts College, Mass.

Professor B. K. Emerson, of Amherst College and the Geological Survey, is this summer continuing his studies in the geology of central Massachusetts. The Taconic Quinsigamond and Ware folios are practically ready for publication.

Professor Jeremiah W. Jenks, of Cornell University, a member of the United States Immigration Commission, is on a tour of the Canadian northwest investigating the matter of American immigration into Canada.

Professor T. G. Masaryk, professor of philosophy in the Bohemian University of Prague, has arrived in New York. He will make an address at the International Council of Unitarians, which meets in Boston in September, and will also make other addresses.

A monument to Bunsen is to be erected at Heidelberg.

Dr. Ernst Kayser, the astronomer, has died at Danzig, at the age of seventy-eight years.

Dr. Heinrich Hoyer, emeritus professor of anatomy at Warsaw, has died at the age of seventy-two years.

The death is announced of Dr. H. Kreutz, professor of astronomy at Kiel.

Dr. Walter von Knabel, docent for geology and paleontology at the University of Berlin, died while on an expedition to the interior of Iceland.

Professor Willoughby Dayton Miller died on July 27, after an operation for appendicitis, in the hospital at Newark, Ohio. Dr. Miller took his A.B. degree at Michigan in 1875. He studied dentistry at the University of Pennsylvania, where he graduated in 1879. He then went to Berlin, and became a professor in the dental department of the university of that city. He held this position until last month, when he resigned it to accept the deanship of the dental department of the University of Michigan. He returned to this country in June, and after a few days spent in Ann Arbor in arranging for the duties which he was to assume in September, he went to his old home in Ohio. Dr. Miller is well known, both among medical and dental men, on account of his most excellent and thorough work on dental caries. His great book entitled "Die Bakteriologie des Mundholdes" has been translated into several modern languages. His death will be greatly regretted both in this country and in Europe.

The hygienic exhibition which is to be held in connection with the fourteenth International Congress of Hygiene at Berlin in September will be under the auspices of the Cultus-minister, the Imperial Health Bureau, and the medical departments of the army and navy, as well as leading representatives of hygienic science in general. The president is Professor Radner.

THE eleventh International Navigation Congress is to be held at St. Petersburg in May, 1908.

THE third International Congress on Provision for the Insane will be held at Vienna from October 7 to 11, 1908, under the presidency of Professor Obersteiner. The general secretary of the congress is Dr. Alexander Pilcz, ix Lazaretthasse 14, Vienna.

IT is stated in *Nature* that the *Nimrod,* in which Mr. E. H. Shackleton's expedition will proceed to the Antarctic regions, sailed from the Thames on July 30 with Lieutenant Rupert England in command. Lord Kelvin has presented to the expedition a standard compass and sounding instruments. The admiralty is lending a compass, chronometers, charts and sounding apparatus, as well as three Lloyd-Creak Dip instruments for the landing party. Watches are being supplied by the Royal Geographical Society, and, in addition, the vessel will be equipped with a liquid steering compass and a special pole compass. The members of the expedition on board of the *Nimrod* are Mr. James Murray, the biologist of the expedition; Mr. W. A. Michell, surgeon and zoologist; and Mr. A. F. Mackay, the junior surgeon of the landing party, who will also engage in zoological work. At Lyttelton, New Zealand, the remaining members of the expedition will join the ship. These include, besides Mr. Shackleton, Mr. E. Marshall, senior surgeon of the shore party and cartogapher of the expedition; Lieutenant Adams, R.N.R., who will be in charge of the meteorological work; and Sir Philip Brocklehurst, for survey work and field geology. Dr. David, professor of geology in Sydney University, has arranged to accompany the expedition south to King Edward VII. Land.

ENGLISH journals state that of eight balloons sent up by the staff of the Manchester University in connection with the international movement to discover data in regard to the atmospheric phenomena of the clouds, three have been located. The balloons carried a recording apparatus, bearing instructions to the finders to return them to Manchester, and the examination of the records, which were picked up at Macclesfield, Lincoln and Leeds, shows that the balloons reached an altitude of about ten miles. A temperature of 20 degrees below zero Fahrenheit is recorded.

ALTHOUGH diamonds have been found in at least thirty places in the United States, the only locality where they occur in place has recently been discovered and has been investigated by Mr. George F. Kunz, the gem expert, and Dr. H. S. Washington, petrographer. They occur in an igneous rock, similar to that of the South African mines, which forms a small stock near Murfreesboro, Pike County, Ark. The first two stones were found August 1, 1906, and since then many of them have been picked up, the total number found at last report being 130. Many are white and of good water, others are yellow and some are of brown bort. The two largest stones weigh 6½ carats, one being exceedingly fine white and the other brown. They are found on the surface as well as within the greenish, friable, decomposed peridotite, a rock somewhat like the famous "blue ground" of Kimberly. The property is being actively prospected and developed.

Nature states that private enterprise has succeeded in founding, with the sanction of the Ministry of Education, confirmed by the Czar, an Institute of Archeology and Archeography in Moscow. The institute, which has just obtained its charter, ranks with a university, and is open to all graduates of Russian or foreign universities. Its aim is to prepare qualified archeologists and "archeographists." The latter term is applied to persons skilled in the preservation and use of historical archives, libraries, museums and other collections, public and private, demanding special knowledge. The Moscow Institute of Archeology is the first institution in Russia founded on autonomous principles; it has the right to elect its own staff of professors, and generally to conduct its own internal affairs, subject only to a possible veto of the minister of education in certain cases. The course is a three years' one, the final year of which must be spent in practical work either in archeological expeditions and research among the monuments of antiquity as yet so little studied in Russia, or in similar special work at home or abroad. The institute grants the degree of doctor of archeology or archeography. Among those connected with the new institute whose names are favorably known outside Russia may be mentioned Dr. Uspensky, director of the institute, the author of fifty capital monographs in Russian; Dr. Fleischer, who was associated with English and American archeologists in recent excavations in Persia; Professor Grot, and other Moscow professors. Docent Visotsky has been appointed secretary to the institute.

UNIVERSITY AND EDUCATIONAL NEWS

The Kansas legislature appropriated for the state university at its last session $250,000 for the erection of engineering buildings, work on which will be begun at once.

Through the generosity of Mr. Arthur J. Cox, of Iowa City, an alumnus of the engineering department of the State University of Iowa, an annual prize of one hundred dollars has been established in the College of Applied Science of that institution for the best thesis submitted for the first degree in engineering. The prize is to be known as the "Thomas J. Cox prize in engineering," in memory of the father of the donor.

According to Consul-General T. St. John Gaffney, of Dresden, during the winter 1906–7 the twenty-one universities of Germany were attended by 45,136 students, of whom 254 were women. He gives the following details: The increase over the corresponding term of last year is 2,740 students. In addition to these numbers, 5,509 persons availed themselves of the privilege of listening to lectures without matriculating as members. Of this class 2,105 are women. As regards the various courses, the figures give the total number of Protestant students of theology as 2,208 and of Catholic, 1,708. The number of students of law is given as 12,146, of medicine, 7,098; of philosophy, history and languages, 10,985, and of mathematics and natural sciences, 6,234. The largest increase of students has taken place in medicine and philology, while there is a continued scarcity of Protestant theological students. The best attended university is that of Berlin, with 8,188 students; next to this comes Munich, with 5,567; Leipzig, with 4,466; Bonn, with 2,992; Halle, with 2,250, and then Breslau, Göttingen, Freiburg, Strassburg and Heidelberg. The two last have improved their position in the tabulated list of attendances, whereas Tubingen, Giessen and Erlangen, which are favorite universities in summer, take lower places in the list than formerly.

Dr. James E. Talmage has resigned his position as professor of geology at the University of Utah in order to devote himself to investigation in the field of mining geology. Professor Talmage has occupied the chair since its establishment as an endowed professorship thirteen years ago. In 1897 he retired from the presidency of the University of Utah to continue his work in geology. His successor in the department of geology is Dr. Fred J. Pack, who is one of his former students and a graduate from Columbia University, now professor at the Brigham Young College.

Dr. Frederick Hollister Safford has been promoted to an assistant professorship in mathematics in the University of Pennsylvania, and Messrs. Maurice J. Babb and Louis O'Shaughnessy have been appointed instructors in mathematics.

Dr. Gustav Hellmann has been appointed professor of meteorology at the University of Berlin and director of the Meteorological Institute, in succession to Professor W. von Bezold.

Dr. Cornelius Doelter, of Graz, has been appointed professor of mineralogy in the University of Vienna, in the place of Professor G. Tschermak, who has retired.

M. H. le Chatellier, of the Collège de France, has been appointed professor of general chemistry at the Sorbonne, in succession to Moissan.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, AUGUST 23, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

VALEDICTORY ADDRESS TO THE GRADUATING CLASS OF THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA, JUNE 3, 1907

I HAVE been honored by the request of your institution to pronounce the valdictory address to the members of this year's graduating class, and it appears to me that I can best perform my duty by taking full advantage of the position which I occupy towards you and your alma mater. As you know the outsider sees most of the game, and coming before you as a stranger from a sister institution, keenly interested in the progress and development of medical science and medical teaching in our country, I can speak to you all the more freely and frankly of your relation to your academic foster-mother, of the value of the heritage which she to-day bestows on you, and of your obligations to her, present, past and future.

It is almost a misnomer to speak of a valedictory address to a class of graduating medical men. It is true that in one sense, the purely physical and narrow aspect, this day marks a profound change in your professional careers. You are about to close one chapter of a continued story. You bid good-bye to the lecture rooms and laboratories, to the hospitals and clinics in which you have received your preliminary training, and to the men who guided and directed your studies. And in turn, this venerable and honorable seat of medical teaching and learning, a landmark in the educational development of our country, bids you God-speed, and offers you its commendation of work well done, its confident expectation of the equally successful work which it has a right to look for at your hands in the broader fields of your future activity. But the Jefferson Medical College does not say "Good-bye" to you, no more than you can, in the higher and broader sense of mental and moral activity, ever break the bond which you have here formed for all time. A valedictory must, under such circumstances, of necessity become a salutatory to the men who, having completed the preliminary stage of their professional life, enter into the full development and exercise of their chosen duties, a welcome to the broader expansion of their coming usefulness to mankind, a greeting of fellowship, not a farewell. It is not the bricks and mortar, the iron and stone of the Jefferson Medical College which your memory will hold among its most valued and cherished associations. No matter where your lot in life may place you, your thoughts and your hearts will turn, with the image of your alma mater before your mental vision, to the men you have here encountered, men who have taught you and modelled your lines of thought, men who stand to you as examples of success in the chosen field of their work, as standards of professional honor and of an honored profession, of upright life and dealing, of high place in their community. These are the men who have given to this college of yours, all through the long years of its honorable career, the high reputation and exalted standing of which you are to-day proud. That is what the Jefferson means to you, and will continue to mean all your life, and those ties are not broken by graduation. You, the most recent graduates, share with your predecessors, and will so share with those who are to follow you in the years to come, an heritage of untold value in the influence and incentive which your alma mater through these men has extended to your development.

But it seems to me that it is not enough for you to be merely justly proud of this association, to be satisfied with a grateful acknowledgment of your institution's services to you as undergraduates. Noblesse oblige—and I think that each one of you owes her a debt, which for value received in stimulation, example, incentive and education, you will try to discharge to the best of your individual ability. It is true, as we have just said, that the strength of a school lies not in the value and extent of costly buildings and equipment, but in the force, character and ability of the men selected to perform its work. That is clear, because they form a concentrated group, where the individual effort and the combined efficiency are evidenced in the daily contact with the student body and with the public at large. But it is also true that the real strength of a teaching institution is dependent in equal proportion upon the character and standing of the men sent forth from its training to their life's work. Their relation to their college is not so strongly in direct evidence, because they are distributed as individuals, but it is none the less real and vital. Their very dispersion affords the opportunity of carrying to all parts the influence and stimulation which they have received, the standards which they have been trained to hold in their work and in their broader relation to the community. Lowering of these standards, failure and inefficiency in the work—that is, perhaps you may think, a wrong which will primarily wreak itself on the individual at fault. But it has a more extended meaning, it carries beyond the mere personality involved, it is a wrong to the institution to which you owe so much, who honors you with her endorsement to-day, who certifies for your efficiency to the public, who counts on you to uphold her high traditions, and who confides no small part of her reputation to your care and custody. And with the sense of this responsibility assumed on your part I give you greeting and welcome from the school which to-day awards to you its degree, and extend to you the fellowship of the profession whose ranks you to-day formally join.

And now permit me for a moment to look back on some of your personal experiences of the past four years of undergraduate life, and to ask you to consider and interpret them in reference to the influence they should exert on the shaping of your future careers. Any one of your various branches of study will furnish ample material to point my meaning, but let me draw my illustration from my own field and recall to your minds some phases of your anatomical studies. Probably, at the very outset of your anatomical work you were more or less confused and overwhelmed by the multiplicity of detail which you were called upon to master. Much of it undoubtedly appeared to you unnecessarily complicated, needlessly minute and exhaustive in description and classification. Eager for the practical application of knowledge, you possibly questioned the actual value of some of the information which, by the terms of your course, you were required to make your own. But let me ask you now, at the close of your successful preparatory period, to regard the hours thus spent from a slightly different standpoint and to draw from your experience a lesson for your future independent guidance and conduct. Remember, in the first place, that to many of you, at least, when you began your professional work as undergraduates of this school, methods of natural object study were new and the correct perspective difficult to acquire. Subconsciously, perhaps, you gradually came to realize the value of the training which these early anatomical exercises developed in the close association and coordination of brain, hand and eye.

It is quite true that to you, practitioners of medicine and surgery, much of the knowledge thus acquired will be of no direct practical use in its individual and concrete form. To the coming expert in internal medicine the foramina and processes of the sphenoid bone are of little importance, nor does the successful practitioner of midwifry find that his cases hinge on his knowledge of the terminal distribution of the ulnar artery. As stated thus boldly, this is undoubtedly true, but in drawing these conclusions you should not lose sight of some important facts.

In the first place, whatever special avenue of professional activity may open to you, the training which you have received here in mastering the details of organic structure, in correctly estimating the physical, mechanical and biological problems you will encounter, in analyzing the trend and the ultimate effect of a pathological environment on normal structures, these are the forces which your medical course has placed at your disposal, and your ultimate success will depend on the keenness, dexterity and judgment with which you employ them. It makes little difference how you have acquired the correct methods of study and interpretation, to what exercise you owe the delicacy of touch, the capacity for accurate observation and logical deduction. You have chosen an arduous profession. You have passed successfully through your preliminary training. You are fitted to begin your real work, but remember that this real work, the work which in the end is going to count for you, for your institution, for your profession as a whole and for mankind at large, that work, as far as it may be placed in your hands, is just about to begin. And in that work the same methods that you have followed in your undergraduate course, of accurate observation and record, of close examination by sight and touch, of correct analysis and sound comprehensive synthesis, of reliable memory and logical deduction from established facts—these are the elements which will produce real results. The era of empiricism in medicine has passed for good and all, and to-day the practitioner of medical science must be a scientist in the true sense of the word and work by scientific methods.

Because of this fact I ask you to recognize the value of the training you have received and to realize that in no other way could the mental and physical aptitude for your work have been developed.

Again, let me point out to you what the acquisition on your part of sound methods of biological study means to you, as active participants in the steady advance of the future. As you look back over the earlier developmental stages of medicine your mind reverts to certain great landmarks, mile-stones in the natural progress of the science. You will think of asepsis, surgical anæsthesia, serum therapy and other great achievements in special fields. But consider the vast amount of infinite care and patience and keen reasoning which led up to these epoch-making advances, think how much close observation and correct experiment bridged the intervals between them.

Nothing in the biological sciences is so minute that it may be safely overlooked, nothing apparently so unimportant that it may be safely disregarded. A few years ago the parabranchial bodies were scarcely noticed or known. Contrast this with the modern parathyroid therapy of tetanus. And so I say to you again that, as you look back over your undergraduate course, the work you have accomplished should mean to you the preparatory training for the work now before you, and in whatever line you find that work, as your professional lives shape themselves, there you will use and further develop the methods of observation which you have acquired in this school.

A few days ago I received an abstract of a report covering the work of your department of general anatomy for the academic year just closing. To all who have the sound development of scientific medical education close at heart it is a most inspiriting document, both in the performance of achieved advance and in promise for the future. I venture to extend to this institution the cordial congratulations and full appreciation of a sister university for this material evidence of high standards and purposes. For we are all, individuals as well as schools, working for the common end, and the more complete our mutual faith and confidence is, the closer we stand shoulder to shoulder, the steadier and surer will be the advance of medical education and the resultant progress of the medical profession.

I can not do better than close my remarks to you with a quotation from the document referred to, in which your professor of general anatomy states:

> In this, the constructive period of the present anatomic course, the department recognizes that charts, drawings and models, however valuable they may be as aids to teaching, fail in replacing the actual structure for purposes of study and instruction. It is a cardinal principle of anatomic teaching that the student learns his anatomy chiefly in the dissecting room and in the section teaching. But the student can be assisted advan-

tageously by a well-equipped study collection, comprising not only preparations of adult human structures, but of comparative and embryonic material as well, arranged to illustrate the unity of plan in vertebrate structure.

I think this paragraph states as concisely and clearly as possible the twofold basis underlying all sound study and investigation, not alone in morphology, but in the whole range of the biological sciences, of which medicine is a part, *viz.*, close scientific observation of the actual conditions presented by any problem, and the correlated study of the developmental stages which have produced these conditions.

"Alles Gewordene wird erst verständlich in dem Werden" is the way a great German puts it.

To men who have been trained in these methods and principles, the Jefferson Medical College can safely and confidently intrust her future, in the full assurance that her high reputation will be sustained at their hands.

And so, once again, I bid, on behalf of the trustees and faculty of this institution, God-speed and good fortune to the members of the graduating class.

George S. Huntington
Columbia University

THE THIRTY-SIXTH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY

The thirty-sixth general meeting of the American Chemical Society was held in Toronto, Canada, during Thursday, Friday and Saturday, June 27–29, the place of meeting being the chemical building of Toronto University. At the opening session Emerson Coatsworth, mayor of the city of Toronto, delivered the address of welcome. This was followed by a short address by Ald. J. J. Graham. A welcome on behalf of Toronto University was extended by Dean Maurice Hutton. These addresses were followed by a response on behalf of the members of the society by its president, Professor Marsten T. Bogert.

The members of the local committee were untiring in their efforts to provide for the comfort and entertainment of their guests. This meeting will long be remembered because of the generous hospitality extended to the visiting members.

Luncheons were served in the university building on Thursday and Friday by the courtesy of Toronto University. Thursday afternoon the members of the society were the guests of Mr. Edmund B. Osler, M.P., and Mrs. Osler at a garden party in the grounds of Craigleigh, at Rosedale. In the evening the members were entertained by the local committee and the commodore and officers of the Royal Canadian Yacht Club at Centre Island. In the earlier part of Friday afternoon, the society visited various industrial establishments in Toronto. Later in the afternoon the members of the society were the guests of the Lieutenant Governor of Ontario and Mrs. Mortimer Clark at the Government House. Friday evening the members of the society banqueted at McConkey's. On this occasion Professor Maurice Hutton, chairman of the local committee, proved himself to be a very entertaining toastmaster.

Saturday morning the society was taken to Guelph on a special train to visit the Ontario Agricultural College and Experimental Farm. Luncheon was served at the residence by courtesy of the college.

Saturday evening the visiting members began the trip to the Cobalt mining camp on a special train provided for the occasion. Temagami Lake was reached early Sunday morning. After breakfast a boat was in waiting to carry the society thirty-five miles across the lake to the Lady Evelyn Hotel, where dinner was served.

Monday morning the train reached the

mining camps of Cobalt. Here small parties were formed and visits were made to many of the mines in the district. In the evening the visiting members were the guests of the Haileybury Club of Haileybury, Ontario. Returning, the society reached Toronto Tuesday morning.

A summary of the many events of these meetings appeared in the Toronto papers. At the last general assembly a hearty vote of thanks was extended to the local committee and the citizens of Toronto from whom these many courtesies were received.

The number of members in attendance was 150, of whom 120 were visitors. The next meeting will be held in Chicago, beginning December 26.

The following addresses were given before the general assembly:

The Measurement of Chemical Affinity: Wilder D. Bancroft.

Chemistry and Canadian Agriculture: Frank T. Shutt.

American Chemical Research: J. Bishop Tingle.

The Vagaries of Beryllium: Charles L. Parsons.

Deflocculated Graphite: E. G. Acheson.

These addresses will be printed in full at an early date.

The following papers were read before the society:

PHYSICAL CHEMISTRY

W. D. Bancroft, chairman

Corrosion in Persulphate Solutions: J. W. Turrentine, Cornell University.

Copper is dissolved in persulphate solutions quantitatively. The loss in persulphate content of the solution is equivalent to the copper dissolved. The corrosion of copper in persulphate solution is therefore analogous to the electrolytic corrosion in sulphate solutions. Nickel, aluminum and iron also behave in persulphate solutions as one would expect from their electrolytic corrosion when made anode in sulphate solutions, *i. e.*, nickel is but slightly attacked in sodium persulphate, but more readily so in ammonium persulphate; aluminum is not attacked at all, and iron is quite readily corroded.

Coefficient of Distribution: Livingston R. Morgan and H. R. Benson.

The following results are reported:

1. The molecular weights of alcohol in ether and of acetic acid in ether are the same as in water.

2. The molecular weights of acetic acid and alcohol in molten $CaCl_26H_2O$ and molten $LiNo_33H_2O$ do not vary with the concentration.

3. The molecular weight of alcohol in benzene varies but slightly with the concentration.

4. The coefficient of distribution is shown to be independent of the heats of solution of the substance in the two solvents.

The Measurement of Chemical Affinity: W. D. Bancroft.

The heat of reaction is not a measure of chemical affinity; but Gibbs has shown that the electromotive force is a measure for the case of completely reversible systems. Cases which have been studied experimentally are: precipitation of metal by metal; allotropic forms of metals; amalgam cells; stable and instable salts; metathetical reactions; oxidation and reduction cells; light. When the gas pressures or the osmotic pressures are known for a system in equilibrium, it is possible to calculate the work done against the chemical affinity by displacing the equilibrium, provided the equilibrium formula is known. This gives a relation between the electromotive force and the equilibrium constant, which has been tested for: precipitation of metal by metal; amalgam cells; stable and instable salts; metathetical reactions; oxidation and reduction cells. The method of calculating chemical affinity from the equation for equilibrium has then been applied to the cases in which electromotive force measurements are impossible or inaccurate.

There is no way at present to measure chemical affinity in the case of an apparently irreversible reaction, in other words, in the overwhelming majority of instances. It is suggested that the best line of attack is the study of the electromotive forces of irreversible cells made up of oxidizing and reducing agents.

The Stable Hydrates and Acid Salts of Ferrous Sulphate: Frank B. Kenrick, University of Toronto.

The object of the experiments was to determine the composition of the ferrous sulphates stable at ordinary temperatures in systems containing the components FeO, SO_3 and H_2O. Mixtures of varying proportions of these components together with a little ammonium sulphate were shaken until equilibrium was reached, and the liquid and moist solid phases analyzed. From these results the composition of the solid phase was calculated, the amount of liquid adhering to the solid being determined from the quantity of ammonium found.

The existence of the following chemical individuals, besides the ordinary green vitriol, has been proved with a fair degree of certainty: $FeO \cdot SO_3 \cdot 4H_2O$, $FeO \cdot SO_3 \cdot H_2O$, $2FeO \cdot 3SO_3 \cdot 2H_2O$, $FeO \cdot 2SO_3 \cdot H_2O$ and $FeO \cdot 4SO_3 \cdot 3H_2O$.

The Mechanism of the Acetacetic Ester Synthesis: W. Lash Miller, University of Toronto.

The rates of the condensation of oxalic ester with acetone and with ethyl acetate have been measured by Mr. Clark and Mr. Cooke, the progress of the reactions being determined by colorimetric measurements after adding ferric chloride. Some interesting features of the behavior of the red coloring matter have been studied incidentally.

Mutual Solubility of the Chlorides of Calcium and Sodium: W. O. Robinson, Bureau of Soils, Washington.

The complete isotherm of the system calcium chloride, sodium chloride and water at 25° has been determined. The solubility of calcium chloride hexahydrate is very greatly depressed by sodium chloride. The "constant solution" contains 78.49 grams calcium chloride and 1.846 grams sodium chloride to 100 grams of water. The hexahydrate of calcium chloride inverts to the tetrahydrate, in presence of an excess of sodium chloride at 29°.

The Measurement of the Vapor Pressure of Solutions with the Morley-Brush Gauge: O. F. Tower, Adelbert College, Cleveland.

The method is a differential one. The gauge was described, and the results of measurements with solutions of potassium chloride and cane sugar were given. The paper was of a preliminary nature.

Absorption of Water Vapor by Soils: F. E. Gallahger and H. E. Patten, Bureau of Soils, Washington.

The absorption of water vapor by quartz flour, a soil separate, and typical soils, has been studied with special reference to the controlling conditions. The rate of approach to equilibrium between soil and water vapor has been followed at various degrees of humidity, and these equilibrium points determined. The amount of water absorbed increases with the humidity, but not in a simple mathematical relation. The equilibria between soils and atmospheres saturated with water vapor were studied over a temperature range from 25° C. to 100° C., and, contrary to Hilgard's results, it was found that the amount of water absorbed decreased with increasing temperature. This confirms the results obtained by earlier investigators for the absorption of water vapor as well as for gases in general.

Determination of Solid Phases in Four-Component Systems: J. M. Bell, Bureau of Soils, Washington.

When only one solid phase is present in a four-component system, a modification of the Bancroft method for the determination of the composition of the solid may be employed. By the use of two triangular diagrams in each of which one of the ordinates represents the sum of the percentages of two components, the percentage composition of the solid may be determined graphically.

Double Sulphates of Ammonium and Calcium: J. M. Bell and W. C. Taber, Bureau of Soils, Washington.

In a recent paper d'Ans has claimed that the formula attributed by us to the double sulphate of lime and ammonium, viz., $CaSO_4 \cdot (NH_4)_2SO_4 \cdot 2H_2O$, should have only one molecule of water. It has been found in our later experiments that washing the double salt with the liquids which d'Ans has used, causes a rapid decomposition of the compound, and it has been shown by further experiments that the formula first proposed by us is the correct one.

Reactions between Copper Sulphate and Lime: J. M. Bell and W. C. Taber, Bureau of Soils, Washington.

When lime is added in excess to copper sulphate solutions, the solid phases consist of calcium hydroxide, gypsum and blue copper hydroxide, which are thus shown to be the constituents of Bordeaux mixture. When the lime is added in just sufficient quantity to precipitate all the copper and the solution is faintly alkaline, there is an olive-green copper hydroxide precipitated.

When lime is added in insufficient quantity to precipitate all the copper, the precipitate consists of a mixture of gypsum and a basic sulphate of copper. The basic sulphates of copper have been investigated by adding copper oxide to various copper sulphate solutions. It was found that the composition of the solid was variable and was intermediate between the two generally accepted basic sulphates of copper.

When there is neither acid nor base in excess, the study becomes one of the mutual solubility of copper sulphate and gypsum. The solubility of gypsum passes through a minimum as the concentration of copper sulphate increases.

The Solubility of Calcium Carbonate in Certain Aqueous Solutions: F. K. Cameron and W. O. Robinson, Bureau of Soils, Washington.

Calcium carbonate is much more soluble in potassium sulphate solutions than in potassium chloride solutions. In solutions of potassium chloride it passes through a maximum. When the system is saturated with carbon dioxide at atmospheric pressure the calcium carbonate is again more soluble in the more dilute potassium sulphate solutions than in those of potassium chloride, where again it passes through a maximum. In the more concentrated potassium sulphate solutions syngenite is formed.

Copper as Anode in Chloride Solutions: Saul Dushman, University of Toronto.

Increasing the concentration of the chloride, or rotating the anode, increases the proportion of cuprous salt formed. The experiments are in agreement with the supposition that cuprous and cupric salts are formed in such proportions that the solution at the surface of the anode is in equilibrium with metallic copper.

The Ignition Temperatures of Gaseous Mixtures: K. GEORGE FALK, Columbia University.

The method of determining the ignition temperatures of gaseous mixtures by calculating the rise in temperature, produced by the adiabatic compression of the gases, by means of the formula

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{k-1},$$

in which V_1 and V_2 denote the initial and final volumes of the mixture, T_1 the initial temperature, T_2 the ignition temperature, and k the ratio of the specific heats of the gases at constant pressure and constant volume, was applied to mixtures of carbon monoxide and oxygen and the following results obtained:

		T_2 (absolute)
1	$CO + O_2$	911
2	$CO + O_2$	879
4	$CO + O_2$	907
6	$CO + O_2$	1002

The Theory of "direct" Determinations of Migration: W. LASH MILLER, University of Toronto.

The relations between concentrations of solutions, transport numbers, and motion of the boundary, may be deduced without introducing *time* or functions dependent on it (conductivity, mobility).

This method of treatment makes the relations between the direct and the analytical methods very clear, and shows how the direct method may be applied to solutions of weak acids, etc., without reference to their degree of dissociation.

A Comparison of Collodion, Parchment Paper and Gold-beater's Skin Membranes with Porcelain: S. LAWRENCE BIGELOW, University of Michigan.

Methods for making collodion membranes were investigated and developed.

Some colloids were separated from crystalloids, using the three above-mentioned membranes. The progress of dialysis was followed by the conductivity method, and it was found to occur fastest with gold-beater's skin, slower with collodion and slowest with parchment paper. The results indicate that collodion is to be preferred to parchment for dialyzing.

The rates at which water permeated the above-mentioned substances under different pressures and temperatures were determined. The "permeabilities" were expressed in cubic millimeters of water passing through one square centimeter of membrane per minute. When these values for permeability were laid off as ordinates, against corresponding pressures and temperatures, respectively, as abscissæ, straight lines were obtained for pressures, nearly straight lines for temperatures. This is what would be expected if Poisseuille's formula for the passage of liquids through capillaries applied. More significant than the application of the formula is the fact that the "picture" for porcelain under the same conditions so strongly resembles those for the three membranes. This is evidence, though not by any means conclusive, in favor of the view that the passage of water through membranes is a capillary process.

The article will appear shortly in one of the journals.

The Equilibrium Diagram for the Series Copper-Aluminum: B. E. CURRY, Cornell University.

The freezing point curve for this series consists of seven branches. Six series of solid solutions and one compound, $CuAl_2$, separate from the melt. The β and δ series of solid solutions are instable at the lower temperatures.

Electrolytic Separation of Silver from Copper: H. W. GILLETT, Cornell University.

Silver can be separated electrolytically from copper in a tartrate solution by a constant voltage method. Vigorous stirring is essential if a good deposit of silver is to be obtained.

Some Unique Conductivity Curves: Edward C. Franklin and Harry D. Gibbs, Leland Stanford University.

With solutions of silver nitrate in methylamine the molecular conductivity first increases with increasing dilution, then passes through a maximum followed by a minimum. This abnormal behavior is probably the resultant of three factors, the self-ionization of the salt, the dissociating power of the solvent and the viscosity of the solvent.

A Dynamic Method for Determining the Temperature Pressure Curves of some Monovariant Systems of the Second and Higher Orders and its Application to a Dissociation: W. D. Horn, Bryn Mawr. This paper will appear in full in the *American Chemical Journal.*

Recent Advances in Electrolytic Analysis: Edgar F. Smith. Reported by title.

Electrical Conductivity of Solutions in Ethylamine: F. L. Shinn. Reported by title.

INDUSTRIAL CHEMISTRY

W. H. Ellis, chairman

Some Reactions during Water Treatment: Edward Bartow and J. M. Lindgren, The University of Illinois.

A series of tests was made to determine the amount of calcium and magnesium removed by each addition of reagent. The mineral matter in the water consisted almost entirely of the bi-carbonates of sodium, magnesium and calcium.

It was found that after the neutralization of carbon dioxide the calcium is removed. A reaction then takes place between the reagent and sodium bicarbonate, when present, and finally, magnesium is removed. The reactions within the limits of solubility of the precipitates take place in order almost quantitatively, with but little overlapping.

The experiments suggest the necessity for considering the presence of sodium bicarbonate in water treatment.

Some Experiments to Determine the Amount of Volatile Matter in Coal: A. Bement, American Trust Building, Chicago.

To ensure that no combustion would occur, an inert gas was continually passed through the crucible under slight pressure during the heating process. For convenience in preparation hydrogen was employed and the charge was heated by an ordinary Bunsen burner. The result was, that even after heating for periods of 100 and 120 hours, a loss still continued, and the indications were that it would have gone on for additional periods of equal lengths of time, at least.

Deflocculated Graphite: Edward G. Acheson, The Acheson Company, Niagara Falls.

Experiments on clays, carried out in the year 1901, showed that by adding vegetable extracts—gallotannic acid, extract of straw—to moderately plastic weak clays, their plasticity was increased, the amount of water required to produce a given degree of fluidity was lessened, and the size of the particles in suspension was much reduced.

The effect on finely divided graphite is much the same; and by the use of a little gallotannic acid and a few drops of ammonia, suspensions may be prepared which last indefinitely. Extensive tests are now being made to determine the value of this "deflocculated graphite" as a lubricant, with most encouraging results.

The Optical Rotation of Spirits of Turpentine: CHAS. H. HERTY, University of North Carolina.

In collaboration with the U. S. Forest Service the alio-resins from individual trees of the species *Pinus palustris* (long leaf) and *Pinus heterophylla* (Cuban) have been studied throughout a full season. The optical rotation of the several volatile oils shows wide divergence among trees of the same species. In the case of *P. palustris* the oils are generally dextro-rotatory, though one was found to be lævo-rotatory. The oils from *P. heterophylla* were found to be lævo-rotatory, though varying widely among the individual trees of this species. In every case, however, the rotation was found to be practically constant throughout the year.

The Volatile Oil of Pinus Serotina: CHAS. H. HERTY, University of North Carolina.

This oil, obtained by distillation of the alco-resin of the pond pine, is shown to consist chiefly of lævo-limonene. Its physical constants are given and the tetra-iodo addition product of the limonene prepared.

The Estimation of Carbon in Iron and Steel: E. P. MOORE and J. W. BAIN, University of Toronto.

During the solution of iron and steel in acidified potassium cupric chloride, it has been suspected that there is an escape of volatile hydrocarbons. The evidence has been based upon indirect methods of analysis; and by arranging for the direct estimation of any evolved hydrocarbons, it has been found that there is a constant loss during the operation, of such slight magnitude, however, as to be negligible for ordinary analytical purposes.

The Examination of Linoleum: PERCY H. WALKER and E. W. BOUGHTON.

Chemical tests as to quality of linoleum are of little value. The loss by abrasion is of value, though when taken alone it may lead to wrong conclusions; if, however, the appearance of the samples before and after abrasion is taken into consideration this test becomes probably the best available.

Canadian Shales and Products: CHARLES BASKERVILLE and W. A. HAMOR.

Ultramarine and Pyrophyllite: CHARLES BASKERVILLE. Reported by title.

The Constants and Variables of the Parr Calorimeter: S. W. PARR.

Pure Coal and the Deterioration of Coal Samples: S. W. PARR and W. F. WHEELER. Reported by title.

Determination of Benzene in Illuminating Gas: L. M. DENNIS and ELLEN S. McCARTHY. Reported by title.

A Furnace for Ceramic Use: FRED BONNET, JR.

A down-draught furnace built on the regenerative principle. The construction is of three circular seggars one inch thick, the inner one being eight inches in diameter. A temperature of 1,400° C. can be obtained in an eight-hour run.

INORGANIC CHEMISTRY

C. L. Parsons, chairman

Sodium Alum: W. R. SMITH.

A résumé of the conflicting statements in chemical literature regarding sodium alum, and descriptions of experiments showing that this alum exists below 33 degrees, but that it does not exist above that temperature; also results on new data for solubility, preparation, etc.

On the Non-existence of Clarke and Kebler's Cadmium Iodide: J. F. SNELL, University of Cincinnati.

Crystallization of cadmium iodide from hydriodic acid, decolorized by cadmium, resulted in formation of products of low specific gravity, similar in behavior to those described as cadmium iodide by Clarke and Kebler (*Am. Chem. J.* **5**, 235, 1883), but these on analysis proved to contain some hydriodic acid and water. It is concluded that there is no satisfactory evidence of the existence of a form of cadmium iodide of lower specific gravity than 5.6.

Platinum Resistance Furnace for Melting Points and Combustions: S. A. Tucker.

A description of a new electric furnace consisting of a quartz tube, heated by a spiral of platinum tape, the whole being surrounded by infusorial earth enclosed in an asbestos box. Most excellent results on combustions and on the determination of melting points were obtained in this apparatus.

Determination of Carbon Dioxide: W. H. Waggaman, Bureau of Soils, Washington.

The apparatus differs from that previously described by Cameron and Breazeale, by having an Ostwald regulator to control the flame under the decomposition flask, and by having a coil of tubing to cool the upper portion of the flask. Fairly accurate results for CO_2 from several organic compounds and carbonate minerals have been obtained in forty minutes.

Some New Compounds of Indium: F. C. Mathers and C. C. Schleuderberg, Cornell University.

This paper outlines the methods of preparation and properties of some new compounds of indium.

Indium perchlorate was prepared by dissolving metallic indium in perchloric acid. The solution was allowed to crystallyze in a vacuum desiccator.

Indium iodate was prepared by precipitating a solution of indium chloride with potassium iodate. It is a white crystalline substance, soluble in 1,500 parts of water and 150 parts of 1:5 nitric acid. It is decomposed by hydrochloric acid.

Indium selenate was formed by dissolving indium hydroxide in selenic acid which had been prepared by the electrolysis of copper selenate.

Indium cæsium selenate (alum) was prepared by crystallizing a solution of *indium selenate* and *cæsium selenate.*

The Separation of Iron from Indium: F. C. Mathers, Cornell University.

Nitraso β-naphthol quantitatively precipitates iron from an acetic acid solution while indium remains in solution. Colorimetric analysis of the indium solution after the removal of the iron showed that the content of the iron varied from mere traces to .025 per cent.

A System of Qualitative Analysis for the Common Elements: The Aluminum and Iron Groups: A. A. Noyes, W. C. Bray and E. B. Spear. Presented by E. B. Spear.

This is a continuation of the work already published in the *Journal of the American Chemical Society* and will appear later.

Distribution of Mineral Nutrients in Soil Separates: G. H. Failyer, J. G. Smith and H. R. Wade. Reported by title.

Potassium Ammonozincate: Edward C. Franklin, Stanford University.

The compound $Zn(NHK)_2 2NH_3$ has been prepared and studied. The analogy between the ammonia and water systems of bases, acids and salts is shown to extend to the formation of the ammonia analogue of potassium zincate. This is a continuation of previous work along similar lines.

Separation of Lithium Chloride from the Chlorides of other Alkalies: L. KAHLENBERG and F. C. KRAUSKOPF, University of Wisconsin.

The separation depends on the solubility of lithium chloride in pyridine while the other chlorides are insoluble in this reagent. The presence of three per cent. of water is not detrimental.

The Influence of Acid Residue upon the Stability of Cuprammonium Salts: W. D. HORN, Bryn Mawr.

This paper will appear in an early number of the *American Chemical Journal.*

An Anomalous Behavior in the Radioactivity of some Uranium Compounds: RICHARD B. MOORE and HERMAN SCHLUNDT, Butler College, Indianapolis.

When a 4-N solution of ammonium carbonate solution is added in excess to a saturated solution of uranyl nitrate, a yellow well-crystallized carbonate of uranium and ammonium separates out. This salt was found to increase very considerably in activity on standing. It was found that the salt on standing lost in weight and the same effect could be obtained by heating, the increase in activity being directly proportional to the loss in weight. The nitrate, acetate and sulphate of uranium on heating behaved in a similar manner.

On heating the complex uranium ammonium carbonate, ammonia water vapor and carbon dioxide are evolved simultaneously.

The initial increase in activity that was observed on the double carbonate does not indicate that a new radioactive type of matter had been separated from uranyl nitrate by a modification of the method of Crookes. The loss in weight decreases the absorption of the α-rays and the increase in activity consequently results.

Tellurium-Tin Alloys: HENRY FAY, Massachusetts Institute of Technology, Boston.

Tin and tellurium unite to form the compound SnTe, which melts at 769°. This compound forms a eutectic with tellurium which contains 85 per cent. of tellurium and which melts at 399°. It also forms a eutectic with tin, which melts at practically the same temperature as tin, 232°. The composition of this second eutectic has not been definitely determined, but it has been established that it contains less than 1 per cent. of tellurium.

On the Properties of Sodium Bismuthate: HENRY FAY and HELEN R. HOSMER, Massachusetts Institute of Technology, Boston.

A complete study of the bismuth-oxygen ratio in various preparations of the so-called sodium bismuthate was made. From the results obtained it is highly probable that sodium bismuthate does not exist as such except in the fusion of bismuth oxide with sodium hydroxide and sodium peroxide. It is impossible to identify it absolutely here on account of the rapidity with which it hydrolyzes into sodium hydroxide and a mixture of tetravalent and pentavalent bismuth oxides.

Of the various methods for the preparation of sodium bismuthate, the fusion method alone is capable of oxidizing the bismuth to its highest form.

Vanadium Sulphide, Patronite and its Mineral Associates from Minasragra, Peru: W. F. HILLEBRAND and W. T. SCHALLER.

The Mercury Minerals of Terlingua, Texas: W. F. HILLEBRAND and W. T. SCHALLER. Reported by title.

The Reaction between Hydrazine Sulphate and Ammonium Vanadate: A. W. BROWNE and F. F. SHETTERLY.

This article will appear in the *Journal of the American Chemical Society*.

Separation of the Yttria Earths: Benton Dales. Reported by title.

ORGANIC CHEMISTRY

J. Bishop Tingle, chairman

I. *On the Affinity Constant and Constitution of Several Urazoles.* II. *On the Velocity Constants of the Reactions between Alkyl Halides and Urazoles:* S. F. Acree and G. H. Shadinger.

The affinity constants of phenyl-urazole and 1-phenyl-4-methyl-urazole are 0.00001, that of 1-phenyl-2-methyl-urazole is 0.00000006, that of 1-phenyl-3-ethoxy-urazole is 0.00000004, while the constants for phenyl-3-thio-urazole and 1-phenyl-3-thio-4-methyl-urazole are 0.017. New evidence has thus been produced in favor of the view that phenyl-urazole and phenyl-3-thio-urazole are tautomeric compounds.

Work on the reactions of alkyl halides with urazoles, hydroxides, carbonates, thioacetates, etc., proves that the alkyl halide reacts with the anion of the urazole, hydroxide, etc.

The alkyl halides do not seem to form alkyl derivatives through the intermediate dissociation into alkyl and halide ions.

The alkyl halides do not seem to react with salts by first uniting with the cathion and forming a complex cathion which then reacts with the anion.

The alkyl halide seems to react as a neutral molecule with the anion of the substance which is alkylated.

The Synthesis of 7-amino-4-Quinazolones from m-toluylenediamine: M. T. Bogert and V. J. Chambers, Columbia University.

The diamine was acetylated, the toluene methyl group oxidized to carboxyl, the acetanthranil prepared from this di-acetamino acid, and quinazolones produced by condensing this acetanthranil with primary amines.

An Investigation of Certain Properties of the Sulphanilic Acids: V. J. Chambers, Columbia University.

A preliminary study of certain reactions of o-sulphanilic acids, together with the determination of the relative stability of the acyl derivatives of o-, m- and p-sulphanilic acids.

Studies in Nitration III. Nitration of N-Acylated Compounds of Aniline derived from Monobasic Acids: J. Bishop Tingle and F. C. Blanck, Johns Hopkins University.

The experiments were carried out under the same general conditions as were employed in the nitration of the *N*-alkyl derivatives of aniline; nitric acid alone, and in admixture with acetic acid, oxalic acid, trichloracetic acid and concentrated sulphuric acid, respectively, being employed. The following acyl-derivatives were used: formanilide, acetanilide, trichloracetanilide, propanilide, stearanilide, benzanilide, metabrombenzanilide, orthotolylsulphoneanilide, phenylsulphoneanilide, phenylacetanilide, picranilide. All the products of the reaction have not yet been fully identified.

On the Constitution of Phenyl-urazole (III.): A Contribution to the Study of Tautomerism: S. F. Acree, Johns Hopkins University.

Experimental work and the application of the mass law show that the relative amounts of the two stable derivatives formed in the reaction of a tautomeric compound, existing in two tautomeric forms in equilibrium, and another reagent depend upon (1) the relative reactivity of the two tautomeric forms towards the other reagent, (2) the ratio between the amounts of the two tautomeric forms when they are in constant equilibrium with each other, and (3) the rapidity of the change of each of these tautomeric forms into the other as the equilibrium between them is disturbed.

Various phases of the equilibrium conditions existing in solutions of tautomeric acids or bases, or their salts, have been studied by the application of the mass law.

The conditions under which normal and abnormal hydrolysis of salts of tautomeric compounds can be determined have been discussed.

A large number of derivatives of phenylurazole have been made and studied.

Studies in Catalysis: S. F. Acree and J. M. Johnson, Johns Hopkins University.

The study of the rearrangement of acetyl-chloramino-benzene in the presence of acids has shown that the velocity is proportional not to the concentration of the hydrogen ions, but to the square of the concentration of the hydrogen ions.

The study of the reactions of carbonyl compounds with hydroxylamine and hydroxylamine hydrochloride has shown that the reaction is a reversible catalytic one, and that the equilibrium point is changed by a change in the concentration of the hydrogen ions.

A general discussion of catalytic reactions has shown why the three so-called laws of catalysis were deduced from the experimental material previously available, and under what conditions they do or do not hold.

The Use of Benzyl Cyanide in the Synthesis of Certain Aromatic Succinic and Glutaric Acids: S. Avery, F. W. Upson and G. R. McDole, University of Nebraska.

Analogous to sodium malonic ether, sodium benzyl cyanide condenses with aldehyde cyanhydrins to form products which on hydrolysis yield alkyl succinic acids. S-diphenyl succinic and the heretofore unknown s-isopropyl phenyl succinic acid were formed by the above reactions.

With the ethereal salts of unsaturated acids, sodium benzyl cyanide forms condensation products analogous to those obtained by Michael's reaction. On condensing with ethyl cinnamate and hydrolyzing, two stereo isomeric phenyl glutaric acids were formed.

Mechanism of the Claisen Condensation: J. Bishop Tingle and E. E. Gorsline, Johns Hopkins University.

The condensation product of ethyl phthalate and camphor exists in the keto and enolic forms.

A study has been made of the action of sodium and of sodium ethylate on ethyl benzoate. Sodium ethylate is eliminated and, apparently, a sodium compound, $C_6H_5C(ONa):C(ONa)C_6H_5$, is formed. With water this is converted quantitatively into benzyl alcohol and benzoic acid, in equi-molecular proportion. Ether does not exert any apparent catalytic effect on the formation of the above sodium compound of ethyl benzoate; and sodium ethylate, free from alcohol, is without action on ethyl benzoate. Experiments in which the quantity of sodium was varied show that the yield of condensation product is greatly increased by treating the ester with two atomic proportions of sodium and then adding sodium camphor.

Intermolecular Condensation in the Perthalic Acid Series: J. Bishop Tingle and B. F Lovelace, Johns Hopkins University.

At the last meeting of this society Tingle and Cram reported that phthalanilic acid,

$$C_6H_4 < \begin{matrix} CONHC_6H_5 \\ CO_2H \end{matrix},$$

in presence of aniline and alcohol, is converted at a temperature below the boiling point of the latter into phthalanil,

$$C_6H_4<\begin{matrix}CO\\CO\end{matrix}>NC_6H_5.$$

The investigation has been continued by us in two directions; on the one hand, we have studied the effect of bases other than aniline on the condensation, and, on the other hand, have endeavored to ascertain the result obtained by substituting for phenyl some other group in the compound,

$$C_6H_4<\begin{matrix}CONHR\\CO_2H\end{matrix}.$$

Results show that by the use of pyridine or quinoline instead of aniline the phthalanilic acid is transformed into phthalanil as readily as by the use of aniline. Consequently the condensation must be due to salt formation and not to the reactivity of the carbonyl group.

Action of Primary and Tertiary Amines on Camphoroxalic Acid: J. BISHOP TINGLE and L. F. WILLIAMS, Johns Hopkins University.

Ethyl-amine yields a compound of the type

$$C_8H_{14}<\begin{matrix}C:CCO_2NH_3C_2H_5\\ | \quad | \\ CONHC_2H_5\end{matrix}. \qquad (I.)$$

When heated above its melting point it yields the derivative,

$$C_8H_{14}<\begin{matrix}C:CH\\ | \quad | \\ CONHC_2H_5\end{matrix}. \qquad (II.)$$

Ethylene diamine reacts to some extent like a secondary amine, because the elements of water are not eliminated; the condensation compound has the formula,

$$C_8H_{14}<\begin{matrix}CHC(OH)CO_2NH_3\\ | \quad | \qquad\qquad | \\ CONH\cdot CH_2\cdot CH_2\end{matrix}.$$

Paranitraniline gives a derivative of the type (II.) above. Orthoaminophenol yields a lactone,

$$C_8H_{14}<\begin{matrix}C:CCO—\\ | \quad | \\ CONHC_6H_4\end{matrix}>O,$$

whereas paraminophenol gives a compound of type (I.).

Action of Secondary Amines on Camphoroxalic Acid: J. BISHOP TINGLE and L. F. WILLIAMS, Johns Hopkins University.

The *diketone* employed was camphoroxalic acid. The following amines were investigated: diamylamine, diisoamylamine, diisobutylamine. These all gave compounds of the type,

$$C_8H_{14}<\begin{matrix}C\ \ C(OH)CO_2H\\ | \quad | \\ CONR_2\end{matrix},$$

which, when heated above the melting point, evolved carbon dioxide and water, giving the compound

$$C_8H_{14}<\begin{matrix}C:CH\\ | \\ CONR_2\end{matrix}.$$

Dibenzylamine yielded *directly* a derivative of this second type. The same is true of methylaniline, ethylaniline and of acetylphenylhydrazine. Benzylethylamine, on the other hand, gave compounds of both types.

The Action of Benzene and Selenic Acid: HOWARD W. DOUGHTY, University of Wisconsin.

The following compounds were made and studied: $(C_6H_5S_2O_3)_2Ba$, $(C_6H_5S_2O)_2Ba$ and $C_6H_5S_2O_3H$. The acid product begins to break down at 182°.

Tetrachlorgallein and some of its Derivatives: W. R. ORNDORF and T. G. DELBRIDGE. Reported by title.

Studies in Nitration IV. Nitration of N-Acylated Compounds of Aniline derived from Dibasic Acids: J. BISHOP TINGLE and F. C. BLANCK, Johns Hopkins University.

The following aniline derivatives were investigated: oxalic acid, oxanilide, succinanilic acid, succinanil, succinanilide, tartranilide, phthalanil, phthalanilic acid. In general, the results were in agreement with those recorded in the other papers of this series. The position taken up by the entering nitro group appears to depend not only on the nature of the groups already present in the molecule, but also, and to a very marked extent, on the strength of the acid which is mixed with the nitric acid.

Studies in Nitration II. Nitration of Aniline and of its N-Alkyl and Aryl Derivatives: J. Bishop Tingle and F. C. Blanck, Johns Hopkins University.

A large number of experiments have been carried out with nitric acid alone and when mixed with glacial acetic acid, oxalic acid, trichloracetic acid and concentrated sulphuric acid, respectively, in order to ascertain its action on aniline, methyl-aniline, ethyl-aniline, diethylaniline, dimethylaniline and diphenylamine. It is found that oxalic acid is without apparent influence on the reaction. As regards aniline itself, it is shown that aniline nitrate is always the first product formed during nitration; that, in presence of a slight excess of concentrated nitric acid, a colored dehydration compound is obtained. This is analogous to certain colored derivatives of the nitrophenols and is being further investigated.

Conditions affecting the Claisen Condensation: J. Bishop Tingle and E. E. Gorsline, Johns Hopkins University.

Most of the experiments were carried out with camphor, but in some cases other ketones were used. The results show that calcium or sodamide react only at relatively higher temperatures and the presence of a little alcohol is necessary; with sodium as the condensing agent the time required for the reacting substances to attain equilibrium is a function of the temperature. The effect of variation in the solvent is quite marked. The esters of the higher aliphatic monobasic acids appear to react somewhat differently from the esters of similar acids belonging to the aromatic series.

AGRICULTURAL, SANITARY AND BIOLOGICAL CHEMISTRY

Frank T. Shutt, Chairman

Unification of Terms used in Reporting Analytical Results: Cyril G. Hopkins, University of Illinois.

It is pointed out that there is great lack of uniformity in existing literature in the terms used for reporting analytical results, especially in agricultural chemistry.

In view of these facts, and providing concurrent action is taken by the Association of Official Agricultural Chemists and by the American Chemical Society, the Association of American Agricultural Colleges and Experiment Stations has endorsed a report favoring the adoption of the element system for reporting analytical results in the analysis of soils, ashes and fertilizers, as rapidly as possible.

In the case of foodstuffs, condiments, etc., it is recommended in the statement of analytical results to use names of compounds or groups of compounds actually present as such in the material, this being in accordance with the present general practise.

On a Method of Applying Moss Litter for Deodorizing and Desiccating Purposes: Thomas Macfarlane. Reported by title.

The Determination of Boric Acid in Common Salt: W. D. Bigelow and Clement S. Brinton, Bureau of Chemistry, Washington.

The authors collected about eighty samples of common salt, representing all grades, from the various manufactures over the United States, and examined them for the amount of boric acid present, using a modification of Howard's method for turmeric in mustard (Science, Vol. 19, page 583). Of the eighty samples examined only six contained boric acid to exceed 1 part in 100,000. Five of these samples were examined for boric acid by Thompson's method, with the following results: 0.020 per cent., 0.096 per cent., 0.202 per cent., 0.064 per cent., 0.080 per cent. All of the samples which ran high in boric acid were obtained from the western part of the United States, and the majority from Nevada.

Solubilities of Food Colors: Edward Gudeman, Suite 903–4, Postal Telegraph Building, Chicago.

Preliminary report on collaboration work with Professor E. R. Ladd, Associate Referee on Colors, Association Agricultural Official Chemists.

The solubilities of three coal tar colors, Oraline Yellow, Turquine Blue and Amaranth Red, and of three vegetable colors, Accoline Yellow, Lazuline Blue and Cladonal Red, were determined in cold and hot water, muriatic acid (1 per cent.), ammonia (1 per cent.), ether, petroleum ether, ethyl, methyl and amyl alcohols, acetone, acetic and amylic ethers, carbon disulphide, class; and conclusions drawn were that solubilities of the colors themselves and of the extraction values of the solvents are no criterion to judge the character nor the class of the colors, and that such methods are of no value in differentiating between coal-tar and vegetable colors.

Determination of Boric Acid in Butter: Robert Harcourt. Reported by title.

Meat Extracts and Juices: W. D. Bigelow and F. C. Cook. Reported by title.

Notes upon Composition and Analysis of 100 American Honeys: C. A. Browne, Jr. Reported by title.

B. E. Curry,
Secretary

New Hampshire College

SCIENTIFIC BOOKS

A Laboratory Manual of Invertebrate Zoology. By Gilman A. Drew, Ph.D., professor of biology at the University of Maine. Pp. vii + 201. Philadelphia and London: W. B. Saunders Company, 1907. $1.25 net.

For the majority of our students the value of our biological courses lies not in the acquisition of a more or less detailed knowledge of a series of animals or plants. Such a knowledge is, of course, a necessity in training the specialist, but the average student soon forgets the number of podobranchs and pleurobranchs of the lobster, never remembers long the exact position of the synergides and in six months' time can not tell whether yellow or green is the Mendelian dominant in peas. The greatest gain to the student is in a training of the powers of observation and the cultivation of a spirit of independence which does not accept a thing as so upon the *ipse dixit* of the text.

From this standpoint Drew's laboratory manual seems most excellent pedagogically. It does not tell him what he will find (and usually he will find it if so told), but it asks him what he does find and refers him to the specimens for the answers. In the hands of the competent teacher the resulting training is most excellent, while such directions in the hands of an incompetent instructor—well, such books will force the incompetent into other lines.

The proof of the pudding, says the old saying, lies in chewing the string. Just so the real test of this as of all other class books, lies in its actual use with students. As far as one may judge from reading the pages, Dr. Drew has produced a work of real value. Twelve groups of invertebrates are recognized, and in each, detailed directions for the study of one or two forms are given and accompanying these are hints for the external study of allied forms. If these are followed out they afford ample illustration of the tables of classification with which each group is introduced. More matter is introduced than can be used in the ordinary year's course, but this is not a disadvantage, as it allows a choice of forms according to the exigencies of location, the predilections of the instructor and the like. A rather careful reading of several sections reveals no serious faults, while typographical errors are few. We have not met any directions for injection; although starch mass is mentioned several times, no formulæ are given for its preparation. "Calkins" is referred to several times, but the beginner can hardly be expected to know of Calkins's work on the Protozoa. Aside from this, references to the literature are few. *Lencosolenia* occurs on p. 17.

J. S. KINGSLEY

Makers of Modern Medicine. By JAMES J. WALSH. Fordham University Press. 1907.

Dr. Walsh describes in this book the life and works of several famous men who are in a way the founders of modern medicine, but the names are hardly those which one would select as representing in a well-rounded way the foundation of modern medicine as a whole, since some of the very greatest are not mentioned. Vesalius, Harvey and Virchow would certainly deserve places if there were any intention of making such a complete list, but in his preface Dr. Walsh explains that this is a series of sketches which may be followed by others. In these subsequent sketches we may perhaps hope to find some mention of the great surgeons who have done so much to help in building the foundations. Morgagni, Auenbrugger, Jenner, Galvani, Laennec, Graves, Stokes and Corrigan, Müller, Schwann, Bernard, Pasteur and O'Dwyer form the subject of the sketches, which are very uniform in plan and general treatment.

Perhaps the most striking thing in this uniformity is that every one of the men described was of the Catholic faith and the essays in each instance lead up to a discussion of their devotion to the church, and to the dominant idea that great scientific work is not incompatible with devout adherence to the tenets of the Catholic religion.

Dr. Walsh recognizes well the salient characters of these men, the great teachers, the great humanitarians, the toiling investigators and the brilliant geniuses who make one step into the unknown, and makes clear too the interdependence of these qualities upon one another in the truly great. Thus there seems no doubt that in comparing Laennec with Auenbrugger we must see that while their most brilliant achievements were alike signal advances in the art of physical diagnosis, Laennec's power as a teacher, his discoveries in the realm of pathological anatomy and his deep human sympathies mark him out as a man standing on a higher plane than that of Auenbrugger. In any such series of essays it becomes necessary for the writer to form some such estimate of the relative importance of the life-work of each man and here doubtless many would differ from Dr. Walsh in some respects; but as far as he allows himself to discuss this, he is fair and his estimates well weighed.

The papers were written and published separately at intervals and later put together into book form, and this results in a good deal of repetition of monotonous discussion as well as of incident and quotation, but on the whole for the purpose for which they are aimed, the general instruction of the public in matters pertaining to medical history, they are, like the similar essays of Richardson, extremely entertaining and useful.

W. G. MACCALLUM

THE JOHNS HOPKINS UNIVERSITY

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for July opens with a note on the "Agassiz Centennial," being the remarks of Charles W. Eliot. These remarks, being brief and to the point, and couched in smooth English give a much better idea of the charm of Agassiz and the great influence of his personality than do most of the longer articles that have appeared. A. W. Morrill gives a "Description of a New Species of Telenomus with Observations on its Habits and Life History," the species being named *Telenomus ashmeadi.* Frederic T. Lewis discusses "The Development of Pinnate Leaves" and D. P. Penhallow makes some "Contributions to [our knowledge of] the Pleistocene Flora of Canada," based on leaves from the interglacial deposits of the Don Valley, Toronto. Finally, William E. Ritter gives the "Significant Results of a Decade's Study of the Tunicata." This is a most interesting paper, one of the kind that the student or "all around" naturalist appreciates, giving, as it does, in a concise form and clear language the results, and the bearing, of the observations made on this group of animals during the past ten years.

The Zoological Society Bulletin for July is an interesting number and records many important facts. First it notes the arrival of a pair of the Sudan African Elephants, *Elephas oxyotis,* the species with huge ears, and the one that attains the greatest size. The lamented Jumbo was a fine example of this species. "An Important Educational Collection" is contained in the Small Mammal House comprising examples of six orders of mammals to which it is hoped to add examples of three other orders (Pinnipedia will hardly rank as more than a Suborder). For teaching the rudiments of the classification of mammals this collection is most important, the more that it is well labeled, and the labeling at the Zoological Park is of the highest order, as instanced by the labels in the Reptile House. The ground in the north end of Baird Court has been laid out in a beautiful Italian garden and a new walk laid out through the fine beech woods by the beaver pond. Many species of birds living in the park have nested, including the rare Trumpeter Swan. Eighteen species of our warblers are now to be seen in the bird house, a most unusual number to be in captivity.

The Journal of Comparative Neurology and Psychology for July includes a paper by C. Judson Herrick on "The Tactile Centers in the Spinal Cord and Brain of the Sea Robin, *Prionotus carolinus,*" giving data hitherto unpublished upon which the author relied in part in his analysis of tactile and gustatory connections in fishes. The "accessory lobes" of the spinal cord of the gurnards are adapted for short reflexes, chiefly confined to the segment involved and not affecting greatly distant parts of the central nervous system. The second paper is "An Experimental Study of an unusual Type of Reaction in a Dog," by G. van T. Hamilton. The animal was trained in a complicated experiment box to determine the limits of complexity in association possible to the dog. James Rollin Slonaker reports on "The Normal Activity of the White Rat at Different Ages," recording by means of a kymograph record made by a revolving cage the total spontaneous activity of the rats from day to day.

DISCUSSION AND CORRESPONDENCE

STÖHR'S TEXT-BOOK OF HISTOLOGY

To the Editor of Science: My edition of Stöhr's "Histology," reviewed in Science, July 26, has been the subject of some misunderstanding. The publishers of the previous American editions obtained Professor Stöhr's permission to make additions and changes in the book, provided that a preface disclaiming his responsibility for such changes should be inserted. Several text-books written on essentially the same plan were then available for American students, namely Huber's excellent version of Böhm and Davidoff; MacCallum's edition of Szymonowicz which presents fully certain American researches; Schäfer's brief but instructive Essentials; Ferguson's Histology illustrated by photomicrographs; Bailey's, and others, each with peculiar and desirable features. There was, however, no book which presented histology from a strictly embryological point of view, describing the development of an organ as an introduction to its adult structure. Since this treatment was considered both scientifically and pedagogically practicable, and since its use at the Harvard Medical School was hampered by the lack of a text-book, the editor accepted the offer of Messrs. P. Blakiston's Son & Company to rearrange Professor Stöhr's book upon this plan. The editor had no desire to work over again and to illustrate anew the familiar facts of histology, which were so well presented in several available books, notably in that of Professor Stöhr. The resulting volume has been used with gratifying success in the elementary course at the Harvard Medical School. There are defects in illustrations and in statements (such as that which eliminates Paneth's cells from the duodenum), but the feature of this edition is its embryological treatment.

Professor Stöhr believes that histogenesis is too imperfectly known to be included in a text-book of histology, and that morphogenesis is there out of place. Such figures and embryological accounts as I have included he draws and presents in lectures on systematic anatomy. The reviewer in Science, however, believes that the idea of embryological arrangement is excellent, but that it has not been properly carried out. Thus he notes that the formation of the germ layers is not described in human embryos, although he does not state that human material is not yet available. If the chick and pig are referred to when similar human embryos have been described, it is because the student uses the former in the laboratory.

Another criticism is the failure to recognize American investigators, who are seldom referred to by name, and who, it is said, are "ignored" or "apparently unknown." Many of the papers cited, as those of Bardeen, MacCallum, Hendrickson, Calvert, Bensley, Opie, and Flint were re-read by the editor immediately before writing the corresponding sections of the book. It has been Professor Stöhr's practice to omit personal references, which he believes are out of place in an elementary histology. To do justice the book should teem with such references. The considerable number which I have introduced refer to very recent, or to important controverted work. A student should always have access to the memoirs, but whether or not they should be listed in an elementary text-book is questionable. Since the reviewer in Science believes that acknowledgment should always be made, it seems unjust to him that Professor Stöhr should have modified his diagrams of the spleen and lung after the appearance of Professor Mall's and Professor Miller's work, respectively, without recording his acknowledgments. I am informed that Professor Stöhr some time ago wrote to the publishers that he had examined Dr. Miller's papers and used them as far as they seemed right to him, and that the diagram was mostly drawn according to Miller.

Some microscopic discoveries may be readily verified. Such was Professor Sabin's finding of the jugular lymph sac in mammals, so obvious a structure that I have a drawing of it made by a student some years before her paper explained its nature. In the text-book this sac is described but its discoverer is not recorded. Other findings, like those of the splenic lobules and units and of the atria of the lung may perhaps be verified after careful study by special methods. If neither the author nor the editor of the book is sure that he can identify the atria, he can not honestly describe them.

Professor Mall's researches on connective tissue which are thought by the reviewer to have received insufficient attention, are referred to on pages 39, 42 and 50 with accompanying figures. Altogether it is quite probable that German work is less fairly treated than American in this text-book, but the national element was not and should not be considered.

This edition of Stöhr's "Histology" was written to assist teachers in using the embryological method of presenting the subject. It is hoped that any teacher who is interested in such a method will examine the book.

Frederic T. Lewis

Cambridge, Mass.,
July 27, 1907

SEISMOTECTONIC LINES AND LINEAMENTS—A REJOINDER

In the issue of Science for July 19, 1907 (pp. 90–93), Professor William M. Davis has reviewed my recent paper, "On Some Principles of Seismic Geology," published in Gerland's "Beiträge zur Geophysik" in March last (vol. 8, pp. 219–292). To his statement that "the seismotectonic lines seem, so far as earthquakes are concerned, to be largely influenced in location and direction by the evidently subjective element of the location of cities and villages in which observers are numerous," I would say, that some modification of the results unquestionably arises from this cause, and this is true of all studies in seismic geography, as is fully set forth in my report. That it has not exercised a controlling influence upon the results, a careful reading of the report should show. Were this not the case, why should New York City, with its population of more than 3,000,000, be represented by nine epicenters, and East Haddam, Conn., by 145? why should Philadelphia have seven epicenters, and Newburyport, Mass., 84? Does it seem likely that in all southeastern New Jersey the little hamlet of Toms River should have been singled out for seismic prominence; in eastern Maryland, Accomac; and in the eastern Carolinas, Snow Hill?

When Professor Davis says: "Indeed, there is even less reason for thinking that seismotectonic lines should be closely related to centers of urban population than that rivers should run by large cities," he is attaching his handle at the wrong end. There is an excellent and most obvious reason why large cities should be located along the course of rivers, and there is an equally potent reason why seismotectonic lines should generally intersect large towns provided seismotectonic lines are expressed as lineaments. The seismotectonic line, like the lineament, and the proverbial horse, should come before the city and the cart, respectively. The relation of seismotectonic lines to cities has been discussed in my report on page 225.

doubtless be generally so interpreted by those not familiar with the paper under review. Stripped of some verbiage (baselevels, cycles of erosion, revived erosion, etc., with which the matter has little to do), the discussion might well have been taken from pages 254–255 of the paper reviewed, where I had supposed that the matter was presented in a somewhat new light. No possible objection can be raised to Professor Davis's borrowing of this idea and adopting it, but I should not like it to be supposed that the view is not also my own.

The subject of the straightness of fault lines and lineaments has been taken up in my report along the line of Professor Davis's discussion of it (pp. 285–286), as it has also in my earlier papers; and, I venture to think, in a more nearly adequate fashion. Better than any discussion of this subject is a presentation of evidence. Early in the present season I suggested to Mr. W. D. Johnson, of the United States Geological Survey, then as now in the Owen's Valley, California, the great desirability of securing photographs, and if possible maps, of the earthquake faults which were formed there in 1872. In response to this suggestion Mr. Johnson has, with painstaking labor, prepared detailed maps covering considerable areas of the faulted region, and these with an unusual generosity he has placed at my disposal for study. These maps will shortly be published and will make, I do not hesitate to say, one of the most important of

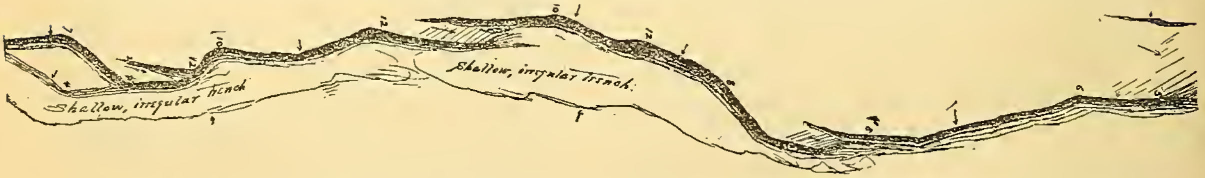


Fig. 1. Map of a zone of dislocation revealed at the surface after the earthquake in the Owens Valley, California, in 1872. Surveyed by Mr. W. D. Johnson, U. S. Geological Survey, in June, 1907. Scale, 240 feet equal one inch. The figures indicate throws, and the arrows the facings of the scarps.

The second portion of Professor Davis's review, which is headed "Fault Scarps and Fault-line Scarps," from the manner of its presentation would give the impression that it is in opposition to my own view, and it will

contributions to the science of seismology. The portion of one of these areas which is printed herewith, sets forth the complex nature of a zone of displacement; especially, however, its zigzagging course, its sudden variations in displacement, its distribution of the throw over several near-lying and generally parallel planes, and, finally, the general persistence with which the zone of dislocation adheres to a definite course.

The object of this reply is to make clear that with the exception of the minor differences above referred to, the theses which Professor Davis has defended in his review, are just those which I have myself set up in the report reviewed, as well as in some other papers upon structural geology.

Wm. H. Hobbs

University of Michigan,
July 22, 1907

RAILWAY SIGNALS

To the Editor of Science: By some inadvertence Dr. J. W. Baird, of the University of Illinois, in criticizing a recent article of mine on "Railway Signals," in the *Century Magazine,* has attributed to me the belief that the human retina at night is color-blind; and he wonders how, according to my doctrine, an engineer ever distinguishes his color signals at night. As a matter of fact, I distinctly state, in the very article he criticizes, that at night the eye is *not* color-blind: "Colors are readily seen at night if they are intense enough."[1] The passage of mine which he quoted speaks explicitly of *faint* lights; for the signal-lights, bright enough in themselves, often become faint by distance, fog, smoke or storm. And of faint lights it is demonstrably true, as I said, and as every careful student of the subject knows, that the eye "no longer detects their proper colors."

2. As to the relative sensitiveness of the outlying portions of the retina for color and for form, it should be said that at a certain angular distance from the fovea a red danger-light can appear "white"—a common sign of safety. But in my own case I can easily distinguish correctly a horizontal from a vertical line, still farther off to the side. And even when, with greater angular distance, the direction becomes obscure, I find no tendency in a line-signal to appear to be its very opposite, as in the case of certain color-signals. So far as the practical problem of signaling is concerned, therefore, it seems probable that indirect vision would be less likely to cause disastrous misperception of a line-signal than of color; and that Dr. Baird's contention here is not *stichhaltig.*

3. The fact that some illuminated semaphores have failed would hardly seem to justify the judgment that what I recommend is "antiquated" and a failure. As I shall attempt to show elsewhere, there is an essential difference between the long line of lights which I propose for signaling, and the devices that have failed.

4. Dr. Baird charges me with promulgating the "erroneous conception" that there are individuals weak in their color sense but by no means color-blind; and declares that "several thousand cases of 'color-weakness,'" examined by Nagel, of Berlin, turned out in every instance to be color-blind. This is certainly astonishing. For Nagel himself, in the very latest issues of his journal,[2] affirms that he has found many cases of markedly weak color-sense that were *not* color-blind *at all.* He finds the color-weak to be usually "anomalous trichromates"; but quite recently he has examined carefully a person who showed in a pronounced way the characteristic marks of color-weakness (Farbenschwäche), and yet was not even "*anomal.*" Except for the color-weakness, his color-system was the normal "three-color" system. The "popular" and "erroneous" conception that there are color-weak persons who are not color-blind, seems thus destined to continue.

It is the more striking that these misrepre-

[1] "Railway Disasters at Night," *The Century Magazine,* May, 1907, p. 120, col. 2.

[2] *Zeitschrift für Sinnesphysiologie,* Vol. 41, pp. 250 f.; Vol. 42, pp. 65 ff. Could Dr. Baird's "several thousand cases of 'color-weakness,'" all proved by Nagel to be color-blind, have perhaps been drawn from the following passage in Nagel?—"*Among many thousand persons whose color-sense I have investigated, I have found not a single instance of markedly weak color-sense that did not on closer examination turn out to be an anomalous trichromatic color-sense.*" (Ibid., Vol. 41, p. 251). It is perhaps needless to add that "*di*chromatic" would have been used by Nagel had he meant (even partially) color-blind.

sentations, not of myself alone, but of Nagel and of the present state of color-investigation, should appear in a communication devoted to exposing the scientific mistakes of the popular magazines.

George M. Stratton
The Johns Hopkins University

SPECIAL ARTICLES

DIEMICTYLUS OR NOTOPHTHALMUS AS NAMES OF A SALAMANDER

The very important work of Dr. Leonhard Stejneger on the "Herpetology of Japan and adjacent territory" has just been published, and among the many interesting points raised (and mostly satisfactorily settled) is one respecting a genus represented by very common American salamanders. The genus variously called *Diemictylus,* or *Notophthalmus,* being represented by a couple of Japanese species, is adopted with the first name. It is said, "Derivation and meaning obscure. Two derivations suggest themselves, namely, *διαμυκτος*, from *διαμιγνυμι*, or *δι-ἡμικοτλοσυ*, but the application of neither is obvious." The deduction is undoubtedly correct and my familiarity with names coined by Rafinesque and his methods in doing so enable me to give an explanation.

Rafinesque (1820), in his Annals of Nature (p. 5), claims that his *Triturus viridescens,* type of *Diemictylus,* has "the posterior [feet] with only three toes and two lateral knobs." The name evidently is intended to allude to this character and is badly condensed from *δις*, twice, *i. e.*, two, *ἡμι-*, half, and *δακτυλος*, finger, the "two lateral knobs" being considered as half-toes. An analogous contraction is Rafinesque's *Decactylus,* curtailed from *δεκα*, ten, and *δακτυλος*, finger.

Dr. Stejneger has not given any reason for his preference of *Diemictylus* over *Notophthalmus,* but he may have some unknown to me. I have; however, always regarded *Notophthalmus* as the proper name. Rafinesque named both in the same article and on the same page (5), *Diemictylus* on line eight and *Notophthalmus* on line twenty-six. The characters assigned to both are worthless. It was open to any later naturalist to adopt either name. S. F. Baird, in 1850, in the *Journal of the Academy of Natural Sciences of Philadelphia* (N. S., I., 281, 284), recognized that both *Diemictylus* and *Notophthalmus* were based on the same form and preferred the latter name. This, so far as I know, was the first use by an original investigator of either.

Edw. Hallowell, in 1858, in the same journal (N. S., III., 362), substituted *Diemyctylus* (changed from *Diemictylus*) for Baird's *Notophthalmus.* In this course, he was followed by Cope and other American zoologists. J. E. Gray, however, followed Baird in accepting *Notophthalmus.*

Cope (1859) preferred "*Diemyctylus,* though unmeaning, to the egregiously inappropriate *Notophthalmus* of the same date." On the contrary, I consider that *Notophthalmus* is very appropriate for the type species which is distinguished by the ocelliform dorsal spots, figuratively known as eyes, in accordance with many similar cases.[1] It is also well formed and euphonious. Perhaps Baird was influenced in accepting the name for these reasons as well as because the character connected with it ("toes of the fore feet free and unequal") was less inappropriate than that associated with *Diemictylus* ("fore feet semipalmate with four *equal* toes"). However this may be, *Notophthalmus* should be retained unless Dr. Stejneger knows of an earlier use of *Diemictylus.* We are both obedient to the same rule which provides for such cases, and which has guided him in the same work, a few pages farther on (p. 25) in accepting *Hynobius* rather than *Pseudosalamandra.* We have cause to be thankful for being freed from such a barbarous compound as *Diemictylus.*

Naturalists are to be congratulated because Dr. Stejneger has very satisfactorily accounted for the etymology of *Ambystoma* (p. 24). He has also accepted "the shorter form" for the names of families based on components ending in *stoma,* as "Ambystomidæ for Amblystomatidæ." I have always preferred this course.

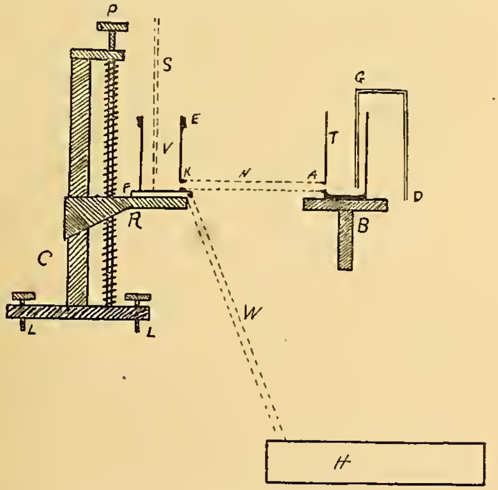
Theo. Gill

[1] *E. g.*, eyes of the peacock's tail.

A NEW RHYTHM AND TIME DEVICE

After having tried various rotation devices for the production of a series of uniform stimulations at regular intervals, I have concluded that the construction of such a machine which will be really reliable, is possible, but would be too expensive to be justified by present needs. Whether the machine could be designed so that gradations through all rates, from say one tenth second to two seconds, would be possible, is a question. Some of the machines which have been used for rhythm work have a fair adjustment for rate, but are irregular in speed, and depend on forms of electric contact which give exceedingly variable current strengths. A reliable and convenient mechanism as yet is not obtainable.

Feeling that rotation devices are out of the question for accurate work, I have turned my attention to the employment of the dropping of water, varying the rate of fall by changing the level of the water in the vessel from which



the drops issue. I have tried several arrangements of apparatus for the purpose, and have finally settled on one which is highly satisfactory. Reference to the figure will show the details of this, although not the proportions, as I have not had the parts drawn to any scale.

About four feet above the sink *H*, is a glass jar *T*, supported on a bracket *B*. From the orifice *A* at the bottom of the jar, a rubber tube *N* runs to another jar *V*, supported by the stage *R* of the statif *C*, which stands on a high table beside the sink. A rubber tube *S* conducts a small stream of water from a faucet to the jar *V*, the tube dipping into the water in the jar to prevent disturbance of the surface. The overflow from *V* is caught by the saucer *F* in which *V* is set, and is conducted noiselessly to the sink by the rubber tube *W*. A band of cloth *E*, its edge flush with the edge of *V*, facilitates the overflowing, and keeps the water level constant. The siphon *GD*, of small bore tubing, slightly constricted in one place to retard the flow, and firmly held by a support not shown, drops the water upon a resonator or key placed in the sink. By turning the head *P* of the screw of the statif, the stage *R* and jar *V* may be raised or lowered, thus raising or lowering the water level in *T*, and accelerating or retarding the rate of the drops.

For auditory stimulation a tin resonator placed in the sink gives admirable results. For other purposes, where it is desired to utilize the making or breaking of an electric current, I have modified a light make-and-break key, by extending the lever and giving it a small disc to be struck by the falling drop. With this, I am able to operate telegraph sounders or telephone receivers for auditory stimulation, and sparks or Geissler tubes for visual, or to record on a kymograph drum.

Some care is needed in setting up and operating the apparatus. Air bubbles must be removed, although the double jar system reduces that trouble to a minimum. Shaking of the apparatus disturbs the drops, so accuracy will not be attained if the building is subject to much jarring. If the size of the drop is not sufficiently large, a ring of rubber tubing slipped over the end of the siphon *D*, will increase the adhering surface. The faucet should be adjusted so that a little water is constantly flowing down the side of *V*. The orifices *K* and *A*, and the tube *N* must be large enough so that the water level in *T* is quickly readjusted when the height of *V* is changed. The siphon *GD* may be of about three thirty-seconds of an inch bore, "drawn" enough in one place to make the water level appreciably above D at slow rates of drop. A jar seven or eight inches high and three or four inches wide will be plenty large enough for T, and V need not be so tall.

I have made a number of record tests of the time accuracy of the drop, and find that it is perfectly reliable for one second to one eighth second, as shown by comparison with a 256-vibration fork. The drop will run much faster than one tenth second, if the size is properly controlled by the means mentioned above, but my key is too clumsy to record well much beyond one eighth. With a slight change in the key that difficulty will be obviated. From one second to six seconds my first records showed an apparent variation. These records for the longer periods were not intended to be extremely close, and were taken with a Zimmermann chronograph. I found later that the variation was in the chronograph, and have not yet tested these intervals with the tuning fork. Compared with a pendulum record, they appear perfectly regular. Intervals longer than six seconds I have not employed at all, although the apparatus is capable of furnishing them.

This device may be put to a variety of uses about a psychological laboratory. In addition to work in rhythm, I find it useful for time-records on the kymograph, for intermittent stimulation in work in fluctuation of attention, and for a time guide for an experimenter in the employment of definite intervals of preparation for a stimulus or between successive steps of an experiment. The key may be adjusted to give a regularity of current strength far greater than that of even mercury contacts of other time machines, making the apparatus especially valuable where this condition is of great importance, as in the rhythm and attention experiments.

Knight Dunlap
Johns Hopkins University

ON QUININE SULPHATE AND HUMAN BLOOD

Quinine sulphate when administered in small doses to healthy students has been found generally to slightly increase the phagocytic action of the polymorphous mentrophiles but in some cases it slightly inhibits.

In vitro an inhibitory effect, together with some laking was found when the strength of the sulphate ranged from 1/1,000 to 1/15,000 while from 1/16,000 to 1/1,000,000 dilution there was increased phagocytosis in periods ranging from 30 to 60 minutes, being most marked at a strength of 1/75,000. There was noted in all suspensions, which contained more than 1/20,000 of quinine sulphate, a marked absence of the granules from the polymorphous neutrophiles. The cell membrane was often gone. Vacuoles were very frequently present. As contrasted with those in the unquinized specimens their cytoplasm showed diminished staining powers which was strong evidence of the destructive action favored by the quinine.

A simple method requiring only a few hours for its accomplishment has also been worked out for studying in vitro the effect of any drug on opsonic index and in connection with the latter subject a means of standardizing the virulency of any organism has been suggested.

Thos. M. Wilson
Hull Physiological Laboratory,
University of Chicago

BOTANICAL NOTES

FARM BOTANY

For botanists who may wish to learn something more about wheat, oats, barley and corn (maize) than is to be found in the ordinary botanical works, the little book, "Examining and Grading Grains" (Ginn), by Professors Lyon and Montgomery will be found useful. Many a botanist will be surprised at the number of things which may be seen in a careful study of these common plants. For classes in applied botany in agricultural schools and colleges it must prove very helpful.

FOSSIL IOWA PLANTS

Professor Macbride's paper on "Certain Fossil Plant Remains in the Iowa Herbarium" is an interesting contribution which appeared recently in the *Proceedings* of the Davenport Academy of Sciences. It is accompanied with a dozen excellent plates. Several new species are described, namely, *Sigillaria calvini, Psaronius borealis,* and *Araucarioxylon occidentale.* Two modern species are recognized, viz.: *Picea mariana* from beneath the drift in Washington county, Iowa, and *P. canadensis* from the base of the blue clay in Keokuk county.

OUR FOREST RESERVES

Under the title of "The Use of the National Forests" the United States Forest Service has issued a booklet of forty-two pages, giving much information in regard to the National Forests (forest reserves), and intended to explain concisely what they are for, and how they should be used. A few well-selected half-tone reproductions of suggestive photographs add materially to what must prove to be a very useful publication.

HISTORY OF AMERICAN BOTANY

In the June number of *The Popular Science Monthly* Professor Underwood publishes an entertaining account of the "Progress of our Knowledge of the Flora of North America," illustrated by half a dozen reproductions of plates from the old works of Porta, Bock, Cornut, Plukenet and Micheli, and a facsimile of a page of Linne's "Species Plantarum." The paper is well worth reading, especially by the younger botanists, who had no part in the work of the last half of the nineteenth century.

SOUTH DAKOTA CONIFERS

A bulletin of more than local interest is No. 102 of the South Dakota Experiment Station, devoted to "Evergreens for South Dakota." It was prepared by Professor Hansen, and brings together the results of many years of experience upon the prairies and plains of the northwest. While the treatment is necessarily quite popular, the bulletin contains much information which must prove useful to the botanist who is interested in the relations of climate, soil and other physical factors to the distribution of species. No botanist can run over these pages without finding that some of his notions as to the distribution of the conifers must undergo material change. Twenty-six half-tone illustrations help the reader to a better understanding of the text.

SEEDS OF COMMON GRASSES

Much like the foregoing is bulletin No. 141 of the Kansas Experiment Station, in which Professor Roberts and Mr. Freeman discuss and illustrate the seeds of certain common grasses, and the common adulterants and substitutes. Here again the botanist who is interested in a critical knowledge of plants may obtain many hints as to the usefulness botanically of such work as this in our experiment stations, when done as carefully as this seems to have been. Few systematic botanists have that accurate and detailed knowledge of the "seeds" of grasses which was necessary in the preparation of this bulletin. It may indeed be considered a valuable contribution to the morphology of systematic botany, as well as a helpful bulletin for the practical farmer.

A TROPICAL SCHOOL OF BOTANY

Professor Doctor Kellerman, of the Ohio State University, Columbus, Ohio, has planned a tropical school of botany for next winter, which ought to attract the attention of some of our young men who are fitting themselves for their life work as teachers of botany. The session extends from December 19 to March 19, and will be held in Guatemala, Central America. The camps will be located at Zacapa (100 miles from the coast), Los Amates (40 miles inland), Izabal (on Lake Izabal), and perhaps also at Livingston (on the coast). Only a small number of young men will be accepted, and those who intend joining are advised to do so at the earliest day possible. The fee for the three months, including traveling expenses, board and lodging, is $226.00. The project is one that should be of interest to botanists generally, as affording excellent opportunities for instruction along unusual botanical lines.

DR. MAXWELL T. MASTERS

The July number of the *Journal of Botany* (London) contains a portrait and short account of the life of the late Dr. Maxwell T. Masters, the well-known English botanist, who died on the thirtieth of May last, at the age of seventy-four years. He wrote "Vegetable Teratology," a book that for nearly forty years has been the standard and practically the only work on the subject. He was also the editor of the *Gardeners' Chronicle,* perhaps the foremost horticultural journal in the world.

PROGRESSUS REI BOTANICAE

Another *Heft* (3) of Dr. Lotsy's "Progressus Rei Botanicae" (pub. by Fischer, Jena) has made its appearance. It carries the first volume from page 533 to its conclusion (p. 642), and contains but one article (by R. P. van Calcar) "Die Fortschritte der Immunitäts- und Spezifizitätslehre seit 1870."

NEW EDITION OF CAMPBELL'S BOTANY

After five years the Macmillans bring out a second edition of Campbell's well-known "University Text-book of Botany." So well written was the first edition that it was not necessary to make many changes in the text; in fact the new book is so little different from the old that it may be used in the same class with no inconvenience. It is practically the best general text-book to-day for the American student of advanced botany.

EXPERIMENTS ON THE INFLUENCE OF LIGHT

In the October *Annals of Botany* Professor Peirce records certain experiments made by him to determine the kind and amount of irritability of certain young plants in relation to light. Although his experiments were interrupted before completion (by the San Francisco earthquake) he shows that as the direction of illumination is usual or unusual certain plants have their normal form, or some other wholly different. "It is evident," he says, "that unless the young plants developing from the spore are exposed to influences like those under which their parents developed, they will be unlike their parents." A broader statement of this conclusion is that "certain physical factors of the environment, constant or periodic but unchanging, constitute means of repeating parental characters generation after generation, and these environmental influences are as essential as the substance. Given the same chemical compounds and the same arrangement of these in the fertilized egg as in the parents, the young must be like the parents *if* their environment is the same." The paper is well worth careful reading, and it is to be hoped that Professor Peirce will be able soon to resume his abruptly interrupted experiments.

Charles E. Bessey
The University of Nebraska

CONCILIUM BIBLIOGRAPHICUM

Dr. Herbert Haviland Field is visiting this country in connection with the Zoological Congress and the interests of the Concilium Bibliographicum of Zurich. Visitors to the Congress will find a set of the cards of this great zoological catalogue on exhibition in the Harvard Medical School. There is also a complete set arranged to date in the American Museum of Natural History. A duplicate set in the American Museum is available for immediate orders.

Dr. Field is seeking to organize the business affairs of the Concilium on a somewhat more permanent basis by the appointment of a director, on a salary to be fixed by American trustees, the director to administer the affairs of the Concilium without any pecuniary interest in its profits or losses, but solely with the interest of maintaining the high character of the bibliographical work which it has already accomplished. For this purpose and for the general expenses of the Concilium an annual sum of $5,000 is needed either from an endowment fund of $100,000 or from a special annual subscription fund.

It seems appropriate that a special effort should be made by American zoologists to raise such a fund in order to further the interests of the Concilium, which reflects such great credit upon this country as well as upon the Swiss government, which has so cordially supported it. For the immediate purposes of the Concilium it is necessary to raise a special fund to cover the purchase of new type-setting machines and other apparatus which will greatly facilitate all operations. During the present summer Dr. Field may be reached by letters addressed in care of the American Museum of Natural History. A special American committee will be formed during the meeting of the International Zoological Congress to take this matter in charge.

Henry Fairfield Osborn

THE BRITISH ASSOCIATION'S GRANTS FOR SCIENTIFIC RESEARCH

At the recent Leicester meeting of the British Association for the Advancement of Science, grants for research were made to the amount of nearly £1,300. The characters of the grants and the approximate amount in pounds is as follows:

Section A—Mathematical and Physical Science. Seismological observations, £40; further tabulation of Gessel functions, £15; kites committee, £25; geodetic arc in Africa, £200; meteorological observations on Ben Nevis, £25.

Section B—Chemistry. Wave-length tables of spectra, £10; study of hydro-aromatic substances, £30; dynamic isomerism, £40; transformation of aromatic nitramines, £30.

Section C—Geology. Fossiliferous drift deposits, £11; fauna and flora of British Trias, £10; crystalline rocks of Anglesey, £3; faunal succession in the carboniferous limestone in British Isles, £10; erratic blocks, £18; pre-devonian rocks, £10; exact significance of local terms, £10; paleozoic rocks, £15; composition of Charnwood rocks, £10.

Section D—Zoology. Index animalium, £75; table at the Zoological Station at Naples, £100; heredity experiments, £10; fauna of Lakes of Central Tasmania, £40.

Section E—Geography. Rainfall and lake and river discharge, £5; investigations in the Indian Ocean, £50; exploration in Spitsbergen, £30.

Section F—Economic Science and Statistics. Gold coinage in circulation in the United Kingdom, £6.

Section G—Engineering. Electrical standards, £50.

Section H—Anthropology. Glastonbury Lake Village, £30; excavations on Roman sites in Britain, £15; anthropometric investigations, £13; age of stone circles, £53; anthropological photographs, £3; anthropological notes and queries, £40.

Section I—Physiology. Metabolism of individual tissues, £40; the ductless glands, £30; effect of climate upon health and disease, £35; body metabolism in cancer, £30; electrical phenomena and metabolism of arum spadices, £10.

Section K—Botany. Structure of fossil plants, £15; marsh vegetation, £15; succession of plant remains, £45.

Section L—Educational Science. Studies suitable for elementary schools, £10.

Corresponding Societies Committee. For preparation of report, £25.

SCIENTIFIC NOTES AND NEWS

At the Meudon Experiment Station, which is affiliated with the Collège de France, M. Daniel Berthelot has been appointed director of the laboratory for plant physics, and M. Muntz, director of the laboratory for plant chemistry.

Professor Francis E. Lloyd has been placed in charge of the department of investigation of the International Rubber Company, Jersey City, N. J. His headquarters are at present with the Central Mexican Division, and he should be addressed at the Hacienda de Cedros, Mazapil, Zacatecas, Mexico.

Dr. L. W. Stephenson has been appointed assistant geologist on the U. S. Geological Survey, and will be engaged for the next two years in the investigation of the geology and water resources of Virginia and the Carolinas.

Frank M. Surface, Ph.D. (Pennsylvania), has been appointed associate biologist at the Maine Agricultural Experiment Station at Orono, Maine.

Dr. David T. Day, who for twenty-one years has had charge of the preparation of the U. S. Geological Survey's annual report on the mineral resources of the United States, has requested to be relieved of duty as chief of the division of mining and mineral resources, in order to devote his time to the preparation for the survey of an exhaustive report on the petroleum resources of the United States. The director has accepted Dr. Day's resignation and has designated Mr. Edward Wheeler Parker to succeed him as chief of the division of mining and mineral resources. Mr. Waldemar Lindgren will be associated with Mr. Parker in the work of this division, and to him has been assigned the scientific supervision of those parts of the annual report on mineral resources that relate to the metalliferous ores.

President Jordan, of Stanford University, has just returned from a visit to Australia and New Zealand. The purpose of this visit was the giving of a course of lectures in the University of Sydney on "The American University, its Organization and Ideals." Lectures on the same subject were given later at the universities of Melbourne and Adelaide and at the colleges at Christchurch, Wellington, Auckland and Wanganui in New Zealand. An address was given on "Agassiz as a Teacher" in the University of Sydney on the centenary of the birth of Agassiz.

Dr. Tempest Anderson, Professor A. R. Forsyth, F.R.S., Mr. D. G. Hogarth, Lieut.-Colonel Prain, F.R.S., and Professor C. S. Sherrington, F.R.S., have been elected members of the council of the British Association for the Advancement of Science.

The meeting of the British Association for the Advancement of Science, which is to be held next year at Dublin, under the presidency of Mr. Francis Darwin, will open on September 2. It will be remembered that Sir George Darwin presided over the South African meeting of the association two years ago. The London *Times* states that the election of Mr. Francis Darwin is appropriate in view of the fact that the meeting next year will mark the fiftieth anniversary of the publication of "The Origin of Species." "The Origin of Species" was, however, published towards the close of the year 1859.

It is proposed to recognize in some suitable manner the scientific services of Professor J. G. McKendrick, F.R.S., who has lately retired from the chair of physiology at Glasgow.

Dr. G. Haberlandt, professor of botany at the University of Graz, has been elected a member of the Vienna Academy of Sciences.

Dr. Vladimir V. Podvysockij, director of the Imperial Institute for Experimental Medicine at St. Petersburg, has been appointed chairman of the committee appointed by the Russian government for the investigation of cancer.

It is reported in the daily papers that Dr. H. W. Wiley, while abroad, is making arrangements for an international conference to be held in this country to consider legislation on pure food and adulterations.

Professor Wm. Bullock Clark, of the Johns Hopkins University, who is spending the summer in Europe, will attend as a delegate and member the celebration of the founding of the Geological Society of London, and of the German Geological Society. Professor Harry Fielding Reid, of the Johns Hopkins University, will also be a delegate to the anniversary meeting of the Geological Society of London.

Mr. H. C. Plummer, assistant in the Oxford University Observatory, has been appointed fellow at the University of California and will be stationed at the Lick Observatory.

Dr. Charles K. Swartz, working under the auspices of the United States and Maryland Geological Surveys, will this summer complete a portion of work on the Paleozoic formations of western Maryland, being assisted by Dr. Ohern and Mr. T. Poole Maynard.

Dr. M. W. Twitchell, professor of geology at the University of South Carolina, will be engaged during the summer in investigating the Coastal Plain deposits of South Carolina.

Harlan I. Smith is making a preliminary archeological reconnoissance of Wyoming for the American Museum of Natural History. This state is the center of an extensive field unknown archeologically. Mr. Smith is endeavoring to interest local scientific and educational institutions in the work, in which they must cooperate if the problems are to be solved.

DR. ELLIOT R. DOWNING, head of the biological department of the Northern State Normal School, Marquette, Michigan, has leave of absence for a year and will spend it largely at the biological laboratories of Europe. Miss Theodosia Hadley, assistant in the department, will take his place during his absense. Dr. Downing's address, until October first, is Woods Hole, Mass.

THE Romanes lecture will be delivered by Lord Curzon, chancellor of Oxford University, on November 2. The subject will be "Frontiers."

THE council of the British Association has recommended the republication of Sir William Hamilton's mathematical memoirs in an accessible form.

SIR JOHN JACKSON has established in the University of Edinburgh a fund for the encouragement of physical research in honor of the late Professor Tait. The fund will yield an annual income of about $1,000.

WE learn from *Nature* that Mr. Charles Hawksley has commemorated the centenary of the birth of his late father by offering the sum of £1,000 to the council of the Institution of Mechanical Engineers for the foundation of a scholarship or premium. The offer has been accepted by the institution, and the terms on which the gift is to be held are under consideration.

DR. WILLIAM THOMSON, emeritus professor of ophthalmology in Jefferson Medical College, Philadelphia, well known for his work in ophthalmology and especially in color-blindness, has died at the age of seventy-four years.

M. AUGUSTE PONSOT, professor of physics at Lisle, known for his researches on photography and cryoscopy, has died at the age of forty-eight years.

DR. EMIL PETERSEN, professor of chemistry at Copenhagen, has died at the age of fifty-one years.

THE death is also announced of Dr. Schlagdenhofen, director of the pharmaceutical faculty at Nancy.

SECTION H—anthropology—of the British Association, having passed a resolution to the effect "That the council of the British Association be asked to impress upon His Majesty's government the desirability of appointing an inspector of ancient monuments, fully qualified to perform the duties of his office, with full powers under the act, and with instructions to report periodically on his work with a view to publication," the council appointed a committee consisting of Sir John Evans, K.C.B., Sir Edward Brabrook, Mr. Sidney Hartland, Sir Norman Lockyer, K.C.B., and Lord Balcarres, to report on the proposal; and the report of the committee, having been approved by the council, was sent with a covering letter to the prime minister on December 19, 1906. The president also attached his signature to a memorial upon the same subject drawn up by the council of the Society of Antiquaries. It is understood that, whilst no immediate action will be taken by the government, the matter is receiving consideration, with the object of placing all ancient monuments in the United Kingdom under adequate protection and more effective supervision.

ARRANGEMENTS for cooperation in the investigation of underground waters and of the stratigraphy of Florida have been completed between the U. S. Geological Survey and the newly organized Geological Survey of Florida. Mr. M. L. Fuller, of the national survey, will have charge of the stratigraphic investigations, which will form a part of the broader investigations of the Atlantic and Gulf Coastal Plains being conducted by the United States and the local State Surveys under the direction of Mr. Fuller. The underground water studies will be divided between the state and the national surveys.

UNIVERSITY AND EDUCATIONAL NEWS

Two research studentships in science of the value of £60 and £40, respectively, have been founded at University College, London, by an anonymous donor; they will be awarded for the first time next session.

The trustees of the college of the city of New York are said to look with favor on the suggestion that a night college be added to the present work of the institution, for the assistance of those young men and women who can not afford attendance at the regular college.

The summer school of the University of Nebraska closed on July 26, after a six weeks' session. An increasing number of regular university students entered the classes, and the instruction consisted very largely of courses which are identical with those which are given during the college year. Students are showing an increasing tendency to remain for these summer courses in order to shorten the time for attaining their degrees. By working three summer sessions the student may gain a semester's university credit, thus allowing him to graduate in three, or three and a half years, instead of four.

The students in the ten Russian universities were last year distributed as follows: Dorpat (founded in 1632), 1,908; Helsingfors, in Finland (founded in the same year), 2,640; Moscow (founded in 1755), 5,489; Kharkoff (founded in 1804), 1,380; Kasan (founded in the same year), 1,255; Kieff (1832), 3,000; St. Petersburg (1819), 4,508; Odessa (1865), 2,066; Warsaw in Poland (1869), 1,400; Tomsk, in Siberia (1888), 786.

The appointment is announced of Professor Charles Henry Benjamin to be dean of the Schools of Engineering of Purdue University, to succeed Dean W. F. M. Goss, who resigns in order to accept a similar appointment at the University of Illinois. Professor Benjamin comes to Purdue from the chair of mechanical engineering at Case School of Applied Science, which he has occupied since 1889, prior to which time he was, for three years, engaged in engineering practise and, for six years, as instructor and professor of mechanical engineering in the University of Maine, of which institution he is a graduate.

At New Hampshire College, Mr. Charles James, F.I.C., has been promoted to an assistant professorship of inorganic chemistry and Dr. D. L. Randall, Ph.D. (Yale, '07), has been elected instructor in the same department.

Professor Charles Puryear, head of the department of mathematics of the Texas College of Agriculture and Mechanic Arts, has been made dean of the college.

Dr. John Weinzirl, who for the past ten years has been director of the Hadley Climatological Laboratory and professor of bacteriology in the University of New Mexico, has resigned to accept a professorship in bacteriology in the University of Washington at Seattle. His place in the University of New Mexico is filled by Jos. R. Watson, a graduate of Western Reserve University.

Dr. R. C. Archibald, lately professor at the Mount Allison Ladies' College, Sackville, N. B., has been appointed professor of mathematics at Acadia University, Wolfville, N. S.

It is announced that Dr. Howard Marsh, professor of surgery at Cambridge, will be elected master of Downing College to succeed Dr. Alex. Hill, who has retired.

At Sheffield, Mr. D. R. de Souza has been appointed demonstrator in physiology, and Mr. W. F. G. Swann assistant lecturer and demonstrator in physics.

Mr. Martin White, who has for some years endowed the teaching of sociology in the University of London, has now founded two professorships in that subject, one permanently and the other for a period of five years. The appointment to the permanent chair has not yet been made; the other has been offered to and accepted by Dr. E. A. Westermarck, who has already held a lectureship in the subject at the university. Dr. A. C. Haddon has also been appointed university lecturer in ethnology for the session 1907–8 under the Martin White benefaction.

Mr. Augustine Henry, of the Royal University, Ireland, has been appointed reader in forestry in Cambridge University.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, AUGUST 30, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

CHEMISTRY AND CANADIAN AGRICULTURE[1]

To me has been accorded the honor of participating in the welcome which is being offered to the members of this society at this, their first, meeting on Canadian soil. At any time and under ordinary circumstances it would have afforded me—as indeed any citizen of Canada—very great pleasure to give you a hearty greeting. Your presence here is evidence of the good-will and friendly feeling that exist between the chemists of the United States and those of Canada, and we are proud to have gathered here in convention representatives of that great chemical body that includes in its membership men from all parts of the North American continent. Chemists, I have always believed, are to be numbered among the men whose work makes for the welfare of their country and they know no political boundary lines in the giving out of the results of their labors. I know that we in Canada have benefited largely by the work of the chemists of the experiment stations in the United States.

But the pleasure of having you here and in some small way reciprocating the favors you have so often showered upon us is enhanced in the great satisfaction we feel that you should visit the Dominion at a time when our country is so prosperous. At no previous stage in its history has there been the same substantial, steady progress and

[1] Address of the chairman of the Section of Agricultural Chemistry at the Toronto meeting of the American Chemical Society, June 27, 1907.

development that has marked the past five years. In agriculture, in all industries and manufactures, in mining, in exports and we may say in all those things which we believe conduce to a country's prosperity, we are to-day in an enviable condition. Nor have we as yet reached the high-water mark. We believe that we have only entered upon an era of "good times." The prospects for the future are bright and the signs of the times indicate that for some years there will be a steady advance—an ever-increasing development of the many great natural resources we possess. In all this I know you will rejoice with us.

And having said this, the question will naturally arise in your minds: What is the secret, the reason for this phenomenal development? My answer is that it is due, chiefly, to a better, more thorough realization by ourselves and those of other countries, of the great agricultural possibilities of this Dominion. We have in our northwestern provinces alone unmeasured, almost illimitable, areas of the most fertile soil, yet awaiting the plough—soil rich and deep, a veritable mine of plant food, chemically and physically perfect and specially adapted, so far as we can judge under the climatic conditions that prevail, for the production of the finest quality of the most important, the most valuable of all food-stuffs—wheat. While we recognize the value of all her other natural resources, Canada is, and will probably always remain, essentially an agricultural—a food-producing—country, capable, as the years go by, of sustaining an immense population and giving a large surplus of food-stuffs for export.

It is not my purpose to make this address a statistical record, but in order to give you proof that I have not spoken in exaggerated terms regarding this truly astounding development I must give you a few figures kindly furnished to me by the Dominion Census Office. They refer to the northwestern provinces, Manitoba, Saskatchewan and Alberta.

	Population	Cereals	
		Acres	Bushels
1900	419,512[2]	3,491,414	43,251,662
1905	808,863[3]	6,025,190	162,244,929
1906		7,894,666	239,841,001

These data need little comment. They furnish evidence of the most satisfactory character respecting our growth as a whole and of the rapid extension of agriculture in the Northwest, particularly. May I quote in this connection the concluding sentence of the Report of the Select Committee on Agriculture and Colonization of the House of Commons, 1906–7?

> A careful survey of the entire field demonstrates that agriculture, the cornerstone of national wealth and power, is in a more prosperous condition at present in Canada than in any other country of the world, while the yet unmeasured territory of rich virgin lands awaits settlement ready to respond bounteously to the industry and intelligence of many millions of willing hands. In a word, Canada is the world's greatest bread field of the day.

If time permitted I should have liked to tell you something of the agriculture, the various soils and climatic conditions characterizing the different provinces as we travel across the Dominion from the Atlantic to the Pacific. There would be much of interest to the agricultural chemist in such a study. But such a recount, even in the briefest form, is now impossible. Every province has its own advantages, but it also has its own peculiar problems to solve. No doubt you already know something of the farming conditions in eastern Canada, which was first to be settled; of the Garden of the Gulf, Prince Edward Island, that has recently been brought to realize the

[2] Population on April 1, 1901.

[3] Population on June 24, 1906.

extent to which she has impoverished her soils by continued cropping with potatoes and oats and who now is endeavoring to restore lost fertility by the development of dairying and the more extensive growth of clover; of Nova Scotia and her world-famous orchards in the valleys of the Annapolis and Cornwallis, her dyked lands which she shares with her sister province, New Brunswick, and from which hay has been cut for many a decade without apparent deterioration of the soil; of the picturesque province of Quebec, on either side of the St. Lawrence, peopled for the most part by the thrifty "habitant" who has tilled faithfully, if at times not over-wisely, the land that has descended from father to son for many a generation; of the banner province of Canada, Ontario, with her strong, productive soils, her immense wealth in live stock, her splendidly developed dairying industry, her cereals and fruits.

Again, in the West there is the province of the Pacific coast, British Columbia, as yet but sparsely settled, where mining and lumbering are more important industries to-day than agriculture, but which nevertheless is daily gaining prominence from the great success that has attended fruit growing within her confines. This industry is still in its infancy, but already the Okanagan, the Kootenay and other similarly situated districts in the semi-arid belt of the interior are exporting large amounts of fruits of the finest quality to the settlers of the northwest provinces.

It is to these latter, comprising Manitoba, Saskatchewan and Alberta, that we now turn our attention, though I can only give you the merest outline of them and their possibilities. The cry for some years past, and still is to-day, "Westward, ho!" People are going in, one might say rushing in, to possess and to till these vast, fertile western plains. The first to enter in and to possess this great lone country were farmers from Ontario and eastern Canada. Of late years, however, while the exodus from the east has continued, these provinces have received thousands from Great Britain, northern Europe and lastly we have welcomed from the great republic south of us, and more particularly from the northwestern states, large numbers of experienced farmers. This area in the west, containing probably more than 170,000,000 acres of arable land, is being fast occupied by an industrious, intelligent, law-abiding people—a progressive, ambitious people, imbued with the spirit of the west, who are not content merely with the methods that satisfied a past generation, but who are anxious, as far as may be possible, to farm their land according to the principles of modern, economic agriculture. Our room for expansion will be evident from the consideration of the following estimates collated from official sources by Dr. Wm. Saunders, director of the Dominion Experimental Farms, and given by him in a paper on "Wheat Growing in Canada," in 1904. Dr. Saunders, I may add, has always been considered as a well-informed and most conservative authority in his statements regarding agricultural matters:

Land fit for settlement in western Canada (Manitoba, Saskatchewan and Alberta): 171,000,000 acres, of which there is now under cultivation 5,000,000 acres.

Present production of wheat and other grains, about 125,000,000 bushels.

Possible wheat production (one fourth under crop annually), 800,000,000 bushels.

With these facts before you it will not be surprising to learn that the past two decades have witnessed great activity on the part of our governments, both federal and provincial, in providing means and establishing machinery for education in farming matters, for the solution of such agricultural problems as require scientific research, and for giving assistance in such ways as may be practicable to the individual farmer in his every-day work. The Ontario Agricultural College at Guelph, instituted in the seventies, has earned a continental reputation for the excellence of the training given her students, now to be found on farms and in technical positions all over the land. A large amount of very valuable experimental work has also been done at Guelph and, through the cooperative society of her graduates, in various parts of the province of Ontario. The system of farmers' institutes has been a further means of disseminating the principles of modern agriculture in the various provinces, chiefly by lectures and addresses, and also to some extent by practical demonstrations in the field. Manitoba and the maritime provinces within the past three years have established agricultural colleges which, besides doing strictly collegiate work, are fast becoming active centers for the propagation of agricultural knowledge.

It is just twenty years ago since the federal government established the Experimental Farm system, comprising at that time a central institution at Ottawa with a scientific staff and laboratories, and four branch farms, located, respectively, at Nappan (Nova Scotia), Brandon (Manitoba), Indian Head (N. W. T.) and Agassiz (British Columbia). Quite recently two others have been added to this list, at Lethbridge, southern Alberta, and Lacombe, northern Alberta. The immediate establishment of others, both in the east and in the west is under contemplation by the government.

It would be altogether too long a story to tell you, even in outline, of the experimental work done in the various branches of agriculture during these years by the experimental farms, in stock-feeding, in dairying, in soil management, in the growth of crops, in the use of manures, in the originating and distributing new and improved cereals and roots, in orchard work, in disseminating information relating to the prevention of insect and fungous pests. But is it not all recorded in the reports and bulletins of the farm, no doubt to be found on the shelves of your libraries?

I must not, however, omit to say that there is a very large amount of work done which finds but little permanent record. The experimental farms are not only for research and experimentation, but for the dissemination of information on agricultural matters generally. We have endeavored to make each farm, and especially the central farm at Ottawa, a bureau to which all engaged in farming should feel themselves at liberty to apply for advice and instruction. To this end the privilege of sending letters to the central farm, Ottawa, free of postage was extended by the government and has been largely used. The experimental farm undoubtedly exerts an influence of great practical value through this correspondence, the magnitude of which will be apparent when I tell you that from the central farm alone in the neighborhood of 35,000 letters are sent out annually in addition to reports, bulletins and other printed matter. This branch of the work has served to keep the farm officers in touch with the farmers in all parts of the Dominion. Further, it has brought to our notice many difficulties which have subsequently furnished most interesting subjects for research and we can point to many valuable results to the country at large that have arisen in the first place from a farmer's inquiry.

But it is of the chemical work more particularly that I am to speak to-day. Agriculture is not a branch of chemistry, but it is, nevertheless, to-day a vocation which calls for the intelligent application of principles based on chemical truths. Physics and biology are sciences that also supply fundamentals, but all must agree that of these three, chemistry takes the first place, furnishing, as it does, the very foundation and framework of modern agriculture. It seems to be the science which above all others we fall back upon for an explanation of all agricultural operations, whether performed by nature or by man. We have not tried to make our farmers chemists, but in the presentation of chemical information relating to farm work (put as far as possible into language understandable to the layman) we have endeavored to make it clear that profitable agriculture to-day means putting into practise the teachings of the laboratory and the experimental plot; and I am happy to say that in this our labors have not altogether been in vain. Looking over the country as a whole and comparing the sentiment of our farming community of twenty years ago with that of to-day, I am well satisfied that good progress has been made in establishing a confidence in, and in awakening an appreciative attitude towards, scientific research and teaching.

Since among the factors that conduce to profitable farming, a productive soil is perhaps the one of greatest importance, it was only natural that from the outset we should have made the matter of the economic maintenance and increase of soil fertility our special study. As I have already told you, we have in certain parts of the older districts of the Dominion soils which have been partially exhausted by irrational and wasteful methods; and again, as you know, we have vast areas in the west, as yet practically untouched, of virgin soil of the finest quality, capable of producing magnificent crops. For the former we have endeavored to devise practical methods that would restore fertility—and this in a large measure without recourse to commercial fertilizers; for the latter we are trying to construct a plan or system of farming that would materially lessen the deterioration consequent upon exclusive grain farming.

In the course of this work during the past twenty years we have examined chemically several hundreds of surface soils representative of cultivated and virgin areas, and collected in every province of the Dominion. Many of these have been submitted to what we might term complete soil analysis, including the determination of available plant food by the Dyer method. Physical determinations, in a large number of instances, have been obtained to supplement the chemical data. With these results at hand and with conclusions we have been able to draw during this period from personal observation and inspection of soils in various parts of Canada, it might naturally be expected that we should be in a position to make some pronouncement regarding fundamental differences that might exist between fertile virgin soils and unproductive, worn soils, respecting the factors that go to make up what we might term fertility, and their relative importance. With regard to these factors, we may say that our work, in accordance with that of many others, has shown that, apart from climatic conditions (temperatures, rainfall, sunshine, etc.) soil-productiveness results from a happy assembling of the chemical constituents of plant food in more or less assimilable forms, of physical properties allowing of soil aeration, the retention of moisture, and the providing of freedom for root extension, and, lastly, the presence of an abundance of those microorganisms which, living on the organic matter of the soil, prepare the nourishment of our farm crops. It is thus seen that, according to our present views, the three sciences, chemistry, physics and biology, must all contribute their share of work towards a complete and correct soil diagnosis. We can not stay now to consider how far our methods to-day are satisfactory towards that end; we all admit they are far from perfect. Nevertheless, there has been a marked advance during the past ten years, and there are at the present time earnest and skilful workers engaged in this research whose labors are yearly adding to our store of knowledge on this important but exceedingly difficult and complicated subject.

Our own work in this matter has been more particularly in tracing the relation of organic matter and its concomitant, nitrogen, to crop-producing power.

1. Very early in our soil studies I was impressed by the fact that our virgin soils of great productiveness were invariably characterized by large percentages of organic matter and nitrogen, and that, on the other hand, worn soils resulting from continuous grain growing or other irrational systems, and soils from naturally poor areas, showed meagre amounts of these constituents. If we except soils from the semi-arid districts of the west, and the muck soils of the east, these statements will apply, more or less strictly, to all types of soils, from heavy clays to light sandy loams.

2. We found, further, that in those soils from humid districts there was a relationship between the organic matter and the nitrogen—that what affected or destroyed the former dissipated the latter; while, on the other hand, the methods that led to an increase of the organic matter also raised the nitrogen content. Undoubtedly these two constituents stand and fall together.

3. Another feature of importance was that accompanying a fair organic content there was usually a goodly proportion of available phosphoric acid, potash and lime: that is, according to the Dyer method of determination.

4. Lastly, it was evident that the proportion of organic matter present influenced in a marked degree the capacity of the soil for holding moisture, and in several other important particulars affected the mechanical condition.

We have not been able to study the effect of the organic matter and nitrogen content on bacterial life, but I believe it will be shown that, other conditions being equal, there is a distinct relationship between these important factors, the latter being determined by the former. Further, that fertility will be found largely dependent upon the rate of nitrification during the growing season, which, though largely regulated by temperature and moisture, must be materially affected by the amount of the food supply that the microorganisms find in the form of partially decomposed nitrogenous organic matter.

Another matter closely connected with nitrification is the liberation in available forms of mineral plant food. Is it not more than probable that the two processes are coexistent and interdependent—possibly identical?

As the years went by and our data increased it became ever more and more plain that in the semi-decomposed organic matter and its nitrogen we had factors of primary importance and of the greatest diagnostic value—that from them we could obtain a fairly clear insight into the character of the soil—chemical, physical and biological.

Since, then, we have reason to believe that the percentage of nitrogen is directly and indirectly a measure of the soil's fertility, and that this percentage is largely influenced by the treatment the soil receives, we may consider the data from one or two series of experiments to show the rate of depletion of soil nitrogen under certain conditions of farming, on the one hand, and, on the other, the extent to which nitrogen enrichment may take place when nitrogenous organic matter is allowed to decay in the soil.

To procure figures that would illustrate the injurious effect on soils by continued grain growing interspersed with fallowing, we obtained from our Experimental Farm at Indian Head, Sask., in 1905, a sample collected from an area that had been broken in 1882 and that had between that date and 1905 borne six crops of wheat, four of barley, and three of oats, with a fallow between each crop since 1887, nine fallows in all. No manure or fertilizer had ever been applied.

HISTORY OF CULTIVATED SOIL

1883, wheat,	1890, fallow.	1898, fallow.
1884, wheat.	1891, barley.	1899, wheat.
1885, wheat.	1892, fallow.	1900, fallow.
1886, barley.	1893, wheat.	1901, oats.
1887, wheat.	1894, fallow.	1902, fallow.
1888, fallow.	1895, oats.	1903, barley.
1889, oats.	1896, fallow.	1904, fallow.
	1897, barley.	

For comparison, a sample of soil was taken from an adjacent area that had never been cultivated, the point of collection being about 120 feet away from where the cultivated soil samples were taken. Each sample was, of course, of a composite nature. There is every reason to believe that the soil over the whole area was originally of an extremely uniform nature and with a similar nitrogen content throughout.

Samples were taken representative of the first four and eight inches, respectively, and the nitrogen results, calculated to the water-free soil, are as follows:

DEPLETION OF SOIL NITROGEN

Nitrogen Content of Virgin and Cultivated Soils, Indian Head, Sask.

	To a Depth of 4 Inches		To a Depth of 8 Inches	
	Per Cent.	Lbs. per Acre	Per Cent.	Lbs. per Acre
Virgin soil.	.409	3824	.371	6936
Cultivated soil.	.257	2402	.253	4730
Difference or loss due to removal in crops and to cultural methods.	.152	1422	.118	2206

In this comparison I am obliged to assume that the virgin soil is no richer to-day in nitrogen than it was twenty-two years ago. This is not, of course, strictly correct, for we must suppose that this prairie soil with its annual crop of grass would year by year increase its nitrogen content. The increase, however, we think, could not be such as to materially affect the significance of the above figures.

The loss of nitrogen consequent upon this style of farming is seen to be enormous. It presents an aspect of western farming of a most serious character. Yet there has not been, so far as we can judge, any marked diminution in the yield during this period; provided climatic conditions are favorable, it is held that this cultivated soil will give as fine a crop as it did twenty years ago. The reason is that there is in this soil to-day in spite of its losses a nitrogen content about twice that considered necessary to the production of a maximum crop—it was one of the richest soils; it still is one of exceptional fertility. In such a matter as this chemistry is as a watchman upon the tower warning us of trouble that is yet afar off and which we still have time to avert; interrogating the soil by pot culture, so much favored by some, would be of no value in announcing the fact that most disastrous losses are taking place.

The next enquiry in this soil study is, what proportion of this loss may be due to removal by crops, what proportion to cultural operations? To answer this we have calculated the nitrogen contained in the various grain crops produced, and find that from this cause there has been removed during this period, approximately, 694 pounds per acre. If we subtract this amount from the total loss, calculated to a depth of eight inches of soil, we shall see that more than twice as much nitrogen has been dissipated by our methods of cultivation than is removed in the crops. The loss ordinarily in the grain growing districts of the west would not in all probability be as great as that here recorded, because as a rule the land is fallowed every third year only, and not every other year, as with the soil under discussion. Nevertheless, the deterioration must be marked and I fear unless checked the experience of the extreme east may be at no very distant date that of the west. It seems to me incumbent upon us at once to seek for methods that are less wasteful—we must introduce a crop for the west as we already have for the east, occasionally, or better still systematically, as in a rotation, that will keep up the store of organic matter and nitrogen.

The natural means for replenishing the soil with these organic constitutents is of course farm manures, but unfortunately in the districts where such are most required the supply is frequently inadequate. We, therefore, at once fall back upon the leguminosæ—the nitrogen gatherers. These are nature's soil enrichers. We know of no other family of plants that can be used on the farm possessing the unique and valuable property of appropriating the free nitrogen of the air—nitrogen which may be subsequently made available for succeeding crops. Not that the fertilizing value of the legumes lies simply and solely in the nitrogen they contain, though therein is their chief merit; the large quantity of humus-forming material they furnish, the mineral matter—potash, phosphoric acid, and lime—set free in their decomposition, are features the significance of which, I think, has been somewhat overlooked. It is, however, simply from the standpoint of nitrogen that I shall present certain data at the present time. They will serve to illustrate the three methods we have employed to demonstrate the manurial value of clover and other legumes, viz.: by analysis of the legumes, by estimation of the nitrogen in the soil before sowing the legume and after its decomposition, and by determining the yields of various farm crops following this use of the legumes.

NITROGEN CONTENT OF VARIOUS LEGUMES

There are presented in the following table data showing the weight of crop and nitrogen per acre furnished by eight of the more common legumes, the determinations being made on the foliage (stems and leaves) and roots (collected to a depth of nine inches), respectively.

Of course, no attempt will be made to say what proportion of this nitrogen was obtained through the agency of the nitrogen-fixing bacteria, but of the strong probability that the greater part was from the atmosphere we have, I think, good evidence in the fact that all these legumes were well provided with nodules on their roots, and also that there is, all things considered, a remarkable agreement between these figures and the increase in soil nitrogen due to the decomposition of the legume crop.

Further, I wish you to consider these results as merely indicative—the amount of nitrogen appropriated and available for manurial purpose would undoubtedly be influenced, within certain limits, by the character of the soil, the prevalence of the nitrogen-fixing bacteria and the nature of the season. In this matter I have been in the

NITROGEN IN VARIOUS LEGUMES

Legumes: One Season's Growth	Weight of Crop per Acre		Per Cent. of Moisture	Nitrogen	
	Tons	Lbs.		Per Cent.	Pounds per Acre
Clover:					
Common red, stems and leaves.	4	1,779	76.24	.920	90
Roots.	2	1,445	71.22	.881	48
Total.	7	1,224			138
Clover:					
Mammoth red, stems and leaves.	6	1,310	79.13	.616	82
Roots.	3	1,260	77.57	.661	48
Total.	10	2,570			130
Clover:					
Crimson, stems and leaves.	11	234	83.32	.382	85
Roots.	3	201	83.87	.304	19
Total.	14	435			104
Alfalfa:					
Stems and leaves.	5	1,192	71.63	.670	75
Roots.	5	558	64.74	.577	61
Total.	10	1,750			136
Hairy Vetch:					
Stems and leaves.	11	1,895	82.78	.544	129
Roots.	2	345	86.35	.414	18
Total.	14	240			147
Soja Beans:					
Stems and leaves.	7	350	74.69	.571	82
Roots.	1	900	80.12	.448	13
Total.	8	1,250			95
Horse Beans:					
Stems and leaves.	7	733	84.04	.429	63
Roots.	2	852	86.72	.308	15
Total.	9	1,585			78
Pease:					
Stems and leaves.	12	1,013	86.56	.476	119
Roots.	1	1,132	84.94	.328	10
Total.	14	145			129

habit of telling our farmers that in the growth of red clover which takes place after the harvesting of the cereal crop and before the season closes (in eastern Canada we advocate sowing eight to ten pounds of red clover seed with all classes of cereals) there should be in the neighborhood of one hundred pounds nitrogen per acre—that is, provided growth has not been retarded by a period of drought. The ploughing under of this crop, either in the late autumn or the following spring, according to the nature of the next crop to be planted, is now a system widely adopted with excellent results.

Though we have shown conclusively that clover can be successfully grown at many points in Manitoba and Saskatchewan, there is not in many parts of these provinces a sufficiency of moisture during the growing season for both clover and grain crops. Further, the severity of the winter is such as to render doubtful the survival of the clover. Therefore, while advocating clover wherever its growth is possible, we have looked about for a legume that would better fulfill the requirements of the case, that would allow the fallowing of the land, say, till the middle of June, to get rid of weeds, and then, being sown, would in two months give such a growth for turning under as to make it of practical value. We think we have such a legume in pease, data regarding which from two months' growth are given in the table. Though the root system is not extensive, it will be seen that by plowing under the whole crop we can enrich the soil by, approximately, two tons of humus-forming material per acre containing in the neighborhood of 130 pounds of nitrogen.

INCREASE OF SOIL NITROGEN DUE TO GROWTH OF LEGUMES

For a number of years we have been endeavoring to determine directly, that is, by analysis of the soil, the amount of nitrogen derived from the growth of a leguminous crop. I may very briefly describe one of the experiments in this series and which, begun in 1902, is still in progress. A plot 16 feet by 4 feet was staked off and the sides protected by boards sunk to a depth of eight inches. The surface soil to this depth was then removed and in its place a strictly homogeneous but very poor sandy loam substituted—the nitrogen content of which was .0437 per cent. This was dressed with the following chemical fertilizer:

Superphosphate at the rate of....400 lbs. per acre.
Muriate of potash at the rate of 200 lbs. per acre.

It was then sown with red clover, May 13, 1902. During each succeeding season the growth has been cut twice, and the material allowed to decay on the soil. At the end of every second season the crop has been turned under, the soil being stirred to a depth of approximately four inches, and the plot resown the following spring. From the subjoined table, it will be seen, four collections and analyses of this soil have been made since the experiment began, and each successive collection has shown a marked increase in nitrogen—an increase which I think very satisfactory for such an open, sandy soil.

NITROGEN-ENRICHMENT OF SOILS DUE TO GROWTH OF CLOVER

	Date of Collection	Nitrogen	
		Percentage in Water-free Soil	Pounds Per Acre to a Depth of 4 Inches
Before experiment.	13–5–02	.0437	533
After two years.	14–5–04	.0580	708
After four years.[4]	15–5–06	.0608	742
After five years.	30–5–07	.0689	841
Increase in nitrogen due to five years' growth of clover.		.0252	308

In two seasons we enriched this soil in nitrogen to the amount of 175 pounds per acre; in five years, despite losses, the land is richer by 308 pounds per acre.

EVIDENCE OF SOIL ENRICHMENT FROM SUBSEQUENT CROP YIELDS

To conduct experiments in the field to prove that the growth of clover has a beneficial influence upon succeeding crops might seem to some as superfluous and unnecessary. The knowledge of the value of clover in this particular is truly a matter of ancient history. Nevertheless, to bring home in a very practical way to the Canadian farmer the fact that he could find in clover and other legumes the very cheapest and best of manures, and to show that our laboratory results would receive confirmatory evidence in the field, we instituted several series of experiments on the Dominion Experimental Farms in the growing of various crops after clover. I shall only present data from two series, but they are typical and may, therefore, very well serve to illustrate the results we have obtained regarding the after-effect of the legume. Each series consisting of two plots, one with and one without clover, was continued for three seasons after the growth of the clover and it will be noticed that there was an increased yield from the plots that had carried the clover—right to the end of the experiment period. The increases are truly phenomenal. All our results have been of an equally convincing nature and it seems almost impossible to comment upon the data without appearing to use extravagant language regarding this method of green manuring. I will, therefore, let the figures tell their own story.

This table requires but a word of explanation. The plots in each series are contiguous, the soil uniform in character with the same history and of an open, sandy nature. In series I. the clover was sown without any nurse crop, one cutting made and removed; in series II. oats were sown with the clover and no cutting of the latter made. In each case the clover was turned under in the following spring.

Perhaps I may have already overstepped the bounds set me and encroached on the valuable time of this convention. I am

[4] The season of 1905 was an exceedingly poor one for clover and the growth on the plot was consequently very meager.

INCREASE OF CROP DUE TO GROWTH OF CLOVER

1900	1901			1902			1903		
		Tons	Lbs.		Bush.	Lbs.		Tons	Lbs.
Series I: Plot A: Clover.	Corn	27	1760	Oats	75	10	Sugar beats	22	600
Plot B: Wheat.	"	19	1280	"	51	26	" "	8	1,260
Increase due to clover.	Corn	8	480	Oats	23	18	Sugar beats	13	1,400
1901	1902			1903			1904		
								Bush.	Lbs.
Series II: Plot A: Oats with clover.	Corn	20	600	Potatoes	202		Barley	45	
Plot B: Oats.	"	15		"	154	40	"	38	16
Increase due to clover.	Corn	5	600	"	47	20	Barley	6	20

anxious not to sin in such a serious matter and, therefore, I will ask you to take this chapter as giving an example of the way in which we have approached some of the fundamental problems in Canadian agriculture. To review, even in a similarly sketchy manner, our work during the past twenty years for the various branches—stock feeding, dairying, fruit growing, etc.—would be now quite impossible. Investigations that occupy several years, such as, for instance, the one undertaken to learn the effect of different feeding stuffs on the quality of the pork produced and in which the fat from more than 300 pigs was analyzed, can not be summarized in a sentence or two. Of a similarly protracted character have been the experiments to ascertain the losses that take place in the preservation of barnyard manure, in winter and summer; of experiments with various cultures or preparations of nitrogen-fixing bacteria—a matter that has engaged our attention since 1897 owing to its relationship to the maintenance of soil fertility through the leguminosæ; of experimental work carried on in different parts of the Dominion to determine how far soil moisture can be controlled by various systems of soil managements, more particularly in orchards; of reclamation work on swamp muck soils, of which there are large areas in eastern Canada as well as in British Columbia. Then, again, chemical work has been brought into requisition for determining the relative value of Canadian forage crops—grasses, Indian corn, rape, etc., and the period in their growth at which they are most nutritious; for the examination of sugar beets in connection with the establishment in Canada of the beet sugar industry; for tracing the effect of environment and cross-breeding on the composition of wheats, with a view to assisting in the discrimination between the many wheats produced by hybridization—a work that has largely received the attention of the experimental farms. And so I might continue, for our field of operations has been a wide one and we have endeavored to make the chemical work useful to as large a number as possible. Perhaps a thought that has been uppermost in my mind, and in the minds of others engaged in this work from the beginning, is that while all our investigations should be conducted with the spirit of true scientific research they should be undertaken as far as possible with a definite, practical purpose in view. So that while our work, I hope, rings true, judged from the chemical standpoint, it may also be accounted of some practical worth to that national industry for the assistance of which our institutions were established. The motto of the Royal Agricultural Society of England, "Practise with Science," always had a certain charm for me. The principle here expressed applied to our work might be interpreted, "Utility with Research." We have not, so far as I am aware, made any discoveries that will revolutionize the agricultural world, nor have we been looking for such; we have endeavored to do the work that came to our hands faithfully and with such skill as we possessed. Our results may not have been made the subjects of magazine articles, nor heralded in the public press under sensational head-lines, but we have the greater satisfaction of knowing that they have been helpful to the Canadian farmer. There is so much work to be done that one feels at times as if a beginning had not yet been made; nevertheless, on looking back it is not difficult to see wherein chemical research has played its part in the development of Canadian agriculture.

May I, in conclusion, say that our work in agricultural chemistry has been very greatly assisted by help in various ways from those in charge of the chemical investigations at the experiment stations in the United States? Many of our problems have been yours. You were the pioneers in the field; we have profited much by your work and experience. We acknowledge with gratitude our indebtedness, and trust that the friendly relations that have so far existed between us may always continue; and that we may always be able to work together, recognizing that our object is one and the same—the progress of agriculture on the North American continent.

Frank T. Shutt

Dominion Experiment Farm,
Ottawa, Can.

DOCTORATES CONFERRED BY AMERICAN UNIVERSITIES

For the tenth consecutive year we publish statistics in regard to the degrees of doctor of philosophy and doctor of science conferred by the universities of the United States. The total number of doctorates conferred was 327, almost exactly the same as in 1905 and 1906, when the numbers were, respectively, 325 and 326. The average number for the past ten years has been 271. There has thus been an increase, though probably not so large as in the number of positions to be filled. It must also be remembered that the number of American students receiving degrees from foreign universities is probably less now than it was ten years ago.

TABLE I.

DOCTORATES CONFERRED

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	Total
Chicago	36	24	37	36	27	32	36	44	31	53	356
Harvard	26	24	36	29	31	28	46	38	46	34	338
Columbia	22	33	21	25	32	39	29	38	42	41	322
Yale	34	30	26	39	29	36	39	34	29	22	318
Johns Hopkins	33	38	33	30	17	23	31	35	32	33	305
Pennsylvania	24	20	15	25	14	29	18	26	28	26	225
Cornell	19	7	19	21	23	20	13	21	19	19	181
Clark	12	5	9	7	1	4	10	18	13	8	87
Wisconsin	5	6	5	6	11	4	12	9	9	19	86
Michigan	7	4	5	3	10	10	8	7	8	7	69
New York	5	9	7	6	4	4	9	7	9	7	67
Boston	0	0	0	0	0	4	7	14	10	9	44
California	1	3	2	2	1	3	3	4	9	5	33
Virginia	0	2	2	8	6	3	1	1	0	5	28
George Washington	1	0	5	3	2	4	3	3	2	5	28
Princeton	0	3	3	8	1	1	2	5	5	3	26
Minnesota	1	2	3	2	3	3	3	3	2	2	24
Brown	1	3	3	2	2	5	0	2	1	4	23
Bryn Mawr	3	3	1	2	2	0	5	2	2	1	21
Nebraska	2	1	1	1	0	0	2	3	7	3	20
Catholic	1	0	0	0	2	2	5	1	5	4	20
Stanford	2	0	2	2	2	1	1	1	2	1	14
Iowa	0	0	0	0	0	2	0	2	5	2	11
Georgetown	0	0	0	0	0	3	1	2	0	4	10
Washington.	0	2	0	1	0	1	1	0	2	0	7
Vanderbilt	0	0	3	1	0	0	0	0	1	1	6
Colorado	0	1	0	0	0	0	2	0	2	0	5
Illinois	0	0	0	0	0	0	0	1	3	1	5
North Carolina	0	0	0	0	2	1	0	1	0	1	5
Missouri	0	1	0	0	0	0	0	2	0	1	4
Northwestern	1	1	0	1	0	0	0	0	0	1	4
Wash. and Lee	0	0	0	0	1	0	1	0	1	1	4
Cincinnati	0	0	0	0	0	1	1	1	0	0	3
Kansas	0	1	0	0	0	2	0	0	0	0	3
Lafayette	0	0	0	0	0	3	0	0	0	0	3
Massachusetts Inst.	0	0	0	0	0	0	0	0	0	3	3
Lehigh	0	0	0	0	0	2	0	0	0	0	2
Syracuse	0	1	0	0	1	0	0	0	0	0	2
Dartmouth	0	0	0	0	0	0	0	0	1	0	1
Tulane	0	0	1	0	0	0	0	0	0	0	1
Western of Pa.	0	0	0	0	0	0	0	0	0	1	1
	236	224	239	255	224	270	289	325	326	327	2,715

Chicago awarded last year 53 degrees, which is the largest number conferred so far by a single institution. This makes the total number of degrees conferred by Chicago larger than the number conferred by Harvard, which latter institution last year stood at the head of the list. Then follow Columbia, Yale, Johns Hopkins, and, with much larger breaks, Pennsylvania and Cornell. There is then a drop to institutions that during the past ten years have conferred less than a hundred degrees—Clark, Wisconsin, Michigan and New York. Those that have conferred less than fifty degrees are headed by Boston and California. This year Chicago and Columbia conferred more than the average number of degrees, while Yale conferred fewer than usual. The most interesting change is the giving by Wisconsin of nineteen degrees, more than twice the average number for the past ten years. This places Wisconsin considerably in advance of Michigan, while among the state universities these two institutions form a separate class.

Table II. gives a comparison of the total number of graduate students and the number of doctorates conferred by nineteen of the leading institutions. The number of graduate students is taken from the statistics compiled by Professor Tombo and printed in SCIENCE. The registration in the graduate schools of these universities was 4,073 and the number of degrees conferred was 283, only about 7 per cent. It thus appears that a comparatively small proportion of the graduate students in our universities take the doctor's degree. A large number go to the universities with only the master's degree in view, and their academic work is regarded as complete when this degree has been received. There are also many students who devote only part of their time to graduate work, and these remain a good many years as graduate students, and often in the end do not take the degree.

The institutions are arranged in the order of the percentage of graduate students who received degrees last year, and the differences are very striking. As the number of degrees conferred in a single year is subject to considerable chance variations, there is also given a comparison of the average number of degrees conferred during the past ten years with the registration for last year, data in regard to the average registration for the past ten years not being available. The Johns Hopkins has by far the best record, one fifth of its graduate students taking the degree each year. Chicago stands next, with one seventh this year and an average of over one tenth. Harvard, Yale, Pennsylvania and Cornell give the degree each year to 8 or 9 per cent. of their graduate students, Columbia to only 5 per cent.

If these results were due to a severe natural selection and the degree was given to the men who are most likely to contribute to the advancement of science and learning, there would be no ground for regret. But it is by no means certain that this is

TABLE II.

	Registration in Graduate Schools 1906–1907	Doctorates Conferred in 1907	Per Cent.	Average Number Doctorates Conferred Annually 1898–1907	Per Cent.
Johns Hopkins	156	33	21	31	20
Virginia	43	5	12	3	7
Chicago	358	53	15	36	10
Cornell	212	19	9	18	8
Pennsylvania	285	26	9	23	8
Harvard	437	34	8	34	8
Michigan	96	7	7	7	7
Wisconsin	302	19	6	9	3
Yale	357	22	6	32	9
Columbia	808	41	5	32	4
Minnesota	53	2	4	2	4
Nebraska	95	3	3	2	2
New York	222	7	3	7	3
Northwestern	40	1	3	½	1
Princeton	110	3	3	3	3
California	204	5	2	3	1
Stanford	49	1	2	1	2
Missouri	107	1	1	½	½
Illinois	139	1	1	1	1
Total	4,073	283	7		

the case, or that those who received the degree of doctor of philosophy were of greater average ability or better average training than graduates in medicine or law. The supply of men for academic positions and for positions in the government service and other places where the ability to conduct independent research should be a requisite is inadequate, and it is to be feared that it does not represent the intellectual aristocracy of the nation.

Table III. shows the number of degrees conferred in the sciences enumerated in

TABLE III.

DOCTORATES CONFERRED IN THE SCIENCES

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	Total	Per Cent.
Hopkins	19	17	20	19	9	10	17	18	18	21	168	55
Chicago	12	11	16	14	13	21	14	21	14	28	164	46
Harvard	11	7	15	15	14	15	23	12	17	12	141	42
Columbia	10	19	10	11	14	15	11	13	16	15	134	42
Yale	11	14	9	18	10	13	15	13	15	6	124	40
Cornell	11	2	10	13	16	13	8	13	7	11	104	57
Penna.	8	7	5	12	5	13	9	12	11	8	90	40
Clark	12	5	6	6	1	4	10	18	9	6	77	89
Wisconsin	2	4	1	3	2	0	4	3	2	7	28	33
Michigan	0	3	1	0	5	4	6	?	5	4	28	41
California	1	3	1	2	1	3	2	3	3	5	24	73
Geo. Wash.	1	0	3	1	1	4	0	3	2	2	17	60
Nebraska	2	1	1	1	0	0	1	2	3	2	13	65
Brown	1	0	0	1	2	4	0	2	1	1	12	52
Stanford	2	0	0	1	2	1	1	1	2	1	11	78
Princeton	0	3	1	0	0	1	1	3	0	2	11	42
Virginia	0	2	0	4	1	2	0	0	0	2	11	39
Bryn Mawr	1	2	1	2	1	0	2	0	1	0	10	48
Iowa	0	0	0	0	0	1	0	2	3	1	7	64
Minnesota	0	0	1	0	1	1	0	1	1	2	7	29
Washington	0	2	0	1	0	1	1	0	2	0	7	100
New York	1	1	0	1	0	0	1	1	1	0	6	9
Catholic	0	0	0	0	1	2	1	0	0	1	5	25
Illinois	0	0	0	0	0	0	0	0	2	1	3	60
Kansas	0	1	0	0	0	2	0	0	0	0	3	100
Mass. Inst.	0	0	0	0	0	0	0	0	0	3	3	100
Missouri	0	1	0	0	0	0	0	1	0	1	3	75
N. Carolina	0	0	0	0	2	1	0	0	0	0	3	60
Vanderbilt	0	0	1	1	0	0	0	0	1	0	3	50
Wash. & Lee	0	0	0	0	1	0	1	0	1	0	3	75
Colorado	0	0	0	0	0	0	0	0	2	0	2	40
Lehigh	0	0	0	0	0	2	0	0	0	0	2	100
Northwestern	0	1	0	1	0	0	0	0	0	0	2	50
Boston	0	0	0	0	0	0	0	0	0	1	1	2
Cincinnati	0	0	0	0	0	0	0	1	1	0	1	100
Dartmouth	0	0	0	0	0	0	0	0	1	0	1	33
Georgetown	0	0	0	0	0	0	1	0	0	0	1	10
Lafayette	0	0	0	0	0	1	0	0	0	0	1	33
Syracuse	0	0	0	0	1	0	0	0	0	0	1	50
Total	105	106	102	127	103	134	129	143	140	143	1232	45

Table IV. Of 2,715 degrees conferred during the past ten years, 1,232, somewhat less than half, have been in the natural and exact sciences. The relative proportion of degrees in the humanities and in the sciences has not altered appreciably in the ten years covered by these statistics. The Johns Hopkins has conferred more degrees in the sciences than any other institution, but is closely followed by Chicago and at a not very considerable distance by Harvard, Columbia and Yale. Fifty-five per cent. of the degrees conferred at the Johns Hopkins have been in the sciences, and 57 per cent. at Cornell, whereas in the other leading institutions the percentage is decidedly less—46 at Chicago, 42 at Harvard and Columbia and 40 at Yale and Pennsylvania. It is rather surprising to note that at Wisconsin only one third of the degrees are in the sciences. At California and Stanford, where the numbers are, however, too few to give reliable figures, the percentages are 73 and 78.

Table IV. gives the degrees conferred in each of the sciences. Chemistry, as always, leads with about the usual number of degrees. There is an increase this year in the number of degrees in physics and zoology, 22 and 18, respectively, and a decrease in the number in psychology to 10. In previous years sociology and education

TABLE IV.

DOCTORATES CONFERRED IN THE SCIENCES

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	Total
Chemistry	27	32	26	28	27	33	35	36	38	38	320
Physics.	11	7	15	24	12	14	17	14	19	22	155
Zoology	12	11	11	15	16	12	15	15	22	18	147
Psychology	18	15	9	13	8	18	10	21	12	10	134
Botany	11	11	12	8	12	9	17	15	16	15	126
Mathematics	11	13	11	18	8	7	13	20	9	11	121
Geology	6	5	5	10	6	10	7	4	11	7	71
Physiology	4	1	4	1	8	8	1	3	3	8	41
Astronomy	3	2	4	5	2	4	4	3	4	3	34
Paleontology	0	4	2	1	0	2	2	3	2	0	16
Bacteriology	0	1	1	1	1	3	3	0	1	3	14
Anthropology	2	0	2	1	0	1	2	1	0	1	10
Agriculture	0	0	0	0	2	2	2	2	0	2	10
Anatomy	0	1	0	1	0	4	0	0	0	3	9
Engineering	0	0	0	1	0	3	1	3	0	0	8
Mineralogy	0	2	0	0	1	1	0	1	1	0	6
Pathology	0	0	0	0	0	3	0	0	1	1	5
Metallurgy	0	0	0	0	0	0	0	1	1	1	3
Geography	0	0	0	0	0	0	0	1	0	0	1
Meteorology	0	1	0	0	0	0	0	0	0	0	1
Total	105	106	102	127	103	134	129	143	140	143	1232

have been included among the sciences, when the work of the candidates was supposed to be inductive or statistical in character. But it is not possible, with the information at hand, to discriminate between work that is scientific and work that is historical or literary, and the degrees in sociology and education have this year been eliminated from the table.

The institutions that conferred three degrees or more in special subjects are as follows: *Chicago,* chemistry 5, zoology 3, botany 4, mathematics 4, physiology 4; *Columbia,* chemistry 5; *Cornell,* chemistry 4; *Harvard,* zoology 3, psychology 3; *Johns Hopkins,* chemistry 11, physics 3; *Massachusetts Institute of Technology,* chemistry 3; *Pennsylvania,* physics 4; *Yale,* chemistry 3.

The names of those on whom the degree was conferred in the natural and exact sciences, with the subjects of their theses, are as follows:

University of Chicago

George David Birkhoff: "Asymptotic Properties of Certain Ordinary Differential Equations with Applications to Boundary Value and Expansion Problems."

William Richards Blair: "The Index of Refraction of Water for Electric Waves by Interference Methods."

Roy Hutchison Brownlee: "On Precipitated Sulphur."

Stephen Reid Capps, Jr.: "The Pleistocene Geology of the Leadville Quadrangle, Colorado."

Charles MacDonald Carson: "A Study of the Equilibrium Relations of $S\lambda$ and $S\mu$."

Rollin Thomas Chamberlin: "The Gases occluded in Rocks."

William Crocker: "The Rôle of Seed in Delayed Germination."

Edna Daisy Day: "The Digestibility of Starch as affected by Cooking."

Emil Goettsch: "The Nature, Structure and Distribution of the Œsophageal Glands of Mammals."

Lawrence Emery Gurney: "The Viscosity of Water at Low Rates of Shear."

Charles Claude Guthrie: "The Relation of Pressure in the Coronary Vessels to the Activity of the Isolated Heart and Some Closely Related Problems."

Paul Gustav Heinemann: "The Kinds of Bacteria concerned in the Natural Souring of Milk."

Willis Stose Hilpert: "The Stereoisomerism of Nitrogen Compounds: Stereoisomeric Chlorimido Esters."

Hemming Gerhard Jensen: "Toxic Limits and Stimulation Effects of Some Salts and Poisons on Wheat."

James Wright Lawrie: "The Chemistry of the Acetylidene Compounds."

Hugh McGuigan: "Oxidations of Various Sugars in the Animal Body."

Andrew Fridley McLeod: "On Aldol, Pentarythrose and the Action of Copper Acetate on the Hexoses."

Arthur Ranum: "On a New Kind of Congruence Groups."

Oscar Riddle: "The Genesis of Fault-bars in Feathers and the Cause of Alternation of Light and Dark Fundamental Bars."

Gustav Ferdinand Ruediger: "The Mechanism of Streptococcus Immunity."

Victor Ernest Shelford: "The Life-histories and Larval Habits of the Tiger Beetles."

Frances Grace Smith: "Morphology of the Trunk and Development of the Microsporangium of Cycads."

John Sundwall: "The Structure of the Lacrymal Gland."

Reinhardt Thiessen: "The Vascular Anatomy of the Seedling of Dioon."

Charles Henry Turner: "The Homing of Ants: An Experimental Study of Ant Behavior."

Anthony Lispenard Underhill: "Invariants under Point Transformations in the Calculus of Variations."

Buzz M. Walker: "On the Resolution of Higher Singularities of Algebraic Curves into Ordinary Double Points."

Shigeo Yamanouchi: "A Study of Apogamy."

Johns Hopkins University

John August Anderson: "Absorption and Emission Spectra of Neodymium and Erbium Compounds."

Clyde Shepherd Atchison: "Curves with a Directrix."

Frederick Conrad Blanck: "The Nitration of Aniline and Certain of its Derivatives."

Taylor Scott Carter: "The Fluorescence, Absorption and Magnetic Rotation Spectra of Potassium Vapor."

Frank Lawrence Cooper: "Measurements of Wave-lengths of the Spark Spectra of Chromium, Manganese and Calcium; also of the Arc Spectra of Cerium and Thorium; together with a Study of the possible Influence of Variations of Current, Capacity, etc., in the Spark Circuit."

Paul Brown Dunbar: "The Osmotic Pressure of Cane Sugar Solutions in the Vicinity of 4° Centigrade."

William Davis Furry: "The Epistemological Use of the Esthetic Consciousness."

William West Holland: "The Osmotic Pressure of Cane Sugar Solutions in the Vicinity of the Freezing Point of Water."

Harry Nichols Holmes: "Electric Osmose."

Aubrey Edward Landry: "A Geometrical Interpretation of Binary Syzygies."

Benjamin Franklin Lovelace: "The Osmotic Pressure of Glucose Solutions."

Bartgis McGlone: "Notes on the Anatomy and Life-history of *Moira Atropos*."

Daniel Webster Ohern: "The Trilobita, Mollusca and Echinodermata of the Paleodevonian of Maryland."

James Newton Pearce: "Dissociation as measured by the Freezing-point Lowering and by Conductivity-bearing on the Hydrate Theory. The Composition of the Hydrates formed by a Number of Electrolytes."

Francis Mitchell Rogers: I. "The Osmotic Pressure of Glucose Solutions in the Vicinity of the Freezing-point of Water." II. "The Use of Weight-normal Solutions in the Measurement of Osmotic Pressure."

William Henry Schultz: "The Effect of Chloral-hydrate upon the Properties of Heart-muscle."

Guy Howard Shadinger: I. "On the Affinity Constants and Constitution of several Urazoles." II. "On the Velocity Constants of the Reactions between Alkyl Halides and Urazoles."

Lloyd William Stephenson: "The Mesozoic Deposits of the Coastal Plain of North Carolina."

Charles Milton Stine: "The Effect of one Salt on the Hydrating Power of another Salt present in the same Solution."

William Reed Veazey: "The Conductivity and Viscosity of Solutions of certain Salts in Water, Methyl Alcohol, Ethyl Alcohol, Acetone, Nitrobenzene and Binary Mixtures of these Solvents."

Leon Franklin Williams: I. "A Study of the Action of Primary, Secondary and Tertiary Amines on Camphoroxalic Acid." II. "Acyl Derivatives of Ortho- and Paraminophenol."

COLUMBIA UNIVERSITY

Henry Kreitzer Benson: "On the Use of Molten Salts containing Water of Crystallization as Solvents."

William Nathan Berg: "The Digestibility of Various Proteins in Solutions of the same Acids."

Louis Jacob Cohen: "Some New Double Phosphates."

William Klaber: "On Certain 7-nitro-4-quinazolones."

Elsie Kupfer: "Studies in Plant Regeneration."

Albert Buell Lewis: "Tribes of the Columbia Valley."

Abram Lipsky: "Rhythm as a Distinguishing Characteristic of Prose Style."

Robert Cecil McMahon: "Technical History of the White Lecythi."

John Maurice Nelson: "Some Compounds derived from Succinylosuccinic Ester."

Raemer Rex Renshaw: "4-aminophthalic Acid and some of its Derivatives."

William Carl Ruediger: "The Field of Distinct Vision."

Charles H. Shamel: "Geology in the Law."

Charles Rupert Stockard: "The Development of the Mouth and Gills in Bdellostoma Stanti."

George Booker Waterhouse: "The Influence of Nickel and Carbon in Iron and the Overheating, Burning and Restoring of Nickel Steel."

Anne Sewell Young: "The Stellar Clusters *h* and *x* Persei; Measurement and Reduction of the Rutherford Photographs."

HARVARD UNIVERSITY

John Mead Adams: "The Transmission of Röntgen Rays through Metallic Sheets."

Arthur Mangun Banta: "A Comparison of the Reactions of a Species of Terranean with those of a Species of Subterranean Isopod."

Marshall Albert Barber: "On Heredity in certain Microorganisms."

Charles Scott Berry: "An Experimental Study of Imitation in Animals."

William Charles Brenke: "A Contribution to the Theory of Trigonometric and Zonal Harmonic Series."

Herbert Spencer Davis: "Spermatogenesis in Acrididæ and Locustidæ."

Louville Eugene Emerson: "An Investigation in the Simultaneous Stimulation of Adjacent Touch Spots on the Skin."

Calvin Olin Esterly: "The Light-recipient Organs of the Copepod Eucalanus Elongatus."

Herman Brunswick Kipper: "Ketone Substitution Derivatives of Orthohydroxyketones, Alkali-insoluble Phenols."

Edward Mueller: "The Atomic Weights of Potassium and Chromium."

Ernest Linwood Walker: "The Parasitic Amœbæ of the Intestinal Tract of Man and other Animals."

Karl Tinsley Waugh: "The Rôle of Vision in the Mental Life of the Mouse."

CORNELL UNIVERSITY

John Eliot Coit: "The Cultivated Peony."

Thomas G. Delbridge: "Tetrachlorgallein and its Derivatives."

Philena Belle Fletcher: "The Bees of the Cayuga Fauna."

Lee Fred Hawley: "Contributions to the Chemistry of Thallium II."

John Peter Magnusson: "Equilibrium between Hydrogen Sulphide and Ammonia."

Frank Curry Mathers: "A Study of the Atomic Weight of Indium."

Richard Morris: "On the Automorphic Functions of the Group $(0, 3; l_1, l_2, l_3)$."

Elsie Murray: "Organic Sensation."

Charles Smith Prosser: "The Classification and Distribution of the Series of Central and Eastern New York."

Effie Alberta Read: "A Contribution to the Knowledge of the Olfactory Apparatus in Dog, Cat and Man."

Francis Robert Sharpe: "The General Circulation of the Atmosphere."

UNIVERSITY OF PENNSYLVANIA

Harold Charles Barker: "Thermo-electromotive Forces of Potassium and Sodium with Platinum and Mercury."

Bertha May Clark: "On the Variation of the Heat of Mixture with Concentration and Temperature."

Charles Aaron Culver: "A Study of the Propagation and Interception of Energy in Wireless Telegraphy."

John Frazer: "The Application of the Rotating Anode to Certain Electrolytic Separations and an Investigation of the Electro-deposition of Indium with the Use of the Rotating Anode."

William Peter Haseman: "A Method for the Determination of the Optical Constants of Metals in the Infra-red."

Thomas Potter McCutcheon, Jr.: "New Results in Electro-analysis."

Mary Isabel Steele: "Regeneration in the Compound Eyes of Crustacea."

Frank Macy Surface: "The Early Development of a Polyclad, Planocera Inquilina, Wheeler."

UNIVERSITY OF WISCONSIN

Florence Eliza Allen: "On the Determination of Cyclic Involutions of Order Three."

William Ballantyne Anderson: "A Spectroscopic Study of the Spark Spectrum in Various Gases at High Pressure."

Lewis Fussell: "Self-excited Polyphase Asynchronous Generator."

William George Marquette: "Concerning the Organization of the Spore-mother-cells of *Marsilia quadrifolia*."

George Matthew Reed: "Injection Experiments with *Erysiphe cichoracearum* DC."

Frederick Lafayette Shinn: "On the Optical Rotatory Power of Salts in Dilute Solutions."

John Weinzirl: "The Action of Sunlight upon Bacteria with Special Reference to Tuberculosis."

CLARK UNIVERSITY

Horace Leslie Brittain: "A Study in Imagination."

William Franklin Copeland: "Periodicity in Spirogyra."

Oris Polk Dellinger: "Comparative Study of Cilia as a Key to the Structure of Contractile Protoplasm."

Tadasu Misawa: "A Sketch of the History of the Modern Philosophy of Education."

George Edwin Stebbins: "Sound Distortion by the Telephone Transmitter and Receiver."

William Edward Story, Jr.: "An Investigation on the Poulsen Arc in Wireless Telegraphy."

YALE UNIVERSITY

Henry H. Conover: "On Certain Problems in the Calculus of Variations."

Arthur Harmount Graves: "The Morphology of *Ruppia Maritima*."

William Barri Kirkham: "The Early Development of the Mammalian Egg."

Philip Henry Mitchell: "Purin Metabolism in the Embryo."

David Lindsey Randall: "The Use of Potassium Permanganate in the Estimation of Iron, Mercury and Molybdenum."

Tadasu Saiki: "The Chemistry of Non-striated Muscle."

UNIVERSITY OF CALIFORNIA

Benjamin Marshall Davis: "Early Life-history of *D. pusillus* Ritter."

Harvey Monroe Hall: "The Compositæ of Southern California."

James Davis Maddrill: "A Study of Several Stars of the Delta Cephei Type."

Thorburn Brailsford Robertson: I. "On the Conditions of Equilibrium of an Associating Amphoteric Electrolyte."

Charles Edwin Weaver: "Geology of the Napa Quadrangle, California."

UNIVERSITY OF MICHIGAN

Benjamin Franklin Bailey: "Induction Coils, an Experimental and Theoretical Research."

Calvin Henry Kauffman: "Contribution to the Physiology of Saprolegnia."

Frederick Arthur Osborn: "Change of Index of Refraction of Liquids with Temperature."

Donald Dexter Van Slyke: "Action of Molecular Silver, Silver Sulphate and Silver Chloride upon some Halogenated Triphenyl-carbinol-chlorides."

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Raymond Haskell: "The Effect of Concentration and Ionization on the Rates of Diffusion of Salts in Aqueous Solutions."

Robert Browning Sosman: "The Hydrolysis of Ammonium Acetate and the Ionization of Water at High Temperature."

Morris Archer Stewart: "The Dissociation Relations of Sulphuric Acid."

THE GEORGE WASHINGTON UNIVERSITY

Frederick Warren Grover: "The Simultaneous Measurement of the Capacity and Power Factor of Condensers."

Walter Otheman Snelling: "Contributions to the Study of Tellurium."

UNIVERSITY OF MINNESOTA

William Macdonald: "The Reclamation and Settlement of Arid Lands."

Anthony Zeleny: "The Capacity of the Mica Condenser and its Application as a Standard for the Comparison of Electrical Quantities."

UNIVERSITY OF NEBRASKA

Ruth Marshall: "The Arrhenuri of the United States."

Elda Rema Walker: "On the Structure of the Pistils of some Grasses."

PRINCETON UNIVERSITY

Claude Silbert Hudson: "The Forms of Milk-sugar."

Harvey Ernest Jordan: "The History of the Chromatin during the Early Stages in the Development of the Female Reproductive Cells of *Asterias Forbesii*."

UNIVERSITY OF VIRGINIA

Frank Walker Reed: "Singular Points in the Approximate Development of the Perturbative Function."

William Beverley Stone: "The Groups of Two, Three and Four Parameters of Space and their Differential Invariants."

BOSTON UNIVERSITY

William Robinson: "History of Automatic Electric and Electrically-controlled Fluid-pressure Signal Systems for Railroads."

BROWN UNIVERSITY

Victor Emmanuel Emmel: "Regeneration in *Homarus Americanus*."

CATHOLIC UNIVERSITY OF AMERICA

Thomas Frederic McKeon: "The Diurnal Variation of the Spontaneous Ionization of Air in Closed Metallic Vessels."

UNIVERSITY OF ILLINOIS

Edward Murray East: "A Study of the Factors influencing the Improvement of the Potato."

UNIVERSITY OF IOWA

George Cutler Fracker: "On the Transference of Training in Memory."

UNIVERSITY OF MISSOURI

Howard Sprague Reed: "The Value of Certain Nutritive Elements in the Plant Cell."

LELAND STANFORD JUNIOR UNIVERSITY

Harry Baker Humphrey: "Studies in the Morphology and Physiology of some California Hepaticæ."

SCIENTIFIC BOOKS

THE ANTARCTIC EXPEDITION OF THE "DISCOVERY," UNDER CAPT. SCOTT, R.N., 1901–1904

The National Antarctic Expedition, 1901–4. Natural History, Vol. II., Zoology (Vertebrata; Mollusca; Crustacea). London, The British Museum, 1907. 4°, 348 pp., 44 pl. Map and many illustrations in the text. Vol. III., Zoology and Botany (Invertebrata; Marine Algæ; Musci). 275 pp., 62 pl. 1907.

The British Museum having undertaken to publish and supervise the reports of the Antarctic Expedition under Capt. Scott, the two handsome and profusely illustrated volumes now under consideration comprise the first fruits of this arrangement. The Vertebrata are reported on by E. A. Wilson, W. P. Pycraft and G. A. Boulenger. Dr. W. G. Ridewood contributes an extensive memoir on *Cephalodiscus,* of which two new species were obtained. The Mollusca and Brachiopoda are treated by E. A. Smith, W. E. Hoyle and Sir Charles Eliot. W. T. Calman, A. O. Walker, G. S. Brady, Dr. Thiele and Professor Gruvel report on the Crustacea; L. V. Hodgson on the Pycnogonids; Dr. Trouessart on the Acari; Dr. Fowler on the Chætognatha; Dr. von Linstow on the Nematodes; and Mr. A. E. Shipley on the Cestodes. The Cœlenterates are treated by Messrs. Hickson, Gravely and Rennie; the sponges by R. Kirkpatrick. Mr. and Mrs. Gepp undertake the Marine Algæ except a new species of *Lithothamnion* which is described by M. Foslie; while the scanty flora of mosses is the subject of a discussion by J. Cardot.

Each memoir is separately paginated and there is no general index.

It is obvious that, within the space available, only a brief survey can be given of such an aggregation of short reports. Professor Herdman introduces volume III., by a ten-page report on methods of collecting in Antarctic seas, which is well worthy of attention from those whose fortune it may be to prepare for such work under analogous conditions. The peculiar difficulties, due to the extremely low temperatures encountered, are such as would often not be anticipated by collectors without experience in Polar seas, and offer an interesting field for experiment. It may be mentioned that the reviewer's experience in opening and keeping open holes in the ice at temperatures below minus 30° Fahr., leads to the belief that a soft iron or copper chisel of triangular section, hafted with a heavy pole of wood, is the most efficient. The extreme temperature seems to harden the soft metal sufficiently, without rendering it brittle as in the case of steel tools.

The reports on the marine mammals and birds are the most voluminous and contain perhaps the largest amount of material of general interest. The absence of the southern right whale from the icy seas is confirmed, but Mr. Wilson believes that Ross's report of its presence sixty years ago may, nevertheless, have been correct. The process of extermination of this species has been nearly successful, owing to the habit of whalers destroying the nursing young in order to secure the mother. The most common species are the finback, and a small Australian *Balæna,* but killers are plentiful and gregarious. A supposedly undescribed species of whale, with an extraordinarily long back fin, is illustrated and described, but not named, as is another probably new species of dolphin, resembling *Lagenorhynchus.*

The seals observed were the usual four Antarctic species, to which were added most unexpectedly a young male sea elephant, killed at McMurdo sound far from its usual haunts. Data are included on Hooker's sea lion which was studied at Laurie Harbor, Auckland Island *en route* to the Antarctic. All these animals are admirably illustrated by colored plates and sketches, as well as half-tone figures from photographs of the living animal.

Among Antarctic birds the penguins stand naturally preeminent, and the most remarkable of these is the great Emperor penguin, which attains a weight of ninety pounds. An extremely interesting account of the breeding habits of this species, hitherto hardly known, shows that it lays its single egg in the depth of the southern winter. No nest is made, but the egg is held between the thighs of the parent, resting partly on the feet, enveloped by a loose fold of the abdominal integument, and pressed against a medial bare spot. The body temperature of the bird exceeds 100° Fahr., which is sufficient to incubate the egg during its long period of six or seven weeks.

When the mother bird feels the need of food she releases the egg, which is immediately seized by one of her associates, who broods it in the same manner. Thus a group of several birds cares for a single egg during the intense cold and darkness of the polar night. When the young is hatched the nestling continues to be brooded in the same way, and so eager are the birds to possess themselves of a young one that many of the chicks perish from the injuries sustained from the competing nurses. The young birds are fed by regurgitation. Eggs of this species, of which only a single specimen was previously known, are covered with a rough chalky layer and are of a pale green color, punctuated by numerous minute pores. The species lives entirely on the floe and pack ice. Their food appears to be chiefly crustacea, small fish and cuttlefishes, whose beaks, together with more or less gravel, are constantly found in the stomach. The other most familiar bird of the expedition was MacCormick's Skua, a bold and most persistent thief, one of which followed the sledge party to latitude 80° 20′ south, the only bird or beast met by the party during three months of solitude on the Polar ice cap. This species has the most southern range of any bird, and to the northward of the pack is replaced by the larger and darker-colored Antarctic Skua.

The fishes comprise ten species, mostly small, of which four are regarded as new.

The mollusks comprise about sixty species, about three fourths of which appear to be undescribed, the majority of which are small, dull-colored, and of the groups characteristic of Polar seas. Sir Charles Eliot finds two new genera, *Tritoniella* and *Galvinella,* among the Nudibranchs. Mr. Smith also reports two new genera among the Gastropods, *Neoconcha,* a peculiar Tænioglossate form, and *Trichoconcha,* which very closely resembles the Arctic *Torellia.* He also adds two new Brachiopods to the species already known, both belonging to the genus *Magellania.*

We have already alluded to the extensive memoir by Dr. Ridewood on *Cephalodiscus,* a genus related to *Rhabdopleura,* in which two new subgenera are instituted, and two new species described.

Two shrimps, both previously found by the German Polar Commission at South Georgia, and four species of Cumacea are added to the list of Antarctic crustacea. The collection of amphipods numbers fifty-three species, of forty-three genera, of which four genera and eighteen species are new to science. As in Arctic waters the Lysianassidæ preponderate. A single species of *Nebalia* is noted by Thiele and nine species of Ostracoda are enumerated by Brady, seven of which are new.

Two species of sessile barnacles occur, both previously known, and two new species of *Scalpellum.*

The *bizarre* animals belonging to the Pycnogonida were represented by a large collection, including three new genera and twenty-eight species, including the anomalous *Decolopoda* of Eights, described seventy years ago, and which has five pairs of legs; a fact of which naturalists were long incredulous. Why Eights's generic name is not retained Mr. Hodgson does not explain.

Two specimens of Halacaridæ were dredged in Granite Harbor, which Trouessart believes to be identical or only subspecifically distinct from *Halacarus alberti* of the Arctic.

The Alcyonaria presented few remarkable features. Several of the forms appeared like connecting links between others formerly separated, as *Primnoisis* and *Ceratoisis, Primnoella* and *Caligorgia.* A single specimen of Pennatulid, *Umbellula carpenteri,* first made known by the Challenger Expedition, was obtained off the great ice barrier. The hydroid zoophytes were well represented by twenty-five species, most of which are of epizoic habit and nearly all from McMurdo Sound.

The species of sponges are distributed as follows: Tetractinellid, four species; Monaxinellid, forty-three species; and Calcarea, twenty-four species. There are no horny sponges, but some of the forms found were represented by a very large number of individuals. Of Hexactinellids there are ten species, all belonging to the Rossellidæ.

The number of marine algæ collected is but small, yet among them are some interesting novelties. The authors of the report upon them regard it as too early to attempt a comparison between the algoid floras of the Arctic and Antarctic. Some of the species are, however, certainly identical. A single species of *Lithothamnion* collected proves new. Seven species of mosses were found, bringing up to the number of fifty-one, the total of Antarctic species.

These volumes form an admirable addition to our knowledge of Antarctica, and will prove a lasting monument to the energy and devotion of those who constituted the little band of explorers in this, the most dreary and inhospitable region of the entire globe.

W. H. DALL

SCIENTIFIC JOURNALS AND ARTICLES

University of California Publications in Zoology, Vol. 3, is made up in large part of "Contributions from the San Diego Marine Laboratory." It includes several papers of a faunistic nature with descriptions of many new species from the pelagic fauna of the San Diego Region; on the littoral and pelagic Ostracoda and on the Cladocera by Chancey Juday, on the Copepoda by C. O. Esterly and on the Dinoflagellata by C. A. Kofoid. A list of "The Marine Fishes of Southern California," by E. C. Starks and E. L. Morris contains notes on the œcology and distribution of 246 species. A paper by H. B. Torrey on the California Shore Anemone (*Bunodactis xanthogrammica*) discusses the synonymy and occurrence of a widely distributed anemone. Mr. C. O. Esterly in "Some Observations on the Nervous System of Copepoda" describes the innervation of the æsthetasks of Copepod antennæ and ascribes a sensory function to the rostral prongs of *Diaptomus* and to certain furcal bristles of *Cyclops,* but finds no sensory nerve supply to the so-called tactile bristles of the antennæ. "A Discussion of Species Characters in *Triposolenia,*" a group of bizarre organisms belonging to the Dinoflagellates, by C. A. Kofoid, calls attention to the "unit" nature of specific characters, to their non-adaptive significance, to the coincident distribution of related species and to the support which these facts lend to the Mutation Theory. The same author finds in a second paper on "The Significance of the Asymmetry of *Triposolenia,*" that this is an adaptive structure which presents against the action of gravity the maximum vertical projection of the body on sinking and therefore delays descent from the illuminated upper strata of water to abyssal regions. In a paper by H. B. Torrey and Ann Martin on "Sexual Dimorphism in *Aglaophenia*" definite structural differences are shown to exist between the corbulæ of male and female colonies in the four California species. In each species, the leaflets of the male corbulæ are less completely fused than in the female, leading to a readily recognizable dimorphism. The purpose of "Biological Studies on Corymorpha, II., The Development of *C. palma* from the Egg" by H. B. Torrey was to discover (1) to what extent the form of the species might be determined by its activities, and (2) to compare the normal embryonic processes with those which appear in the regenerative development. The embryonic development is characterized by the plasticity of the tissues. The regions of the body, the tentacles, frustules, peripheral canals, axial endoderm, are molded largely out of more or less differentiated epithelial tissues without recourse to residual cells. These plastic processes are accomplished by various mechanical factors, including absorption of water, osmotic pressure, and amœboid movement.

Terrestrial Magnetism and Atmospheric Electricity for March contains a portrait of Roald Amundsen, and the following articles: "Concerning Pulsations of Short Period in the Strength of the Earth's Magnetic Field," by H. Ebert; "Contribution to the Study of the Effects produced on the Magnetic Declination by the Total Solar Eclipse of August 30, 1905," by C. Nordmann; "Note on the Present Position of the Earth's Magnetic Axis derived from Declination Data alone," by W. van Bemmelen; "What is the Earth's Magnetic Axis and its Secular Motion?" by L. A. Bauer; "Sketch of Life and Work of Roald Amundsen"; Notes: "Progress Magnetic Survey Pacific Ocean" [illustrated], "Magnetic Work in Canada, Mexico and Central America," "Personalia"; "Recent Papers in Atmospheric Electricity by Lüdeling, Lutz, Benndorf, Wood and Campbell, and Rudolph," abstracted by P. H. Dike.

DISCUSSION AND CORRESPONDENCE

THE ADMINISTRATION OF THE U. S. GEOLOGICAL SURVEY

To the Editor of Science: May I ask for space in your columns for the enclosed letters, which seem to me to be of sufficient general interest to warrant their publication?

Very truly yours,

W. S. Tangier Smith

Los Gatos, California,
July 26, 1907

Reno, Nev., June 1, 1907.

To the Director
U. S. Geological Survey,
Washington, D. C.

Sir: I hereby tender my resignation as assistant geologist on the United States Geological Survey.

This action was fully determined upon over four years ago, but was delayed, at first, until I should have finished the work upon which I was then engaged, and, later, as a measure of self-protection while my report of that work was in the hands of the editorial staff. The reasons for my resignation now are the same which determined my original decision to leave the survey, having been merely strengthened by my experience in the interval. Aside from some personal considerations (which are not essential to the present statement), these reasons all have to do with the character and management of the organization as I have known it.

Not to enter into details, I merely wish to record here my protest not only against the prejudiced and arbitrary methods of the geologist in charge of geology, and the commercial spirit which has grown up under his administration, but also, and chiefly, against the bureaucratic policy inaugurated before that administration and under it developed to such an extent that, in my opinion, it calls for protest from every self-respecting scientist who comes in contact with the organization. This policy is based on the assumption that any persons who hold positions of administrative authority on the survey constitute, *ipso facto*, an infallible scientific tribunal, whose function it is to pass judgment on the work of all other scientists who may be their official subordinates, and to suppress all heresies. As opposed to this assumption, I desire here to reaffirm what I have repeatedly declared in my communications and correspondence with officials of the survey—my conviction of the inalienable right of every scientist to the free expression of his own opinion, and the individual responsibility for his own work, no matter what the auspices under which the work is done, or opinions published.

Very respectfully,

(Signed) W. S. Tangier Smith

Department of the Interior,
United States Geological Survey,
Washington, D. C., June 11, 1907.

Dr. W. S. Tangier Smith,
Reno, Nevada.

Sir: I have forwarded your resignation to the Secretary of the Interior and have recommended its acceptance.

I regret that you feel that a protest is necessary against the administration of this bureau. I believe that the misunderstanding on the part of yourself and other geologists who have presented similar protests comes from the fact that you fail to see that administrative authority carries responsibility. Thus it is that in the matter of publication it is not so much the desire of the administrative officers of the survey to constitute themselves into a scientific tribunal as to be true to their official oaths and administer the survey with due regard for the letter and spirit of the congressional enactments which provide for the continuance of this work. You and I as individual scientists may have personal opinions regarding scientific work, but as long as we are members of a government organization we must conform to the purpose of the appropriation under which our work is done. In short, when we become members of an organization which pays for our work, we surrender a certain part of the "inalienable right," as you term it, to the free expression of our own opinion.

Very respectfully,
(Signed) Geo. Otis Smith,
Director

Los Gatos, Cal., July 17, 1907.

Dr. Geo. Otis Smith,
Director.
U. S. Geological Survey,
Washington, D. C.

Sir: I am in receipt of your letter of June 11 acknowledging my resignation from the survey, and referring to the protest accompanying it. I had intended to write to you to assure you that nothing in that protest referred to you personally; but, from your last letter, I am sorry to learn that your attitude in the matter is apparently hopelessly opposed to mine.

You mention, somewhat vaguely, "administrative responsibility," "official oaths" and "congressional enactments." Now, in my conception, the supreme responsibility of the scientist is to discover the truth and to tell it, in accordance with the clearest vision vouchsafed him; and this responsibility can not be superseded by the demands of any administrative position nor abrogated by any official oath. As for the "letter and spirit of the congressional enactments," if these should ever happen to come into conflict with scientific truth (which does not seem to me a very probable contingency, so long as congress and the Geological Survey confine themselves to the accepted limits of their respective fields of work), I would venture to suggest that congressional enactments are more easily changed than the facts of the universe, and that it is not necessary, in the interest of the former, to suppress or falsify even an individual conception of the latter.

But you say that in joining the survey the individual surrenders a part of the "inalienable right" of the scientist. Here, apparently, is the crucial point of the whole discussion. If this were generally accepted as a basic principle of the survey, it could not long support the claim of being a scientific organization, for no scientist with the highest conception of his calling would ever voluntarily accept such conditions of service; and the organization would speedily become, what your principle would logically make it, an artificial structure of red tape, reared by "administrative responsibility" (which easily becomes a synonym for autocratic privilege) on the foundation of "congressional enactments," and inspired by nothing higher than the ambition to secure more appropriations. In contrast to this bureaucratic conception, let me quote President Eliot's words with reference to scientific investigators: "They must set their own standards of excellence; for society can not supply men capable of supervising, regulating or stimulating them. . . . The scientific investigator must be a law unto himself. The utmost that governments or universities can do for him is to provide suitable facilities and conditions for his work, and to watch for results."

Since your letter was written in your official capacity, I suppose that you will not object to its being published, together with mine, as a contribution to a discussion of general interest to the scientists of the country.

With sincere regret for the difference of opinion which has developed between us, I am

Very respectfully,
(Signed) W. S. Tangier Smith

TYPE OF THE GENUS ASTACUS

To the Editor of Science: Within the last decade, a good deal of controversy has been engaged in anent the type of the crustacean genus *Astacus*. These differences of opinion have arisen owing to authors having disregarded Degeer 1778 ("Mem. Ins.," VII.), who fixed as type *A. fluviatilis* Fabr. (= *Cancer astacus* Linné).

G. W. Kirkaldy

SPECIAL ARTICLES

COLOR VARIETIES OF THE RABBIT AND OF OTHER RODENTS; THEIR ORIGIN AND INHERITANCE[1]

In the issue of Science for January 25, 1907, I have shown that the agouti, or wild type of coat of the guinea-pig, results from the simultaneous presence of three factors, which are separately heritable unit characters, namely, black pigment, yellow pigment and a factor causing the two pigments to be disposed in bands. In uniformly colored (or self) varieties of the guinea-pig, at least one of these three factors is wanting. If the lacking factor is supplied by a cross with a variety which possesses it, then reversion is obtained, that is a return to the wild type of coat.

It is the purpose of the present note to

[1] Published by permission of the Carnegie Institution of Washington.

point out that the same general explanation which was given for the color varieties of the guinea-pig is applicable likewise to the rabbit, but with certain interesting differences.

The gray coat of wild rabbits contains (1) black pigment and (2) yellow pigment (3) arranged upon the hair in bands, most conspicuous of which is a subapical band of yellow. The belly and under surface of the tail are white, due to entire absence of pigment from the terminal portions of the hair in those body regions. Whenever in rabbits the fur above is barred, the belly and lower surface of the tail are white. Three separately heritable factors, which conform with Mendel's law of heredity, are involved in the gray coat. These are *B*, black pigment; *Y*, yellow pigment, and *A*, the barring arrangement of the pigments, which includes absence of pigment from the hair-tips of the belly, as already explained.

Color varieties other than gray lack one or more of these factors more or less completely.

Varieties which lack the factor *A* have unbarred hair, in which the black and yellow pigments are intimately mingled together. Several different shades of color are produced by such combinations of the two pigments, in different proportions. In *black* individuals black pigment is in excess, in *sooty yellow* individuals yellow pigment is in excess, in *blue* individuals the black pigment exists in a dilute form, while the yellow apparently remains scanty in amount. But all three varieties alike, namely, black, sooty yellow and blue, have unbarred hairs and lack the white belly and tail found in wild rabbits. What they all in common have lost, as compared with wild rabbits, is the barring factor, *A*.

Rabbits which retain this factor are readily recognized by the white belly and tail. Such of them as have little or no black pigment in their fur are known as *yellow;* such as have black pigment of the dilute sort found in blue individuals are known as *blue-gray,* and such as have abundant black pigment of the ordinary intense sort are known as *gray;* their coat corresponds in every respect with that of wild rabbits.

Accordingly we can recognize among rabbits two parallel series of color varieties, which differ only in this respect, that in one series the factor *A* is present, while in the other series it is absent.

COLOR VARIETIES OF THE RABBIT

Series 1	*Series 2*
Gray, *BYA*	Black, *BY*
Blue-gray, *B* (dilute) *YA*	Blue, *B* (dilute) *Y*
White-bellied yellow, *B* (traces only) *YA*	Sooty yellow, *B* (traces only) *Y*

Any member of series 1 is dominant in heredity over the corresponding member of series 2, as might be expected, since series 2 is derivable from series 1 by loss of a single unit-character, *A*.

Within series 1, gray is dominant over blue-gray as well as over white-bellied yellow, both these conditions being derivable from gray by modification of the black pigment, in one case in quality, in the other case in quantity.

Similar relations exist between the corresponding members of series 2, black being dominant over its derived conditions, blue and sooty yellow.

Knowing the unit-characters borne by each variety (its gametic formula), one can readily predict the result of crosses between the several varieties. Any cross which brings together the three factors, *B*, *Y* and *A*, will give reversion, *i. e.*, a return to the wild type of coat, gray.

Thus, grays are obtained from mating white-bellied yellow or blue-gray with black. White-bellied yellow mated with blue gives sometimes gray, sometimes blue-gray, depending on the quality of the black pigment transmitted (in traces) by the yellow parent.

Similarly, sooty yellow mated with blue-gray may give either gray or blue-gray. But a mating of sooty yellow with homozygous white-bellied yellow produces nothing but the last named sort, since the black pigment transmitted in traces only by both parents is insufficient in amount to produce the gray coat.

The foregoing statements apply, of course, only to crosses between homozygous individuals of the varieties named. In accordance with the general principles of Mendelian inheritance, it is found in these two series that any variety, which contains a dominant character, may be, as regards that character, either homozygous or heterozygous. Thus, heterozygous gray animals might produce any of the forms included in either series; indeed, in our experiments, all the forms except blue were so obtained, and blues were obtained in the following generation from the blue-grays.

Blue-grays, bred *inter se,* may, when heterozygous, be expected to produce also blue, white-bellied yellow and sooty yellow; blacks may give blue, as well as sooty yellow; blues and white-bellied yellows may each give sooty yellow; but sooty yellow is apparently incapable of producing any other variety enumerated in either series; it is recessive with respect to those varieties.

Accordingly, as regards breeding capacity (*i. e.,* gametic formula), we may distinguish six different sorts of gray rabbits, three of black ones, three of blue-gray ones, two each of white-bellied yellow and blue ones, but of sooty yellow one sort only, if we disregard qualitative differences in the traces of black pigment borne by sooty yellow individuals. An enumeration follows of these various sorts of individuals, most of which, as will be seen, have already been identified. In the enumeration, B will be used for black pigment, B' for the same in minute quantities only, Y for yellow pigment and A for the barring factor.

Gray

1. $BYA \cdot BYA$ breeds true. Found in wild rabbits and in the "Belgian hare" used in our experiments.
2. $BYA \cdot BY$ gives also black. This condition is often found in Belgian hares supposed to be pure, but really not pure as regards color characters. Produced in our experiments.
3. $BYA \cdot B$ (dilute) YA should give only gray and blue-gray. Not certainly known.
4. $BYA \cdot B$ (dilute) Y gives, in addition to gray, black, blue-gray and blue. Observed except as regards the production of blue young; observations not very extensive.
5. $BYA \cdot B'YA$ gives, in addition to gray, white-bellied yellow only. Observed.
6. $BYA \cdot B'Y$ gives, in addition to gray, black, white-bellied yellow and sooty yellow. Observed.

Black

1. $BY \cdot BY$ breeds true. Known to exist.
2. $BY \cdot B$ (dilute) Y gives black and blue. Observed.
3. $BY \cdot B'Y$ gives black and sooty yellow. Observed.

Blue-Gray

1. B (dilute) $YA \cdot B$ (dilute) YA should breed true. Not yet obtained.
2. B (dilute) $YA \cdot B$ (dilute) Y gives also blue. Observed.
3. B (dilute) $YA \cdot B'Y$ should give blue-gray, blue, white-bellied yellow and sooty yellow. Not observed.

White-bellied Yellow

1. $B'YA \cdot B'YA$ breeds true. Observed.
2. $B'YA \cdot B'Y$ gives white-bellied yellow and sooty yellow. Observed.

Blue

1. B (dilute) $Y \cdot B$ (dilute) Y should breed true. Not yet certainly known.
2. B (dilute) $Y \cdot B'$ (dilute) Y gives blue and sooty yellow. Observed.

Sooty Yellow

$B'Y \cdot B'Y$ breeds true, so far as tested.

All of the numerous color varieties mentioned have arisen by *loss,* partial or complete, of one or more of the three independent factors which contribute to the production of the gray coat of wild rabbits.

It may be of interest to compare with the case of the rabbit, the evolution of color varieties among guinea-pigs, mice and rats, which, like the rabbit, are rodents more or less completely domesticated.

The agouti (or wild) type of coat of the guinea-pig is produced by the same three factors as the gray coat of rabbits, *viz.,* black pigment (B), yellow pigment (Y), and a barring factor (A). But in guinea-pigs there occurs also a third pigment of a chocolate-brown color, which is usually associated with black pigment, but has in recent years been obtained entirely separate from black pigment in the variety known as "chocolate." For this factor of the pigmented coat we may use the symbol Br, signifying brown. The homozygous color varieties of the guinea-pig may then be designated as follows:

COLOR VARIETIES OF THE GUINEA-PIG

Series 1	*Series 2*
Agouti, *BBrYA*.	Black, *BBrY*,
	Chocolate, *BrY*.
Yellow (black-eyed), *YA* (*BBr* in eyes and skin only), gives agouti in crosses with black.	Yellow (black-eyed), *Y* (*BBr* in eyes and skin only), does not give agouti in crosses with black.
	Yellow (brown-eyed), *Y* (*Br* in eyes and skin only).

As in rabbits, the color varieties fall into two parallel series, in one of which the factor *A* is present, while in the other it is wanting.

The chocolate variety was first obtained, in the experiments under discussion, from animals of other colors. Later, with the kindly assistance of Mr. Bateson, a chocolate male was obtained in England, where the variety has apparently originated recently. It is not mentioned by Cumberland (see bibliography) in his well-known work on the cavy.

The brown-eyed yellow variety I have obtained only recently in the second generation (F_2) from a cross between black-eyed yellow and chocolate. Its existence elsewhere is unknown to me.

We may confidently expect the production by appropriate matings of two varieties which will fall into series 1, opposite the newly obtained varieties of series 2, chocolate and brown-eyed yellow, from which varieties they will differ only by the addition of the factor, *A*.

The coat pigments of mice are similar to those of guinea-pigs, viz., black, brown and yellow. All three are probably present together in the coat of the gray house-mouse, along with a barring factor, *A*. Loss of *A* produces the black variety, precisely as in rabbits and guinea-pigs; loss of *B* produces the cinnamon agouti variety (a combination unknown as yet in guinea-pigs, as already stated); loss of both *B* and *A* produces, as in guinea-pigs, the chocolate variety. The yellow variety, we must believe, results from the suppression in the coat of both black and brown pigment, but this loss-condition, curiously enough, is dominant in crosses over the more inclusive combinations which contain *B* and *Br*.

Davenport (1904) and Cuénot (1905) have recorded observations upon yellow mice which manifestly bore the factor *A*, since they gave reversion in crosses with black and with chocolate individuals; but it is evident that the yellow mice used in my own experiments (Castle, 1906) lacked this factor completely, for neither grays nor cinnamon agoutis were obtained in crosses with black or with chocolate individuals. Further, Cuénot's black-eyed yellow mice were heterozygous, bearing black as a recessive character; my own, likewise heterozygous, so far as tested, bore in most cases chocolate as a recessive character. The yellow mice of Steer (mentioned by Bateson, 1903), which gave chocolate young, were evidently of this same sort. I have examined the eye pigments of one of the chocolate-producing yellow mice and find it to be brown, as in chocolate guinea-pigs, not black, as Cuénot states the eyes of his yellow mice to have been.

From these scattered observations we may infer that the gametic formula of yellow mice is varied; sometimes they lack *B*, sometimes they lack *A*, sometimes they lack both *B* and *A*; sometimes still other modifications seem to be involved which cause absence of pigmentation from the eyes, or eyes and belly both.

The wild rat doubtless has the same three factors involved in the production of its gray coat, as do the other rodents already discussed, those factors being *B*, *Y* and *A*; but the only one of these which has yet been lost so as to produce a self-colored variety is the barring factor, *A*. Loss of this produces the well-known black variety.

For the sake of simplicity, no reference has been made in the foregoing discussion to albino individuals, which may occur in any or all color-varieties. They are individuals which lack some *activating* substance necessary to make pigments visible. They carry color potentialities precisely as pigmented individuals do, as is clearly shown by the results of crosses between albinos and pigmented individuals. Further, they are differentiated, precisely as pigmented individuals are, in respect to the intensities of the pigments transmitted, and even in respect to color-patterns (spotting and the like). All that the albino seems to lack in comparison with a pigmented animal, is an activating substance, and even this may be present in small amounts in the albino, as, for example, in the Himalayan rabbit and in the similar variety of the albino guinea-pig. My albino guinea-pigs of chocolate parentage have brown-pigmented extremities, those of black parentage have black pigmented extremities.

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W. E. Castle

Zoological Laboratory,
Harvard University,
August 8, 1907

ASTRONOMICAL NOTES

THE ASTROGRAPHIC CATALOGUE

Volumes I. and II. of the Oxford Section of the Astrographic Catalogue, by Herbert Hall Turner, D.Sc., F.R.S., Savilian professor of astronomy, have recently been issued. The Oxford Section extends from Dec. $+24°$ to $+32°$.

The International Congress on Astronomical Photography met in Paris, in April, 1887. Oxford was one of the eighteen observatories which offered to take part in the mapping of the heavens by means of photographs. Two schemes of work were planned, each to cover the entire sky, one with short exposures of 6m, 3m and 20s, the other with exposures of about one hour. Twenty years have elapsed since that time. From Oxford we now have the two volumes above referred to, which are to be followed by six others. The whole bears witness to the ability and energy of the author and his assistants, and will no doubt prove of great value to astronomy. It also illustrates well the magnitude of the original schemes, which appear to have been unwisely large, since these eight volumes will complete only the study of the plates of short exposure. Professor Turner says:

> No attempt has, however, been made to take the long-exposure series at Oxford, as there has never been the least prospect of obtaining funds for publishing the charts, either at Oxford or at the majority of the participating observatories.

Evidently some decades must yet elapse before the completion of the original schemes, even if the need for their completion should remain urgent.

The Oxford plates were made by an instrument of the pattern proposed by the Henry Brothers, of Paris. It has an object-glass of 13 inches aperture, and a focal length of 11¼ feet, so that on the plates 1 mm. equals approximately 1′. The work was undertaken by the late Professor Prichard, but his death, at the advanced age of eighty-five years, took place before much had been accomplished. The catalogue gives the positions of the stars, expressed in rectangular coordinates, and the diameter of the stellar images, from which the magnitudes may be derived. In many cases it would be undesirable to use either of these quantities in the form here given. Tables are given, however, by means of which the rectangular coordinates may be converted into right ascensions and declinations. For the conversion of diameters into magnitudes, the formula is given: magnitude $= a - b\sqrt{d}$, where a and b are constants and d is the diameter of the image. This formula, as Professor Turner points out, introduces large errors for the faint stars. The precision of the positions is much more satisfactory, the total probable error of a coordinate, made up of errors from all sources, being only 0.″39. The number of stars measured in Volume I. is 65,750, and in Volume II., 66,718. Many of these are duplications, owing to the overlapping of the plates, but aside from this desirable duplication, the number of different stars measured in the whole Oxford section will be very great.

VARIABLE STARS

Two contributions to the subject of variable stars have recently appeared in the *Annals* of the Harvard College Observatory.

Volume XLVII., Part I., gives a detailed photographic study, by Mrs. W. P. Fleming, of the comparison stars for the 222 variables of long period, nearly all of which were discovered by her by means of their spectral peculiarities. No star having a spectrum of the class designated Md, that of the third type with the hydrogen lines bright, has yet been found which is not variable, although many stars having a different spectrum are also variables of long period. The present volume deals only with the identification, positions and magnitudes of the comparison stars. Rectangular coordinates, referred to the variable star as a center, are employed. The methods of measurement and reduction have been already explained in the *Annals*. At the time this work was undertaken no good method existed for the determination of photographic magnitudes. Those used in the present volume were derived from measurements of the stars with a scale having a series of images of different intensities. Each image, after the first, which had an exposure of one second, had an exposure three times as long as that of the preceding image. The intervals thus obtained are assumed to represent one magnitude. The magnitudes thus obtained are made to depend upon the visual magnitudes of the brighter stars of the sequence. This method furnishes a scale of magnitudes which, however large systematic errors it may contain, appears to be consistent within itself. Later, when the method which Professor Pickering has devised, or any other method for the determination of absolute photographic magnitudes, is available, systematic corrections can be applied to the values here given to reduce them to an absolute scale of magnitudes. A later volume will furnish a discussion of the observations of the variables themselves.

Volume LV., Part I., contains the Second Catalogue of Variable Stars, prepared by Miss A. J. Cannon. As explained by Miss Cannon, the history of variable star catalogues extends as far back as 1844, when a list of 18 variables appeared, compiled by Argelander. In successive lists the number of objects has increased since that time, at first slowly, but later with great rapidity through the introduction of photographic methods, until we come to the present catalogue, which contains 1,957 variables. This includes the 500 variables found in the globular clusters, but not the 1,800 found in the Magellanic clouds. Altogether, at the present time, about 3,750 stars are known to be variable, of which about 2,900 have been found at the Harvard Observatory. A study of the number and distribution of the variable stars over the whole sky seems now to be within reach. The present catalogue is the result of about ten years of compilation and observation. The foundation of a card catalogue of variable star literature was begun in 1897, by Professor W. M. Reed. This bibliography, carried forward by Miss Cannon, now consists of more than 35,000 cards. This vast amount of material, as well as much unpublished data belonging to the Harvard Observatory, has been used by Miss Cannon in making up the present volume. The main table gives, after the various designations of the star, and its position, the maximum and minimum magnitudes, the period when known, the epoch, class of variable, type of spectrum, provisional number in order of discovery assigned by Kreutz, and the date and name of the discoverer. Auxiliary tables and remarks give much information in regard to the peculiarities of many of the variables. Part II. of the same volume will contain further information, including a study of all the published maxima and minima of variables of long period. S. I. Bailey.

THE SEVENTH INTERNATIONAL ZOOLOGICAL CONGRESS

THE congress held its scientific session last week in Boston in accordance with the program that has already been published in this journal. The meetings were held in the magnificent new buildings of the Harvard Medical School and everything possible was done for the entertainment of the delegates and members. Mr. Alexander Agassiz presided, and general addresses before the congress were given by Professor R. Hertwig, of Munich, on "Neuere Probleme der Zellforschung"; by Sir John Murray, of the *Challenger* expedition, and by Professor W. K. Brooks, of the Johns Hopkins University, whose address was entitled "Are Heredity and Variation Facts?" The titles of most of the papers presented have already been printed in SCIENCE. The number of papers offered in each section was as follows: Animal Behavior, 41; Comparative Anatomy, 44; Comparative Physiology, 28; Cytology and Heredity, 46; Embryology and Experimental Zoology, 36; Entomology and Applied Zoology, 24; General Zoology, 15; Paleozoology, 21; Systematic Zoology, 20; Zoögeography and Thalassography, 30.

The addresses presented before the sections were as follows: *Comparative Anatomy:* Professor J. P. McMurrich, University of Toronto, "The Problem of the Vertebrate Head in the Light of Comparative Anatomy." *Comparative Physiology:* Professor J. Loeb, University of California, "The Chemical Character of the Process of Fertilization." *Cytology and Heredity:* Professor C. E. McClung, University of Kansas, "Cytology and Taxonomy." Professor W. Bateson, Cambridge University, "Facts limiting the Theory of Heredity." *Embryology and Experimental Zoology:* Professor A. A. W. Hubrecht, University of Utrecht, "Larval Envelopes and Fœtal Membranes in Vertebrate Embryos." Professor W. Roux, University of Halle, "Können wir die ursachlichen Wirkungsweisen der typischen Entwickelungsvorgänge ermitteln?" Dr. H. Driesch, University of Heidelberg, "The Stimuli of Restitutions." *Entomology and Applied Zoology:* Dr. G. Horváth, Hungarian National Museum, "Relations entre les faunes hémiptérologiques de l'Europe et de l'Amérique du Nord. Dr. L. O. Howard, U. S. Bureau of Entomology, "The Recent Progress and Present Condition of Economic Entomology." *General Zoology:* Professor C. O. Whitman, University of Chicago, "The Problem of Organic Development." *Paleozoology:* Professor C. Depéret, University of Lyons, "Les migrations des faunes tertiares entre l'Europe et l'Amérique." *Systematic Zoology:* Dr. Theo. Gill, Smithsonian Institution, "Systematic Zoology, its Place and Functions." *Zoogeography and Thalassography:* Dr. R. F. Scharff, Dublin Museum, "On the Evolution of Continents as illustrated by the Geographical Distribution of Existing Animals."

After visiting Harvard University on Saturday, members of the congress went to New York by way of Woods Hole on Sunday. The present week is being spent in New York City and in excursions from the city, Monday being Columbia University day; Tuesday, American Museum day; Wednesday, Cold Spring Harbor day; Thursday, New York Zoological Society day; Friday, Hudson River day; Saturday, visits to Yale University or Princeton University. The delegates and members go to Philadelphia on Monday of next week and visit the scientific and educational institutions of that city on that day and on Tuesday. On Tuesday afternoon they leave for Washington, returning to New York on Friday. On Saturday there is an excursion to Niagara Falls.

Foreign delegates and members in attendance include the following:

British Empire: Dr. Charles W. Andrews, London; Professor William Bateson, Cambridge; Professor Charles J. S. Bethune, Guelph, Ontario; S. F. Harmer, Cambridge; R. H. Johnson, Hobart, Tasmania; Rev. W. G. Marsh, Adelaide; Sir John Murray, Edinburgh; C. Tate Regan, London; Charles F. Rousselet, London; Dr. Robert F. Scharff, Dublin; Arthur E. Shipley, Cambridge; Dr. J. Y. Simpson, Edinburgh; Professor J. A. Thomson, Aberdeen.

France: Professor Raphael Blanchard, Paris; Professor C. Depéret, Lyon; Baron L. Dubreton, Paris; Professor Ch. Gravier, Paris; Baron de Guerne, Paris; Dr. Gustave Loisel, Paris.

Germany: Professor Wilhelm Blasius, Brunswick; Dr. Marcellin Braun, Königsberg; Professor Valentin Haecker, Stuttgart; Professor Richard Hertwig, Munich; Dr. Richard Heymons, Berlin; Dr. Max Luehe, Königsberg i. Pr.; Professor Otto Maas, Munich; Professor Ludwig Rhumbler, Münden; Professor Hugo H. Schauinsland, Bremen.

Belgium: Professor Paul Pelseneer, Ghent.

Holland: Dr. Johannes Buettikofer, Rotterdam; Professor A. A. W. Hubrecht, Utrecht; Professor J. W. van Wijhe, Groningen; Dr. J. Versluys, Jr., Amsterdam.

Austria: Professor Ludwig von Graff, Graz; Dr. J. F. Gudenatch, Czernowitz; Dr. F. de Marassovich, Scardona, Dalmatia; Professor Alois Mrázek, Prague; Dr. Hans Przibram, Vienna.

Hungary: Professor Istvan von Apáthy, Koloszvár; Dr. Géza v. Horváth, Budapest.

Switzerland: Dr. Herbert H. Field, Zurich; Professor Otto Fuhrmann, Neuchâtel; Dr. C. Linder, St. Imier; M. B. P. Merian, Basel; M. P. Revilloid, Geneva; Professor Theophil Studer, Berne; Professor Emile Yung, Geneva.

Russia: Dr. W. Dantchakoff, St. Petersburg; K. Derjugin, St. Petersburg; Professor Evgenij P. Golovin, Kazan; Professor G. A. Koshewnikov, Moscow; Dr. A. Maximow, St. Petersburg; Dr. N. Samssonow, St. Petersburg.

Italy: Count Filippo Cavazza, Bologna; Professor Alessandro Ghigi, Bologna; Count J. A. Salinas, Bologna; Dr. J. Wilhelmi, Naples.

Norway: Miss K. Bonnevie, Christiana.

South America: Professor Emilio A. Goeldi, Para, Brazil.

Asia: Dr. J. C. Ferguson, Shanghai; Dr. S. Watasé, Tokyo.

SCIENTIFIC NOTES AND NEWS

Sir Archibald Geikie has been made Knight of the Most Honorable Order of the Bath (Civil Division).

At the Toronto meeting of the American Chemical Society, the council decided that the offices of editor and secretary should be separated. Professor W. A. Noyes, of the University of Illinois, retains the editorship of the *Journal of the American Chemical Society* and of *Chemical Abstracts,* and Dr. Charles L. Parsons, head of the Chemical Department of the New Hampshire College and secretary of the Section of Chemistry of the American Association for the Advancement of Science, has been elected to the secretaryship.

Professor J. J. Stevenson, of New York University, and Professor W. M. Davis, of Harvard University, are among the Americans who will attend the celebration of the centennial of the foundation of the Geological Society, London, which will take place at the end of next month.

The resignation of Mansfield Merriman as professor of civil engineering in Lehigh University takes effect on August 31. After this date he will devote most of his time to professional practise as a consulting engineer, his office and address being at 45 Broadway, New York.

Dr. T. W. Richards, professor of chemistry at Harvard University, having completed his work in Berlin in connection with the plan for an exchange of professors between the two universities, sailed for America from England on August 19.

Dr. George M. Kober, dean of the Medical Department of Georgetown University, sailed from Baltimore for Bremen on August 14.

Dr. Walter Wyman, surgeon general of the Public Health and Marine Hospital Service, is chairman of the International Sanitary Bureau, which meets in the City of Mexico during the first week of September next.

At the recent congress of School Hygiene in London, the committee appointed to arrange for the next congress, to be held in Paris in 1910, consists of the following members: *Great*

Britain: Professor Osler, Dr. Kerr, Mr. White Wallis and Mr. Cloudesley Brereton. *British Colonies:* Sir John Cockburn, K.C.M.G. *Switzerland:* Dr. F. Zollinger (Zurich). *France:* M. Sigalas (Bordeaux), Professor Lefevre (Lille), and Professor Chabot (Lyons). *Belgium:* Dr. Decroby. *Russia:* Professor Chlopine. *Portugal:* Professors Saccadura and Curry Cabral. *United States:* Dr. Walcott, Dr. Gulick, Professor Da Costa.

Dr. J. Walter Fewkes, of the Bureau of American Ethnology, will undertake the work of excavation, preservation and repairs in connection with the cliff dwellings and other prehistoric ruins in the Mesa Verde National Park, Colorado. The Mesa Verde National Park was created by act of congress approved June 29, 1906. It is on the border of the Montezuma valley, just south of the ancient Montezuma road, and contains some of the best preserved relics of the prehistoric cliff dwellers in the country. Dr. Fewkes is to have the direction of the scientific work of unearthing and preserving the Mesa Verde ruins and an adequate sum has been allotted by the Interior Department for the purpose. He will proceed to Colorado after the completion of extensive excavations at Casa Grande, Arizona. This work is undertaken jointly by the Department of the Interior and the Smithsonian Institution.

Mr. E. W. Berry is engaged in the study of the paleobotany of the Coastal Plain deposits under the auspices of the U. S. Geological Survey.

Mr. H. B. Kummel, state geologist of New Jersey, and Mr. M. L. Fuller, of the U. S. Geological Survey, have completed an extended review of the Cretaceous, Tertiary and Pleistocene formations of New Jersey, in connection with the cooperative investigations and correlation of the Atlantic and Gulf Coastal Plain deposits by the United States and the various State Surveys under the direction of Mr. Fuller.

An investigation of the maximum glaciation of the Sierra Nevada is being made by Willard D. Johnson, geologist of the United States Geological Survey, who will this year complete a study along the full length of the east flank of the range, including a bordering zone of the Basin ranges, and will also make a reconnaissance in Carson Valley at the extreme northern end of the High Sierras.

Dr. Ankermann, assistant in the Berlin Museum of Ethnology, will in October undertake explorations in Kamerun, for which the state has made a grant of 20,000 Marks.

At the fortieth annual meeting of the Canadian Medical Association to be held in Montreal from September 11 to 14, under the presidency of Dr. Alexander McPhedran, Toronto, Dr. Davy Rolleston, London, will deliver the address in medicine; Dr. Ingersoll Olmsted, Hamilton, the address in surgery, and Dr. J. George Adami, Montreal, the address in pathology.

The Joule studentship of the Royal Society has been awarded to Dr. T. H. Laby, of the University of Sydney, now of the Cavendish Laboratory, Cambridge, for an investigation of the conditions of condensation and supersaturation of vapors other than steam.

Professor Walter Baldwin Spencer, F.R.S., professor of biology in the University of Melbourne (formerly scholar of Exeter and fellow of Lincoln, Oxford), has been elected to an honorary fellowship at Exeter College.

On the recommendation of the council of the Royal College of Physicians the Baly medal was awarded to Ernest H. Starling, M.D., F.R.C.P., F.R.S., Jodrell professor of physiology, University College, London, as having preeminently distinguished himself in the science of physiology.

The Keith prize (a gold medal and £50) for the biennial period 1903–5 has been awarded by the council of the Royal Society of Edinburgh to Thomas H. Bryce, M.A., M.D., for his two papers on the histology of the blood of the larvæ of *Lepidosiren paradoxa*, published in the *Transactions* of the society within the period.

Professor Ernest Everett Bogue, head of the department of forestry of the Michigan Agricultural College, died at Lansing, Mich., on August 19, at the age of forty-three years.

On or about September 11, 1907, an examination will be held by the Civil Service Commission to secure eligibles from which to make certification to fill three vacancies in the Naval Observatory, Washington, D. C., in the position of miscellaneous computer, and one vacancy in the position of assistant at $1,000 per annum. Miscellaneous computers are paid by the hour, and earn from $900 to $1,100 per annum. Promotions are made from this grade without further examination to the grades of assistant at $1,200 per annum, as vacancies occur. As an insufficient number of eligibles were secured as the result of the last four examinations to meet the needs of the service, qualified persons are urged to enter this examination. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for full information concerning the examination. Applicants can be examined at various places throughout the United States.

The first meeting of the Italian Association for the Advancement of Science will take place at Parma from September 23 to 29.

Nature states that an institute entitled the Istituto Therapeutico Italiano has been established at Milan under the directorship of Dr. Zanoni, the work of which will be the investigation of the action of new drugs, especially in regard to serumtherapy and hypodermic medication.

We learn from the journal of the American Medical Association that the Sixth International Dermatologic Congress will be held at the Academy of Medicine, New York City, from September 9 to 14. An address of welcome on behalf of the United States will be delivered by Surgeon General Rixey of the United States Navy; an address for the American universities will be delivered by Professor Ira Remsen, of the Johns Hopkins University; and an address for the medical profession of the United States by Dr. Joseph D. Bryant, president of the American Medical Association. Papers will be read by some of the most famous European dermatologists, including Professor R. Campana, Rome, Italy; Dr. Z. Falcao, Lisbon, Portugal; Dr. Vinetta-Bellaserra, Barcelona, Spain; Dr. L. Brocq, Paris; Dr. Unna, Hamburg, Germany; Dr. M. Oppenheimer, Vienna; Professor E. Kromayer, Berlin; Professor E. Hoffmann, Berlin; Dr. A. Buschke, Berlin; Drs. Hallopeau and Gastou, Paris; Professor S. Ehrmann, Vienna, and numerous others. Papers are also on the program by the leading dermatologists of this country. Further details may be obtained from the secretary-general, Dr. John A. Fordyce, 80 West Fortieth Street, New York City.

UNIVERSITY AND EDUCATIONAL NEWS

At the University of Illinois, Dr. G. A. Miller, associate professor of mathematics, has been promoted to a professorship. The department of mathematics now contains three professors, one associate professor, three assistant professors, one associate, six instructors and three assistants.

Dr. Alfred E. Thayer has resigned from the chair of pathology in the University of Texas. His future address will be Asheville, N. C.

Professor F. E. Austin, who has had charge of the department of electrical engineering at the Thayer School of Civil Engineering, Hanover, N. H., will, during the coming year, have charge of the departments of physics and electrical engineering at Norwich University, Northfield, Vermont.

At the Western College for Women, Oxford, Ohio, the following changes have been made in the faculty for next year: Mary F. Leach, Ph.D., assistant in hygiene at the University of Michigan, will take charge of the advanced work in chemistry, bacteriology and hygiene; Mary D. MacKenzie, M.A. (Syracuse), will take charge of the biological department.

Mr. J. L. Simonsen, Schunck research fellow, has been appointed a junior demonstrator in chemistry at the University of Manchester.

Dr. H. Simon has been appointed professor of applied physics at the University of Göttingen.

Dr. Prenant, of the University of Nancy, has been appointed professor of histology in the medical faculty of the University of Paris.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, SEPTEMBER 6, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE NEW OUTLOOK IN CHEMISTRY[1]

Your Excellencies, Your Magnificence, Ladies and Gentlemen:

To-day there has come together here, to welcome a new guest to your noble university, a group of chosen spirits from among the best in this highly cultivated center of learning and civilization. I see before me many men whose names will go down to the future as leaders in their respective widely different fields of work, and rejoice to be in their presence. The opportunity of addressing a gathering so notable could not but be esteemed by anyone as an especial privilege and honor; and to me, whose debt to German scholarship is so exceedingly great, the occasion brings peculiar pleasure.

You are here not only to welcome graciously a newcomer, but also to hear the first lecture of a course concerning one of the most recent developments of human learning. As is well known, the logical process of inductive reasoning based upon carefully planned experiment is relatively a new manifestation of the power of the human intellect. The philosophers of old imagined, observed and reasoned, but neglected experimentation; the artisans, who alone came into close contact with realities, were unable except in the crudest fashion to generalize concerning their results. Because of this separation of thought and deed, man's knowledge of his

[1] Inaugural lecture delivered on May 4, 1907, in the Aula of the Royal Friedrich Wilhelm University of Berlin.

environment remained for thousands of years in a wholly undeveloped state.

From this dormant condition natural science emerged but slowly, although with steadily increasing pace. Little by little, in spite of occasional pauses of inactivity, or apparent forgetfulness, human acquaintance with the fundamental laws of the universe has grown. Each century has added something to the total; and usually each century has added more than any century before. What a contrast such a development presents to that of sculpture, for example, which reached nearly if not quite its highest point of perfection more than two thousand years ago!

In chemistry especially has the acceleration been great; and the effect of recent growth is so remarkable, that, looking back, one is inclined to deny the existence of any real science of chemistry a century and a half ago. If the accumulation of chemical knowledge is depicted diagrammatically in relation to the progress of time, measuring one in the vertical and the other in a horizontal direction, an upward-pointing curve with steadily increasing inclination is obtained. The curve stops at the present day; but unless a cataclysm annihilates the earth's population and its libraries, this line is bound to be continued. Whither will it lead? What further insight into his own constitution as well as that of his environment may man attain? The answer to these questions is fraught with weighty significance as regards the future of the human race.

All the manifold experiences of the human mind are intimately connected with the presence of that which we call material, enlivened by its association with that which we call energy; and the ultimate deciphering of the great mystery of life will depend as much upon the understanding of these as upon the study of the mind itself. Thus modern chemistry should be regarded not only as bringing to medicine and the useful arts its obvious and multifarious contributions, but also as occupying an essentially important place in the realm of intellectual speculation.

First among the influences which have affected the growth of chemistry may be named that kind of insight which may be called the scientific imagination. As this quality of mind has sometimes been assumed to be incompatible with exactness, a brief discussion of its nature will not be out of place. All who have intelligently followed a really original research in chemistry will agree in maintaining that an active and far-seeing imagination is required. Even the gleaner in the field of matter and energy who seeks merely for the facts, without especially concerning himself with the meaning and bearing of these facts, needs imagination, if his work is to be useful. He who lacks imagination will see only that which he is told to see. In any but the simplest scientific task, the mind of the investigator must conceive of many underlying conditions and possible modifying circumstances which are not apparent at first sight, and which demand imagination for their detection and proper adjustment. The highest type of scientific man—he who compares and generalizes his facts, who frames hypotheses concerning their ultimate nature, and who from these tentative speculations evolves new experiments to expand his knowledge—needs an imaginative mind in a yet higher degree. Dealing with impersonal things, instead of with personal emotions, this imagination is indeed of a somewhat different type from that exercised by the poet or artist; but it is none the less fitly to be considered as true imagination, and it likewise yields the singular delight of creative power to its possessor.

Not always have the two types of imagination, the scientific and the poetic, been separated in individuals. Indeed the occurrence of the two in the same individual is so often to be noticed that the two types might well be supposed to be really the same in essence and to differ only in their field of development. History furnishes many a proof of this twofold exercise of originality. For example, Leonardo da Vinci furnishes striking evidence of the manifold working of a powerful imagination. Leonardo was no less eminent as a geologist and engineer than as an artist and a poet. Chemistry too was profoundly interesting to him. His extraordinary writings manifest the fruitfulness of an imagination which has rarely been equaled. His few paintings, which show surpassing insight into human nature and unusual technical skill, were the expression of the same imaginative force. If Leonardo were living to-day, he might be as well known for his investigations into pure and applied science as for his artistic preeminence, since these fields of thought now have much more to offer to the imaginative mind than they had in the days when their scope was more restricted and less appreciated.

In more recent times, Goethe furnishes one of the most brilliant examples of a truly poetic mind which found joy in scientific studies. Goethe was not only one of the greatest poets of all times; he made also notable contributions to the science of his day. The imaginative quality which gives the pervading charm to one product of his genius gave insight to the other.

These are examples of men primarily known for their ability in the directions commonly recognized as imaginative, who have possessed also ability which was or might have been developed in a scientific direction. One may find likewise many cases of the dual use of the imagination among those who are known chiefly for their scientific productions. For example, von Helmholtz's interest in sound was not purely mathematical in its expression; the great physicist loved music for itself, having a wide knowledge of its literature and keen pleasure in its performance. Robert Wilhelm Bunsen's delight in the beauty of the Italian landscape, especially of the country around Naples, will be remembered by any one who knew him; this poetic appreciation, artistic in feeling if not in expression, persisted even to his old age, after pain and disability had caused his interest in chemistry to wane.

The case of Charles Darwin, which is the one example usually cited to prove the supposed incompatibility of the scientific and poetic imaginations, is perhaps rather to be referred to another category. One can hardly follow his long combat with ill-health without feeling that this misfortune, not his scientific interest, was the cause of the apparent atrophy of his literary and artistic sympathy. Darwin in his youth was extremely sensitive to every imaginative impulse; and years of suffering were needed to deaden this intense sensibility.

There is no need of multiplying the many possible examples of this kind, however, for the best place to find evidences of the imaginative insight of a scientific man is in his own work. Here, where his mind has dwelt longest, his mental vision will find its widest scope. Perhaps the most easily traceable record of this immediate effect of the scientific imagination is to be found in the life of Faraday, because he committed his wildest dreams to the pages of existing notebooks. Faraday's originality ranged at large over the whole field of chemistry and physics; to him nothing seemed too strange to be possible, no relation too unlikely to be unworthy of thought. But with this extraordinary disposition to dream things before undreamt, he possessed the steadying power of judgment which enabled him to dissociate his dreams from the reality. He always sought to test each hypothesis by actual experiment, and cheerfully recorded every overthrow when he was convinced of its finality. Experiment served to keep him scientifically sane, and day-dreams inspired his enthusiastic nature to undertake further experiment. Thus each helped the other, with a rare cumulative effect. Without imagination, Faraday could not have made most of his discoveries; but without profound common sense, he would have ended in a madhouse.

The example of Faraday serves also to emphasize the indisputable fact that imagination alone is not a sufficient intellectual outfit for the scientific man. At least one other attribute is essential, namely, good judgment, or common sense, to select between the various possible interpretations of fact and theory presented by the imagination. So emphatically is this true that Huxley maintained science to be nothing more than systematized common sense.

Imagination, then, and good judgment, are necessary, if science is to grow. But both of these admirable qualities were possessed in large measure by some of the ancient philosophers, who nevertheless made but little real progress. What was lacking, that so little advance should have been made in the 400 years between Democritus and Lucretius, and so little more in the succeeding centuries?

To-day, in the light furnished by any successful scientific investigation, the answer, given a few minutes ago, is manifest. This answer is so important that its substance may be repeated. The philosophers with all their intellectual greatness and insight, were too far removed from realities. More thorough observation, more consistent study of the actual operation of the law of cause and effect, and above all more frequent reference of each doubtful case to the almost neglected test of actual experiment should have supported their too vague speculations.

Accurate observation and well-planned experiment, then, besides imagination and good judgment, are needed if science is to advance. But long ago all these essentials were at the command of a few of the best of the alchemists, and yet chemical science loitered in its ever-onward way.

Chemistry began really to become a science and to enter upon the phenomenal growth of recent years only a little over a century ago. Since then its development has been one of the most remarkable features of human progress, and its results are among the most important of human intellectual possessions.

What was the reason for this striking transformation? What was the key with which modern chemistry has opened the door to her treasure house? The answer is easily found. Measurement, the accurate evaluation of the numerical relations of things, has been the "open sesame" whose magic influence has slowly disclosed the hidden wealth. As van't Hoff has pointed out, each new instrument for measuring a given phenomenon of nature led immediately to a greatly accelerated development in that particular field.

No wholly new idea exists under the sun, it is said. Certainly the perception in general of the importance of measurement is almost as old as the hills, although its effect upon chemistry was so long postponed. Plato over two thousand years ago put into the mouth of Socrates the equivalent of these words: "When measuring and weighing and the idea of number are taken away from an art, how little of that art is left!" Essentially this conviction led

Kant to exclude chemistry from the list of true sciences. In Kant's day, as he rightly maintained, chemical inferences depended so little upon any data capable of mathematical treatment, that the experimenter was liable to fall into extraordinary errors of interpretation. The world-wide prevalence of the oddly inverted theory of phlogiston, which imagined that a metal in rusting lost something of its substance is evidence of this defect. Such a theory became untenable as soon as measuring, weighing and the idea of number removed the cause of Kant's reproach.

Measurement, then, revolutionized chemistry—but what forms of measurement? History tells no equivocal tale on this score; every form of measurement whose careful application has laid the foundations of the present science of chemistry is quickly seen to belong to the domain of physics. This is not surprising, since only two of the traditional five human senses, namely, taste and smell, are purely chemical in their action; and these are not easily amenable to precise quantitative treatment. All the other senses, sight, hearing and touch, through which man obtains knowledge of the outside world, depend upon the interposition of physical energy; and the methods of measuring must correspond to this fact.

Thus, Joseph Black brought the balance, an essentially physical instrument, into requisition in order to demonstrate the nature of the caustic alkalies. Lavoisier used the balance to prove the fundamental laws of conservation of mass. The same instrument alone afforded Dalton a sound basis for his laws of combining proportions and of multiple proportions, and therefore the first unimpeachable argument in favor of the ancient atomic theory in which he had believed from childhood. The study of the densities of vapors, of the specific heats of solids, and of the forms of crystals, all found by processes of physical measurements, were the foundations upon which by degrees a logical system of chemical notation was built. The discovery of the quantity-dimension of electrical energy led in Faraday's hands to the new definition of chemical equivalents. The spectroscope, a physical instrument, in the hands of Bunsen and Kirchhoff made possible the detection of new chemical elements. Physical measurements of osmotic pressure led van't Hoff to a new conception of the phenomena of chemical relations in solution; and electrical conductivity was used by Arrhenius as the basis of the generally accepted theory concerning a large majority of the ordinary reactions between inorganic substances. Both the free energy change and the total energy change of a system undergoing a chemical reaction are measured by physical methods, and the proof of Nernst's equation depicting the mechanism of the galvanic cell depends upon the precise evaluation of small electromotive forces. Again, Lord Rayleigh's exact quantitative determinations of the densities of gases with Ramsay's help led to the discovery of a whole series of new elements possessing extraordinary properties. Still more recently physical methods of research are used in identifying the yet more extraordinary radioactive substances, and in endeavoring to solve the unanswered riddle of their possibly transitory existence. Finally, exact analysis, based upon weighing, alone made possible the exceedingly complex syntheses of organic compounds carried on by a long line of brilliant chemists culminating in Emil Fischer. These are only a few striking instances of the discoveries in chemistry which are essentially dependent upon physical processes.

Thus if the various methods of measurement borrowed from physics were taken away from the chemistry of to-day, but little would be left of the science. Chemistry would then become a purely qualitative observational study; she could penetrate but superficially into the hidden world. Therefore it would not be an extreme statement to call all quantitative chemistry *physical* chemistry, with the understanding that by physical chemistry in this sense is meant the application of physical methods of research to the study of chemical problems.

Indiscriminate measurement will lead nowhere, however. The results of the numerical determination of chemical phenomena are by no means all of equal importance. They may be divided into two classes: the first class comprises those which are variable and accidental, depending upon the relatively unimportant conditions of the special case, such as the analytical composition of a piece of granite; and the second class comprises those which are invariable and general, recurring almost or quite unchanged under widely varying conditions. Such results as the latter may be called "physicochemical constants." They claim our immediate attention.

A "physicochemical constant" is a numerical magnitude expressing one of the numerous apparently permanent quantitative relations of mass or energy which seem to be essentially associated with the elementary substances, or chemical elements, and their compounds; it is a fundamental fact, a unique number which touches very closely the ultimate structure of material. As examples, the atomic weights stand out strikingly. Whether or not these quantities, representing the relative weights in which elementary substances combine with one another, are to be referred to the weights of hypothetical atoms, they are certainly concerned in determining the composition of every compound substance in the heavens above, on the earth beneath, or in the waters under the earth. Every proteid in each muscle of our body, every drop of liquid in the ocean, every stone on the mountain top bears within itself the stamp of the influence of this profoundly significant and impressive series of fourscore numbers.

The heat evolved during any chemical combination typifies a different kind of physicochemical constant. Coal on burning sets free a quantity of heat which mankind uses in exceedingly divers ways, deriving therefrom the major part of the energy of manufactures and transportation as well as that needed to warm his habitations. The evolution of quantities of heat in this and other chemical reactions indicates a decrease in the total energy of the substances during the reaction involved; therefore from the point of view of the chemical philosopher, as well as from that of the practical engineer, these figures also are of great importance.

Many other examples of other types of constants might be cited, such as densities, compressibilities, or electrochemical equivalents; all are not of equal significance, but each in its way is fundamental. These properties although undoubtedly somewhat connected with one another, can not yet be safely predicted; each must be ascertained for itself. Thus a colossal task is involved in their accurate determination.

How nearly has this task been completed? The comparative study of the existing accumulation of experimental data concerning chemical phenomena affords reason for congratulation that so much has been done within a single century; but it also reveals the fact that much remains to be done. For in spite of the fact that physical measurements are the basis of all quantitative chemistry, we find, upon comparing the probable accuracy of most results in chemistry with the probable accuracy of many results in physics and astronomy, that chemistry is at present far in the background. In physics or astronomy results attaining an accuracy of one part in a hundred thousand are by no means uncommon, and often a much higher degree of precision than this is reached. For example, in weighing it is easy to detect one tenth of a milligram in a kilogram, a fractional part of only one in ten million. Again, the length of the year in terms of the length of the mean solar day is probably known to within one part in a hundred million. On the other hand, in chemistry few results are to be relied upon to within one part in 500, and many investigations, even of the atomic weights, have yielded results which are not to be trusted within one per cent. Such an error is 100,000 times as great as the possible error of the process of weighing alone.

Why is chemistry still so much behind physics and astronomy in quantitative consistency, when all three sciences depend upon the same methods of measurement? Are the supposed constant magnitudes to be measured in chemistry really variable, that their range of uncertainty should be so large? If they are thus variable, is it worth while to expend much labor in determining the values which they happen to possess at any one time under any one set of conditions?

The question as to whether or not the supposed constants of physical chemistry are really not constants, but are variable within small limits, is of profound interest and of vital importance to the science of chemistry and to natural philosophy in general. If this latter alternative is true, the circumstances accompanying each possible variation must be determined with the utmost precision in order to detect the ultimate reason for its existence. As Democritus said long ago, "the word chance is only an expression of human ignorance." No student of natural science who perceives the dominance of law in the physical universe would be willing to believe that such variation in a fundamental number could be purely accidental. Every variation must have a cause, and that cause must be one of profound effect throughout the physical universe. Thus the idea that the supposed constants may possibly be variable instead of invariable, adds to the interest which one may reasonably take in their accurate determination, and enlarges the possible field of investigation instead of contracting it.

Possible variability is by no means the only reason for being interested in the more accurate determination of the physico-chemical contents, however. Many considerations show that whether the constants are changeable or not, more time and care may be profitably spent upon them than has been spent in the past. The argument may be epitomized by referring back to the theorem of Plato, and somewhat extending it. Plato said: when measuring and weighing and mathematics are taken from an art, there is little left of that art. May we not add that the more efficiently weighing and measuring are used in any art, the more valuable that art becomes? If, as Kant has it, a subject becomes truly scientific only when its facts are susceptible of mathematical treatment, then an extrapolation enables us to say that a subject becomes the more scientific the more accurately the mathematical premises are ascertained. Huxley was wont to say that mathematics might be compared to a mill which would grind exceedingly fine all that was placed within it, but was incapable of making wheat flour out of porscods. Interpreting the simile to suit the present case, it may be said that the accuracy of a quantitative conclusion must depend upon the accuracy of the data upon which it is based.

For example: it has long been surmised, because of the undoubted periodic relations of the elements, that the atomic weights have some fundamental numerical connection with each other. Many acute thinkers have attempted to discover such relations, and some regularities have indeed been found. Obviously, however, if the data are sometimes as much in error as a whole per cent., nothing but vague conclusions can be drawn from such numerical speculations; the time spent upon them is little better than wasted. Before the real numerical relations between the atomic weights can be discovered, it is safe to say that the magnitudes of many of them must be known far more exactly than this. Thus for such speculations the precise determination of these physicochemical constants is essential.

But this case is only an example of a series of similar cases. In general, it is not an exaggeration to say that in order to obtain the ultimate understanding of the mysteries with which chemistry is concerned, all the fundamental data must be determined as accurately as possible. From the point of view of the chemical philosopher no pains is too great for determining these data upon which all his really scientific conclusions must rest.

Thus it is clear that exact experimentation, instead of being as some of the earlier philosophers supposed incompatible with imaginative impulse and unworthy of a true thinker, furnishes the only basis upon which the imagination has a right to build. No hypothesis which disregards the results of measurement is worthy of a moment's consideration; but given these results, fancy may exercise itself at will within the limits thus imposed. The restriction is salutary, because speculation basing itself upon reality is much more likely to reach a useful hypothesis than when unrestricted; and there is plenty of room left for fancy. The quantitative results direct, but do not really hamper imagination.

These lectures will discuss the theory and practise of exact physicochemical measurement. It will be shown that much of the uncertainty affecting the present data of physical chemistry is due neither to the variability of the fundamental phenomena themselves nor to the inability of the physical methods of measurement to yield constant results, but rather to the superposition of other inessential phenomena upon the fundamental ones which it is desired to measure. The discovery and elimination of these inessential phenomena, chiefly chemical in their nature, are really the difficult parts of the measurement; it is their successful accomplishment which makes all the difference between success and failure, and offers a task demanding the ablest knowledge and insight, both chemical and physical, theoretical and experimental. Whether perfect constancy will have been reached when all inessential phenomena have been eliminated, no one can certainly say.

But after all, one may ask, is it worth while in a world filled with burning practical problems demanding speedy solution to expend so much valuable time and energy merely in adding another certain decimal place to a collection of rather dry figures for the sake of abstract scientific learning?

When answering such a challenge, in a manner convincing to the practical man, one must recall to mind again the fact that chemistry serves the world in a twofold fashion, partly as an essential factor in our mechanism for directly obtaining and preparing most of the material comforts of modern living, and partly as one of the most intimately searching of the available rays of intellectual light on the philosophy of nature. The usefulness of the science in its former capacity is easily traced, and any one can see that as methods of manufacture are improved and competition increases, the numerical data involved must be more accurately known. Nevertheless, this manner of helping mankind, although the most direct and obvious, is by no means the most effective way in which increased precision in scientific work may be of service. A much greater gain is ultimately made, although indirectly, through the vastly augmented clearness of view which is given to the science as a whole by the increased stability and trustworthiness of the fundamental basis of facts. The resulting growth of either physical or chemical science as a whole not only brings with it increased satisfaction, and respect for man's intellect; it may also at any time lead to wholly unexpected and unforeseen developments of practical usefulness about which man could not otherwise have dreamed. Thus Liebig and Soubeiran, when they found chloroform, little thought of the priceless boon which the new substance would bring with it to suffering humanity. Faraday, in studying the behavior of wires and magnets, never dreamed of the miracles to be wrought by the modern dynamo. Röntgen was striving only to advance scientific knowledge and not to furnish a sure guide to the puzzled surgeon in his crucial task, when the almost incredibly penetrating rays were discovered.

These records of the past lead us to look forward towards the beckoning future. Has the advantage to humanity to be gained by furthering pure science come to an end? No, a hundred times no! Not until man really understands himself and his environment, will the possibility of the discovery of some new blessing be ended. Prophecy is inevitably uncertain; and yet when one realizes that our frail and often jangling human mechanism is actuated essentially by a series of chemical reactions, and that every material thing connected with our life is a chemical substance, one feels that chemistry must still have vast treasures in store for the human race. What may she not accomplish for the comfort of living, for a rational practise of medicine, for a profound philosophy of nature! One can not but believe that as yet her mission is scarcely begun; and if this mission is to be fulfilled, the great result must be wrought not by superficial, but by fundamental understanding, built upon the solid foundation of exact knowledge.

Theodore W. Richards

SCIENTIFIC BOOKS

The Warblers of North America. By Frank M. Chapman, with the cooperation of other ornithologists. With 24 full-page colored plates, illustrating every species, from drawings by Louis Agassiz Fuertes and Bruce Horsfall, and half-tones of nests and eggs. New York, D. Appleton & Company. 1907. Pp. x + 306. Cloth, $3.00.

Few groups of North American birds are of such general interest as the wood warblers, and this attempt to bring together the information concerning them is a welcome addition to ornithological literature. Its title, however, would much better have been "The Wood Warblers of North America," for the true warblers, family Sylviidæ, also represented in North America, are not treated at all.

Following an "Introductory" chapter, in which the plan of the work is outlined and a list of contributors given, comes the first division of the subject, a consideration of "The Wood Warblers" in general. In this division are the eight headings: General Characters, Plumage, Distribution, Migration, Songs, Nesting Habits, Food, and Mortality. Of these the article on "Migration of Warblers," by Professor W. W. Cooke, that on "Food of Warblers," by Mr. Edward H. Forbush, and that on "Mortality among Warblers," are particularly interesting.

The second division, which comprises the major part of the book, is concerned with a detailed treatment of genera, species and subspecies, unfortunately following the inverted order of Mr. Ridgway's recent review of the family, without his excellent reason therefor. This portion includes for each genus its diagnosis and general characteristics; and for each species and subspecies pertinent information condensed into readily accessible form under a number of subheadings. "Distinguishing Characters" consist of the salient differential points of plumage, together with usually the measurements of total length in skin, wing, tail and bill. We are not, however, altogether satisfied that, as Mr. Chapman claims, the total length of a bird can be more accurately ascertained from a dried skin than from a fresh specimen! Descriptions of the various phases of plumage, from nestling to adult, are next given, and these seem to be full enough for most purposes of identification and comparison. "Geographical Distribution," written chiefly by Professor W. W. Cooke, follows, and is in most cases excellent and very complete, being separated under General Distribution, Summer Range, Winter Range, Spring Migration and Fall Migration—an admirable arrangement, although the General Distribution would much more logically have included the winter as well as the summer home. "The Bird and its Haunts" includes various notes on general habits—again much information in a small compass. Other captions, self-explanatory, are "Song," "Nesting Site," "Nest," "Eggs," "Nesting Dates" and "Biographical References" (to literature).

A "Hypothetical List" of two pages enumerates the species that, according to our author, have but a questionable place in the North American list, by reason of doubtful specific validity or unproved occurrence within our limits.

The book is illustrated by 24 colored plates of birds, 4 half-tones of nests and nesting sites and 4 of eggs. The half-tones, as well as the colored figures, with a few exceptions, such as the water-thrushes, ovenbird and cerulean warbler, are good.

Harry C. Oberholser

Étude minéralogique des produits silicatés de l'éruption du Vésuve (Avril, 1906). By A. Lacroix. Paris, Nouvelles Archives du Muséum, (4). Vol. IX. Pp. 1–172, 1907.

In this valuable and important work the foremost petrographer of France brings together many observations made by himself at eruptions of Vesuvius in 1893, 1905 and 1906, with results of great interest both for the study of volcanic eruptions from the physical side and of the petrography of their products.

In the first chapter a general sketch of the Vesuvian eruptions is given, followed by a detailed description of that of 1906. Two main types of eruption (both central) are distinguished: that of 1895, in which the effusion of lava is tranquil and extends over several months and that of 1872, in which it is violent and rapid, and lasts only a few days. The eruptions of the first type are constructive, so far as the cone is concerned, while those of the latter are destructive. A third, subsidiary type, rare at Vesuvius while the usual one at Etna, is that of 1760, characterized by excentric outflows, the other features being intermediate between those of the first two. The eruption of 1906 belongs to the type of 1872, ending a period of moderate activity which had lasted for nearly 32 years.

In the second chapter the new lavas are described petrographically in considerable detail, two chemical analyses being given, which resemble closely earlier ones of lavas of 1631, 1872 and 1903 made by the reviewer. The leucite phenocrysts appear to have formed prior to the effusion, but at moderate depths; while the formation of the microlites of leucite took place during the effusion. The lapilli which covered Ottajano show very decided chemical differences from these, especially in their higher magnesia and lime and lower alkalies.

In Chapter III. are described the fragments of an earlier date brought up by the last eruption, including lavas, tuffs, intrusive rocks and metamorphosed limestones. In Chapter IV. the effects of autopneumatolysis and metamorphism on these fragments at Vesuvius, and in Chapter V. the similar phenomena at the volcanoes of the Auvergne, Santorini and Martinique are discussed. Many interesting details are here given, which are too numerous for review and for which the original monograph must be consulted.

The final Chapter VI. is devoted to a general discussion and description of the eruptive rocks of Somma and Vesuvius, and is to the petrographer the one of greatest interest and value. A large number of diverse types are described, accompanied by numerous, good analyses by Pisani. Lacroix shows that the variation in composition, both mineralogical and chemical, of the Vesuvian lavas is far greater than has hitherto been thought. In the terms of the prevalent classifications the rocks described are leucite-phonolite, leucite-tephrite, trachyte, phonolite, sanidinite, micro-syenite, sommaite (leucite-monzonite) and monzonite, with corresponding chemical differences, the silica, for instance, varying from 47.31 to 58.61 per cent. In terms of the quantitative classification, which, it is of interest to observe, is employed throughout the work in connection with that commonly in use, the subrangs represented are beemerose, procenose (I. 6. 2. 3), miaskose, ciminose, shoshonose, borolanose, braccianose, vesuvose, shonkinose, ottajanose (III. 6. 3. 2), ourose, and an unnamed one (III. 8. 2. 3). It may be noted, however, that, while the mineralogical and chemical complexity of the mass is thus evident, yet that the predominant rocks are leucite-tephrites, belonging to the subrangs borolanose and braccianose of the quantitative classification, the non-leucitic rocks and those belonging to the persalane and salfemane classes being present in comparatively small amounts. From the analytical data presented Lacroix considers that the average magma of Somma-Vesuvius belongs to borolanose (II. 6. 2. 3), the Vesuvian lavas being mostly dopotassic, while the lavas and tuffs of Somma are for the most part sodipotassic. This introduction of the materials of Somma into the calculation explains the divergence from the position of braccianose (II. 7. 2. 2) previously assigned by the reviewer to the Vesuvian magma. In this final chapter is also included a brief discussion of the formation of leucite, the author laying special stress on the physical conditions, while the reviewer has recently (in the *Journal of Geology*) discussed the question chiefly from the chemical side, the results of both being in harmony with each other.

Ten plates of excellent phototypes, illustrating, the microscopic and megascopic modes and textures of the rocks, close the volume, which is a most important contribution to our knowledge of Italian volcanoes, and is an illuminating example of a modern petrographic monograph.

Henry S. Washington

The Royal Society: some account of the "Classified Papers" in the Archives; with an Index of Authors. Compiled by A. H. Church, D.Sc., F.R.S. Oxford; printed for the author. 1907. Pp. 38. Royal 8vo.

Professor A. H. Church, the distinguished chemist, student of colors, water, gems, and critical author, has published a most exhaustive and interesting account of the "Classified Papers" in the archives of the Royal Society of England. These papers are collected in thirty-nine guard-books, which were made up in 1740 or 1741; a few of the papers were printed, but the greater part are in manuscript. Professor Church gives a comprehensive, clear and incisive account of the formation and character of the early history of that learned institution, known for the past two and a half centuries as "The Royal

Society," in a stately octavo, printed from an unusually neat and clear type. While the first charter of the society was granted July 15, 1662, some of these papers are of earlier date and a few even belong to the time of King James I. It appears that there was a committee of trades connected with Philosophical Society or Assembly, out of which the Royal Society was developed, and some of the more practical papers were contributed to this committee. A few of these, written in 1639, appear in Vol. III.; the documents of still earlier date, in Vol. XXV., may have formed part of the gift made, in 1667, by Mr. H. Howard, of the Arundel Library.

It seems that the appellation "Royal Society" was first employed by John Evelyn in his translation of a work by Gabriel Naudé. This translation, which appeared in 1661, is accompanied by a dedication to Edward, Earl of Clarendon; in this Evelyn writes: "God has Enlightn'd your great Mind with a Fervour so much becoming it in the promoting and encouraging of the Royal Society."

These guard-books may be properly called "classified papers," since the contents are generally arranged according to subject; the chronological order has also been observed in most cases. The collection comprises original papers and also letters or memorials communicated either to the society or to its officers or members; to these are added memoirs and reviews relating to the papers and a few broadsides and prospectuses. A large part of these papers have never been printed, and 2,500 have been indexed as to authors' names, of which there are more than 800; a few, however, are anonymous. Each volume of the guard-books now contains a table of contents and the names of the authors as far as they are known; as the articles are grouped under different subjects in most of the guard-books, a subject-index is not absolutely necessary.

It is impossible in this short note to give any adequate idea of the variety and importance of the papers contained in this collection, to the mathematician, physicist, mineralogist, zoologist, geographer, archeologist, in fact to all scientific workers who are interested in the classics of their particular science. One of the most interesting contributions was a sealed paper by the Hon. Robert Boyle on his "Way of makeing the Phosphorus." There are 103 papers by Robert Hook, 66 by Francis Hauksbee, 84 by Denis Papin and 19 by Sir Robert Moray. Among the other noteworthy names we may mention Isaac Borrow, John Hadley, Sir Hans Sloane, Sir Christopher Wren, Sir Isaac Newton, Giordano Bruno, Andreas Celsius, J. C. A. Helvetius, De Maupertuis, G. E. Rumphius, Prince Rupert, Carolus Linnæus, Athanase Kircher, Cotton Mather, D. G. Fahrenheit, etc.

The guard-books reflect great credit on the thoughtful care and foresight of those who for so great a period have maintained the dignity of the Royal Society and have preserved, not only the manuscripts of the author, but in many cases the entire correspondence on the paper.

Herewith the index to the twenty-five guard-books:

Volume.

I. Arithmetick, Algebra, Geometry, Trigonometry.
II. Surveying, Opticks, Perspective, Sculpture, Painting, Musick, Mechanicks.
III. (1) and (2). Mechanicks, Trades.
IV. (1) and (2). Physiology, Meteorology, Pneumaticks.
V. Journals of the Weather.
VI. Staticks, Hydrostaticks, Hydraulicks, Hydrology.
VII. (1) and (2). Architecture, Ship-Building, Geography, Navigation, Voyages, Travels.
VIII. (1) and (2). Astronomy.
IX. (1) and (2). Mineralogy, Magneticks.
X. (1), (2) and (3). Botany and Agriculture.
XI. (1) and (2). Pharmacy and Chymistry.
XII. (1) and (2). Anatomy and Surgery.
XIII. Monsters; Longevity.
XIV. (1) and (2). Physick.
XV. (1) and (2). Zoology.
XVI. Gramar, Chronology, History and Antiquities.
XVII. Miscellaneous Papers.
XVIII. (1) and (2). Experiments of Papin, Hauksbee and Desaguliers.

XIX. Inquiries and Answers.
XX. Dr. Hook's Papers.
XXI. Halley's Papers.
XXII. (1) and (2). Accounts of Books.
XXIII. (1) and (2). Inoculations.
XXIV. Papers by Collins, Oldenburg and Hook.
XXV. Political: Trade.

GEORGE F. KUNZ

SCIENTIFIC JOURNALS AND ARTICLES

THE July number (volume 8, No. 3) of the *Transactions of the American Mathematical Society* contains the following papers:

J. W. YOUNG: "General theory of approximation by functions involving a given number of arbitrary parameters."

E. R. HEDRICK: "On derivatives over assemblages."

BEPPO LEVI: "Geometrie proiettive di congruenza e geometrie proiettive finite."

OSWALD VEBLEN: "Collineations in a finite projective geometry."

R. L. MOORE: "Geometry in which the sum of the angles of every triangle is two right angles."

O. VEBLEN and J. H. MACLAGAN-WEDDERBURN: "Non-desarguesian and non-pascalian geometries."

L. E. DICKSON: "Modular theory of group-matrices."

OSKAR BOLZA: "Existence proof for a field of extremals tangent to a given curve."

G. A. BLISS: "A new form of the simplest problem of the calculus of variations."

A. E. YOUNG: "On certain isothermic surfaces."

The Library Journal for July contains an article on "The Library and the Museum," by Henry L. Ward, in which he takes the ground that a union of the two is impracticable, that the two differ radically in their methods and administration and that all attempts to unite them have been failures so far as the museum part is concerned.

Bird-Lore for July-August contains articles on "A Southern California Aviary," by H. L. Sefton; "A Report on the Nesting Birds in the Vicinity of Riverview Park, Allegheny, Pa., for 1906," by W. G. Pitcairn, comprising 95 nests of 20 species, 43 nests turning out successfully in spite of the small boy. F. H. Herrick contributes the first half of a paper on "Bird Protection in Italy as it impresses the Italian"; apparently it does not on the whole impress him favorably, for he considers that all birds should be killed and eaten, an idea he tries to carry into practise here. W. W. Cooke contributes the fourth paper on "The Migration of Thrushes" which consists mainly of a fine colored plate. There are "Notes on the Starling," predicting that the importation of this bird will be as greatly deplored as that of the English sparrow. There are important articles on the failure of New Jersey to pass a bill prohibiting spring shooting and on the failure of the bill to permit the sale of certain species of foreign game in New York. William Dutcher makes a strong plea for the preservation of the wood duck, showing that unless radical steps are soon taken the bird will be exterminated.

SOCIETIES AND ACADEMIES

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE North Carolina Academy of Science held its sixth annual meeting at Chapel Hill, N. C., May 17 and 18, 1907.

The academy was called to order by its president, Collier Cobb, and an address of welcome was extended to the academy by President Francis P. Venable of the university. A response to the address was made by the retiring president, John F. Lanneau, of the Academy of Science.

In the evening the academy met in Gerrard hall, and the presidential address "The Garden, Field and Forest of the Nation" was delivered. Following this address a reception was extended to the visiting members in the Y. M. C. A. building. Saturday, May 18, at 9 A.M. the academy convened for a business meeting. Twenty-one new members were elected. The following officers were elected for the ensuing year:

President—T. Gilbert Pearson, of Greensboro, N. C.

Vice-president—W. C. Coker, of Chapel Hill.

Secretary—E. W. Gudger, of Greensboro.

Members of the Executive Committee—Franklin Sherman, Jr., of Raleigh; J. J. Wolfe, of Durham, and John F. Lanneau, of Wake Forest.

The report of the treasurer showed a balance of $122.53.

The following papers were presented:

The Sparsity of the Stars, the Measureless Remoteness of each Star from All Others: John F. Lanneau, Wake Forest College. The paper will appear in full in *Popular Astronomy.*

The Foundations of Geometry: Archibald Henderson, of the University of North Carolina, published in the *Journal of the Elisha Mitchel Society,* 1907.

Some New Sources of Light: C. W. Edwards, Trinity College. Read by title.

Some Interesting Grasshoppers (and their Relatives) of North Carolina: Franklin Sherman, Jr., state entomologist.

He mentions the following species: *Labidura Riparia, Cryptocercus punctulatus, Stagomantis carolina, Diapheromera femorata, Eritettix navicula, Trimerotropis saxitalis, Leptysma marginicollis, Melanoplus punctulatus, Dissoteiria carolina, Gryllotalpa borealis, Myrmecophila pergandei, Tridactylus* sp.

Osteogenesis Imperfecta (with a report of a case): Lewis M. Gaines, of Wake Forest College. Read by title.

Notes on the Cultivation of Algæ for Class Use: F. L. Stevens, of the N. C. College of Agriculture and Mechanic Arts.

Suggestions were given for the isolation and cultivation of algæ upon solid medium, consisting of .75 per cent. agar made up with Knopf's solution. This medium solidifying at lower than 34° can be safely used in plating out algæ. Cultures of several forms were exhibited.

Fusion of Sponge Larvæ with Formation of Composite Sponges: H. V. Wilson, of the University of North Carolina.

The ciliated larvæ of silicious sponges (*Stylotella*) may be made to fuse, thus giving rise to composite sponges. To accomplish this result it is only necessary to bring the larvæ in close contact at the time when the ciliary action is no longer locomotory and fixation is about to occur. The composite masses representing (in the actual experiments) from two to six larvæ complete the metamorphosis.

Wind-polished pebbles, and Palæolithic Man: Collier Cobb, of the University of North Carolina.

The close similarity between wind polished pebbles and work of man was indicated, and the errors which might result were pointed out.

Notes on Zoology of Lake Ellis: C. S. Brimley, Raleigh, N. C.

The paper discusses the occurrence of various insects and reptiles taken by the writer and others in the vicinity of Lake Ellis, Craven County, N. C., during June, 1905, and May, 1906. The rare salamander, *Stereochilus marginatus,* which had not been taken for many years was found to be common, and several specimens of the frog, *Rana virgalipes,* were taken. Nine alligators were secured on the two trips by the author's companion, and several rare snakes. Five species of dragonfly new to North Carolina were secured, and (in June, 1905) numerous specimens of the yellow fly (*Diachlorus ferrugatus*). Notes on other members of the Tabanidæ are also given.

Single Phase Railway Work: F. E. Latta, of the University of North Carolina.

The Relation of the Cattle-tick to Southern Agriculture: Dr. Tait Butler, State Veterinarian, Raleigh, N. C.

The Design of High Masonry Dams: William Cain, of the University of North Carolina.

Three Little-known Species of North Carolina Fungi: J. G. Hall, of the N. C. Experiment Station.

These are of some interest because one is a new species and another has not been reported in print in the United States.

The first is *Martensella pectinata,* Coem, a hyphomycete described in 1863 and is characterized by procumbent sterile hyphæ and erect fertile hyphæ. The fertile hyphæ bear short, lateral branches which become the sporophores.

The sporophores are naviculate and bear the fusiform-cylindric hyaline spores upon basidia all over their face. The face is turned outward from the main hyphæ.

The second species is one of the genus *Epicoccum* also a hyphomycete and was interesting because it showed different colors of mycelium when grown upon different media.

The last species is one of the Pyrenomycetes and belongs to the genus *Podospora.* Its chief interest lies in the fact that the spores are joined in pairs by a non-septate hypha, thus coming very near podospora zygospora.

A New Form of Achlya: W. C. Coker, of the University of North Carolina.

During the fall of 1906 an *Achlya* was found at Chapel Hill, N. C., which agrees with *Achlya racemosa* var. *stelligera* Cornu in many respects, but different from it in having the antheridium cut off immediately below the oogonium, and the fertilizing tube arising from the division wall and entering the oogonium from below, as in *Saprolegnia hypogyna* Pringsheim. Such an origin for the fertilizing tube is new for the genus *Achlya,* and is not known elsewhere except in *Saprolegnia hypogyna.*

Notes upon the Preparation of the Silicate Medium for the Cultivation of Bacteria: J. C. Temple, N. C. Agricultural Experiment Station.

Directions were given for the preparation of this medium obviating the necessity of dialyzing, and making it possible to prepare this medium with greater certainty and greater accuracy. The use of the medium prepared in this way for the culture of various organisms was illustrated by colonies of various bacteria growing in a thriving condition upon the medium.

Breeding Colonies of Birds (illustrated with eggs and stereopticon views): T. Gilbert Pearson, of Greensboro.

The Efficiency of Soil Inoculation in the Production of Root Tubercles: F. L. Stevens, of the N. C. Agricultural Experiment Station.

Data were given concerning the inoculation of soils with liquid cultures obtained from the Department of Agriculture, Washington, D. C. From many tests conducted in various ways there was no evidence whatever that inoculation with these cultures was efficient in the production of tubercles upon legumes. The cultures employed were issued in liquid condition in hermetically sealed test-tubes, and were obtained directly from the Bureau of Plant Industry, Washington, D. C.

The Opportunities for Study and Research at the Beaufort Laboratory: H. V. Wilson, of the N. C. University.

Does Blood Tell? Heredity according to the Experience of the Children's Home Society: Wm. B. Streeter, of Greensboro, N. C.

Probably the most difficult proposition one engaged in child saving has to contend with is the firmly grounded belief in the principle of heredity; that as father, so son; as mother, so daughter. Almost adamantine is the conviction that 'blood will tell' but will it? If the question refers merely to mental and physical qualities, those things which depend upon physiological causes, undoubtedly the answer will be 'yes.' If it refers to moral tendencies, my experience covering a period of twenty years with children born under unfavorable conditions, leads me to answer the question in the negative. As children of my experience were recovered from the custody of vicious parents at an early age, and reared in the atmosphere of moral uprightness, have almost invariably reached their majority in the state of voluntary social purity, I conclude that it is the heredity of environment, rather than the heredity of blood, that determines moral character.

Geology of the Cape Fear River: Joseph E. Pogue, of the University of North Carolina.

The Relation of Sporangium of Lygodium to the Evolution of the Polypodiaceæ: Raymond Binford, of Guilford College. To be published in the *Botanical Gazette.*

The Condensation of Aliphatic Aldehydes with Aromatic Amines: Alvin S. Wheeler, of the University of North Carolina.

The following reaction takes place without any dehydrating agent: $RCHO + 2RNH_2 = RCH(RNH)_2 + H_2O$. In some cases at low temperatures the addition product is obtained. Condensation products of Chloral with the three nitranilines, p-bromaniline, o-toluidine, anthranilic acid, and o-anisidine were prepared. By-products, as yet unidentified, were obtained with o-toluidine and with anthranilic acid. The condensation products are readily broken down by hydrochloric acid and by acetic anhydride. When suspended or dissolved in the glacial acetic acid they react with extreme smoothness with bromine, forming beautifully crystalline compounds which are much more stable than the condensation products.

Chapel Hill Ferns: W. C. Coker, of the University of North Carolina.

A collection of the living ferns and fern allies native to Chapel Hill, N. C., was made and exhibited in pots. Twenty species were represented, including all the known Pteridophytes of the neighborhood, except *Botrychium ternatum* and its variety, *dissectum,* which had not yet appeared above ground.

Notes on Turtles of Genus Pseudemys: C. S. Brimley, of Raleigh, N. C.

This paper discusses the character of the turtles of this genus and shows that the distinctive characters attributed to *P. hieroglyphica, P. Labyrinthica, P. mobilensis* and *P. Concinna* all fall within the limits of individual variation of the last named form. These conclusions are drawn from an examination of all specimens of the genus that have passed through the author's hands for the last five or six years.

Electricity in Heavy Traction (illustrated by lantern slides): J. E. Latta, of the University of North Carolina.

The Design of High Masonry Dams: William Cain.

The claim is made that in addition to the three universally imposed conditions, no tension, safe unit pressures and no possible sliding at any horizontal joint, a fourth condition must be imposed, *viz.,* that the factors of safety against overturning and sliding shall increase gradually from the base upward, to allow for the proportionately greater influence, on the upper joints of the wind and wave action, floating ice or other bodies, and especially of the great forces caused by the expansion of thick ice under an increase of temperature, and by earthquakes.

It was found that this could easily be done by taking the well-known theoretical triangular type of cross-section of dam and making some additions at the top sufficient for a roadway.

A preliminary design is given for a dam 258 feet high, with factors of safety and unit pressures marked on the drawing, satisfying all four conditions, the area of cross-section and height being the same as for the celebrated Quaker Bridge design. A comparison was instituted unfavorable to the latter, in that its factors of safety are too small, particularly in the upper portions, where by the proposed fourth condition they should be largest.

This criticism owes its significance to the fact that the new Croton Dam, of New York, 224 feet high to water surface and finished February 1, 1906, at a cost of over $7,500,000 has a profile for 224 feet in depth, exactly the same as the quaker bridge design for the same depth.

The Optical Rotation of Volatile Oil: C. H. Herty and G. A. Johnson, of the University of North Carolina.

Children's Home Society Methods: Wm. B. Streeter, of Greensboro.

Gametophytes of Botrychium Virginianum: Raymond Binford, of the University of North Carolina.

They were found in moist oak woods under the leaves. Some were almost on the surface of the soil, while others were imbedded one to two inches in the soil. They seem to have gotten down by means of worm holes or cracks made by roots of trees. Sizes ranging from 2 mm. to 10 mm. were shown. Specimens of these plants were exhibited before the academy.

F. L. Stevens,
Secretary

DISCUSSION AND CORRESPONDENCE

SEEING THE LIGHTNING STRIKE

On July 14, 1907, at about 5:30 p.m., for the first time in my life, I saw the lightning strike. I was at a window in the university building, looking westward toward a valley, at the center of which, about a quarter of a mile away, there was a field with a few isolated trees. A thunderstorm coming up slowly from the southwest gave me hopes of seeing the lightning strike. I saw it strike one of these trees. The flash appeared to me as a superb column or shaft of light, about four or five hundred feet high, and about eight or twelve inches in diameter, perfectly straight, vertical and steady. The shaft was white, the base, however, was distinctly red, like the fire of a conflagration, and tinged probably with a little orange. This column of light seemed to stand between the two diverging stems of the tree. It lasted for about two seconds. The thunder was loud, but not the loudest I have ever heard. A light rain was falling at the time.

The effects of the flash seemed to be none whatever. The tree was not shattered and was not set on fire. Some cows grazing about a hundred feet away paid no attention to the discharge, except one which walked toward the tree, as if interested in something there, and then turned around and continued to graze.

The next morning I examined the spot closely. The tree was a cottonwood and stood in moist ground. It consisted of two trunks, about eight and twelve inches in diameter, diverging from a common base towards the north and south. The southern or smaller one had the bark stripped off its western side, in the shape of a broad ribbon, about two yards long and six inches wide. The east side showed two furrows starting from above the same branch, about ten feet above the ground, and running downward in irregular paths. These furrows seemed to have been plowed by a piece of steel and the bark torn off by violence, because there was no sign of scorching or any change of natural color. There was absolutely no other noticeable effect. I was told that a horse standing near the tree had been thrown over a fence, badly stunned but not otherwise injured.

William F. Rigge

Creighton University

SPECIAL ARTICLES

THE METHOD OF TRIAL AND THE TROPISM HYPOTHESIS

In his recent book entitled "Behavior of the Lower Organisms" Professor Jennings has drawn attention to the existence of an issue between two attitudes assumed by investigators in attempts to interpret the behavior of organisms. His own position[1] is made sufficiently clear. He is frankly hostile to what he conceives to be the essentials of the tropism hypothesis, and is equally devoted to what he has called the "method of trial" as a means of explaining facts for whose interpretation he believes the tropism hypothesis to be entirely inadequate.

My reason for venturing upon the present discussion of the issue thus emphasized lies in the fact that, while I have been much impressed by the admirable plea which Professor Jennings has made for the method of trial, I do not quite see the force of his main contentions, as applied either to the destruction of the tropism hypothesis or to the support of its successor.

The value of any hypothesis may be estimated according as it does or does not (1) accord with the facts, (2) simplify the problem to be solved, (3) suggest a new line of advance. These tests may be applied to the hypotheses that at present concern us. The views of Professor Jennings will be considered first.

Professor Jennings attempts to account for the phenomena of organic behavior on the basis of two principles. According to one, "behavior is based fundamentally on the selection of varied movements." According to the other, "the resolution of one physiological state into another becomes readier and more rapid through repetition." These are the "primary facts for the development of behavior." Given organisms that react to changes in their environment, given a variety of responses to the same conditions, and the material is provided for the development of all types and grades of organic behavior in accordance with the two principles just stated.

This is obviously a strict application to the phenomena of behavior of that variant of the Darwinian doctrine known by the name of organic selection. It is a view that lends itself with especial facility to the interpretation of physiological evolution. It distinguishes between adaptations that are relatively unstable, resulting from the capacity of given individuals to accommodate themselves to changing conditions, and adaptations that are relatively stable, such as the inherited adaptations characteristic of races. Its chief contribution to the present discussion lies in the recognition that acquired characters, such as habits, cultivated aptitudes, advantages obtained over competitors by larger experience, may be approved by natural selection, even though heredity decline to place them on a permanent footing. Fortunate individual adaptations of the unstable variety come then to play important rôles in the preservation of the species, and in one sense actually determine the course of its evolution. Such, at least, is the claim of the organic selectionists with whom Jenings allies himself, and I have no wish to deny the hypothesis.

How the organism comes into accord with its environment to the extent that it is able to persist is determined, according to Jennings, primarily by application of the method of trial. The individual itself selects those reactions which are favorable for its existence from a number of random or trial reactions. Let us consider a typical case. Whenever the protozoon *Paramecium*, swimming along its narrowly spiral path by means of the vibratile hair-like cilia that clothe its body, chances to come in contact with an impediment, whether it be in the shape of a sand grain, a droplet of some chemical solution or a sudden change in temperature, the beat of its cilia may be reversed and it may back off for a distance varying with the strength of the stimulation. Another reversal of the cilia then sends it forward again, but not quite in the direction it had previously taken. Owing to the peculiar beating of its cilia, its progress is along a spiral path, with the primitive gullet (hence a structurally defined side) always towards the axis of the spiral. On resuming a forward movement, the creature swerves toward the side away from the mouth. This has been described as an avoiding reaction, since it provides a method of passing obstacles. The method is said to be a method of trial. *Paramecium* backs and fills until it chances to hit upon an unobstructed pathway. No cause of a reversing reaction being offered, it keeps on its way. Its final appropriate reaction is said to be selected from a number of inappropriate trials or errors.

How far the facts obtained from an analysis of the behavior of *Paramecium* are applicable to the analysis of behavior in general may best be considered after an examination of Jennings's scheme according to which behavior develops, that is, becomes more effective:

The behavior of any organism may become more effective through an increased tendency for the first weak effects of injurious or beneficial agents to cause the appropriate reaction; in other words, through increased delicacy of perception and discrimination on the part of the organism. Such a change would be brought about through the law of the readier resolution of physiological states after repetition. When the organism is subjected to a slight stimulus, this changes its physiological state, though perhaps not sufficiently to cause a reaction. Such a slight stimulus would be produced by a very weak solution of a chemical, or by a slight increase in temperature. Now, suppose that this weak stimulus, causing no reaction, is regularly followed by a stronger one, as would be the case if the weak chemical or slight warmth were the outer boundary of a strong chemical solution, or of a region of high temperature toward which the organism is moving. This stronger stimulus would produce an intense physiological state, corresponding to a marked negative reaction. That is, the first (weak) physiological state is regularly resolved by the action of the stimulating agent into the second (intense) one, inducing reaction. In time, the first state would come to resolve itself into the second one even before the intense stimulus had come into action. As a result, the organism would react now to the weak stimulus, as it had before reacted to the strong one. It would thus be prevented from entering the region of the chemical or the heat, even before any injury had arisen.

2. In the same way the organism may come to react positively or negatively to a stimulus that is

in itself not beneficial nor injurious, but which serves as a sign of a beneficial or injurious agent, because it regularly precedes such an agent.

This proposition is illustrated by the approach of an enemy which casts first a faint, later a deeper shadow. The organism comes to react to the faint stimulus.

3. Progress takes place through increase in the complexity and permanence of physiological states, and in the tendency to react to these derived and complex states instead of to the primitive and simple ones. . . .

4. Progress in behavior may take place through increased variety and precision of the movements brought about by stimulation.

New movements, even new organs, such as flagella, might be acquired by the selection of overproduced movements and of overdeveloped structures whose movements become advantageous.

Thus through development in accordance with the two principles mentioned, the organism comes to react no longer by trial, by the overproduction of movements—but by a single fixed response, appropriate to the occasion. . . . Such fixed responses are the general rule in the behavior of higher organisms, and are found to a certain extent in all organisms. In the higher organisms we speak of some of these fixed responses as reflexes, tropisms, habits, instincts.

This is, in brief, the general course of the development of the behavior of single individuals.

Recognizing the dangers in attempting to state adequately the position of an author in this fragmentary fashion, I feel confident I do him no injustice (1) in calling attention to his assertion that fixed responses, such as reflexes, tropisms, habits, instincts, are developed through selection from overproduced random movements by means of the method of trial ; (2) in noting that the substances suggested as agents of stimulation all initiate reactions of the tactual type. Reaction takes place on contact, the essential stimulus being the abrupt change produced by the contact and depending qualitatively not at all on the character of the object touched.

No one, I am sure, would doubt that the behavior of an organism rests somewhere on a basis of physiological change. Such changes, however, may be of various kinds, involving various groups of factors and giving rise to various types of reaction. That definitely directive reactions are reducible to the motor reaction type, as seen in its essential features in *Paramecium*, is a conclusion that does not appear to follow from the present accessible facts of behavior. Though the selection of overproduced movements by trial may account for certain types of behavior, I do not see how it accounts also for definitely directive or tropic reactions. It is not clear that the latter belong in the category of secondary, rather than primary reactions, notwithstanding Professor Jennings's vigorous endeavors to put them there. My difficulties are soon stated.

Any one who has stimulated excised muscle from a freshly killed animal by means of a galvanic current, is aware that its behavior at the moment the current is made or broken is quite different from its behavior during the continuous passage of the current. It is well known that this difference is to be referred first of all to the fact that the make and break responses are caused by sudden changes in electrical potential, which changes do not accompany the passage of the constant current. Further, the reactions of many organisms without muscles to galvanic stimulation exhibit parallel differences. Indeed, it has been determined that the behavior, under galvanic stimulation, of such an organism as *Paramecium,* accords in many essential details with the laws and theories originally formulated with reference to the reactions of the muscles of vertebrates. The passage of the constant current through a muscle may produce a tonic contraction at the kathode, not, however, at the anode. In *Paramecium,* a similar condition expresses itself in the behavior of the cilia. *Paramecium* can be made to turn with the utmost definiteness and directness until its anterior end is toward the kathode. When finally oriented, it is still clearly affected by the stimulus. For the behavior of the cilia at opposite ends of the body, normally uniform, is in this case different.

In this brief résumé of some phenomena

connected with galvanic stimulation, the following facts should be noted: (1) that the phenomena of galvanic stimulation present certain important correspondences with respect both to vertebrate muscle and free-swimming unicellular organisms; (2) that galvanic stimulation is of two kinds and produces two different effects, the constant current producing a definitely directive orientation effect (galvanotropism); (3) that the stimulating effect of the constant current does not cease with the establishment of the permanent orientation. A further fact should be added, namely, that galvanic stimulation is practically unknown in nature.

These facts would appear to lend support to the tropism hypothesis. Professor Jennings, however, believes that the very uniqueness of the electric stimulus in producing its peculiar local effects upon the organism, and its practical absence from nature, vitiate its claims to consideration in any attempt to formulate a universal explanation of the behavior of organisms.

It is not easy to see how, on such grounds, the interesting phenomena of galvanic stimulation are to be so lightly put aside. That a stimulus is unique in any respect is hardly ground for neglecting it. And that it does not occur in nature is for the candid analyst one of its most valuable assets. He thereby gets rid of the selection hypothesis and the mass of unestablished inferences which it has gathered to itself. He is free to examine types of animal behavior which never could have been produced by selection. He comes so much the nearer the fundamental responses of organized matter to at least one stimulus. And he finds, instead of the varied, haphazard reactions which are the only primary reactions for Jennings, two sorts of reactions, one of which is as definitely directive as any class of reactions in the organic world.

If organisms, without the aid of selection, respond definitely and directively to one sort of stimulation, whether in or out of nature, does that not at least raise a suspicion that definite directive reactions, wherever they occur, may also be interpreted without such aid? With such a suspicion in mind, we may examine some of the evidence from nature which has been counted for the trial and error schema.

From galvanic stimuli, then, we may turn to a consideration of the reactions of organisms to light.

In this field numerous investigators have been accustomed to distinguish between two types of reactions which parallel the two types of responses to galvanic stimulation. The first type depends upon rapid changes in the intensity of light and has been called Unterschiedsempfindlichkeit by Professor Loeb. Many years ago, he distinguished this type of reaction from the second or tropic reaction, finding it well exemplified among certain annelid worms that dwell in tubes from which the anterior ends of their bodies project. When the intensity of the light falling upon one of these projecting ends is rapidly diminished beyond a certain degree, the worm suddenly responds by contracting its longitudinal muscles and withdrawing into its tube. It is a significant fact that a corresponding increase in the intensity of the light falling upon an extended worm does not cause a contraction. Similarly, the unicellular *Stentor* passes from a brightly illuminated field into shadow without reaction, but reacts when it reaches the edge of the shadow in passing in the reverse direction.

Whether this difference in the response is directly comparable with certain observed differences in the effects produced by making and breaking the galvanic current we are not yet in a position to determine. That there is an obvious resemblance, however, between the reactions produced in organisms by a constant current and by continuous exposure to light can not be denied. Numerous animals orient themselves with the utmost definiteness and directness so that they may move toward or away from the source of light. Two cases may be examined, both of which Jennings places in the category of trial and error responses.

1. *Euglena* is a chlorophyll-bearing protist, with an asymmetrical body, a long flagellum arising from one end and a spot of pigment

near the base of the flagellum, which appears to be particularly sensitive to light. Like *Paramecium, Euglena* swims in spirals, and possesses a similar avoiding reaction, which follows not only upon stimulation by chemical and mechanical agents, but upon sudden changes in the intensity of light as well. Depending on the strength of the stimulation, the response may be a reduction of the speed of locomotion, a total stoppage, or, rarely, a reversal. Then there is a swerve toward a certain structurally defined side of the organism so that the spiral in which it swims becomes wider than before. It thus comes into a number of new positions with reference to the source of the stimulus. These, according to Jennings, are trial positions or orientations, and which one of them may be selected for the forward movement will depend upon the degree to which it lessens the stimulation which is inducing the trial movements. Continuous selections, based upon a continuous series of new trials, bring the organism finally into such an orientation that it proceeds toward the light around an axis of progression that passes through the latter.

The second case need but be mentioned. The rotifer *Anuræa* is a very small but very different organism from *Euglena*. Nevertheless, it moves also upon a spiral path and its reactions in the presence of light differ in no essential respect from the reactions of *Euglena,* except that the animals experimented upon by Jennings moved away from rather than toward the light. With this difference in mind, the same figure will serve admirably for both organisms (Jennings, Fig. 93, p. 137).

My analysis of their responses, based upon the figure which Jennings himself has drawn, with text description, leads to quite a different conclusion from his. The figure indicates that *Euglena* is both unterschiedsempfindlich and heliotropic. At *a,* the reversal in the direction of the light which has been coming from the direction in which the creature has been swimming produces a sudden change in intensity of stimulation, a shock which results in the swerving from the previous course as indicated between *a* and *c*. The organism recovers rapidly, only to be subjected to the constant stimulus of a steady light from one direction to the end of the experiment. The result of the action of the constant stimulus is a path, from *c* to 5, so perfectly in harmony with the tropic schema, that, in spite of Jennings's descriptions and elucidations, I can only wonder at his running so boldly and so far into the enemy's camp. It is hard for me to conceive how an organism swimming of necessity in a spiral course could react more definitely to a moderate directive stimulus than does *Euglena* here.

It will be noticed that orientation by the method of trial depends, according to Jennings, upon the selection of trial orientations that subject the organism to less and less effective stimulation; that when the final orientation is adopted, the organism is in an *unstimulated condition* with reference to the stimulus which had been acting up to this point. This is clearly the application in the field of light stimulation of the facts obtained by the observation of the reactions of such an organism as *Paramecium* to contacts. It is assumed (1) that the locomotion of *Paramecium* is a necessary result of its peculiar metabolism, and (2) that in the absence of perturbing influences in the environment, it may swim along a spiral course with a straight axis. These assumptions may be granted without, however, admitting thereby the converse, namely, that when the axis of progression is a straight line *Paramecium* is necessarily free from the influence of external stimuli. It does not appear self-evident that as soon as *Euglena* becomes oriented so that its axis of progression passes straight toward the source of light it ceases to be stimulated, to be again stimulated only when it chances to swerve out of that course.

For Jennings there is nothing comparable to symmetrical stimulation in the field of organic behavior. There is likewise nothing comparable to a constant stimulus that does not induce a differential movement. This is as much as to say that an object which is subjected to equal degrees of pressure from diametrically opposite directions is not being affected thereby until perchance the pressure on one side becomes less than the pressure on the other. Or, to draw a parallel from the field of organic behavior itself, it has been determined by many investigators that when, instead of a single source of light, two sources of equal intensity, such as two incandescent lights, are placed symmetrically before phototropic organisms, the latter may move toward or away from them along the perpendicular, passing through a point midway between them. When one light is cut out, the organisms may change their direction at once, moving toward or away from the remaining light. According to Jennings, they are not in a condition of stimulation while moving toward or away from the two lights, but only during the period between the removal of one light and their orientation to the light remaining. Jennings denies emphatically the possibility of symmetrical stimulation in such a case.

Now it has been shown already that the constant galvanic current does produce observable constant effects in organisms which are moving directly toward one pole. It is also well known that certain organisms (*e. g.*, newly hatched barnacle larvæ) after exposure to light for a time, during which they may move toward the light, may change the sense of their response, moving in the opposite direction. There is no doubt that we are dealing here with a physiological effect produced by a constant stimulus that occurs commonly in nature, and that this effect conditions a definitely directive response. Yet, though this sort of behavior is cited in another connection by Jennings, its significance in the present connection is not considered.

But let us consider briefly one other class of facts which receive no consideration in Jennings's book. It is well known that certain phototropic crustacea and insects, when robbed of the use of one eye by a coat of opaque varnish, perform what have been called circus movements. They move in circles in the presence of light, toward or away from the functioning eye according as they are negatively or positively phototropic. These movements are just what would be expected from a phototropic animal that can receive light stimulation only through its eyes, when one eye is kept constantly in the shade. They are in entire accord with the tropic schema. Now it happens that hemisection of the brain causes the phototropic reaction to disappear in certain Amphipods on which the operation has been performed, although unilateral injury of the brain does not interfere with the phototropic response. That these facts are to be explained on the assumption of a reflex of some sort between eyes and locomotor mechanism, and that one eye is connected with that part of the mechanism which operates one side of the body, while the other eye is similarly associated with the mechanism for the other side of the body, seems clear. The reactions of the leg muscles of *Ranatra*, when that animal is subjected to light stimulation alternately on the two sides of the body, change with the utmost definiteness, according to the position of the light with respect to the eyes. The response is unquestionably reflex and singularly definite and local.

To consider just one more case that will bring out still more clearly the difference between Jennings's conception of a stimulus and my own. When the semicircular canals on one side of the head of an animal are removed or injured, or the nerve supplying them is cut, the normal response to gravity will be disturbed. In man, sensations of unbalance would result, general sensations or feelings, such as discomfort, even distress. These are obviously psychical facts. So far as the injured man is concerned, reflex responses to gravity by way of the semicircular canals have never been noted. He has never suspected any mechanism in his body devoted to the task of keeping him physically upright. Accordingly, in the absence of the feeling of discomfort resulting from operation or injury, he may be said to be in a non-stimulated condition, *but only so far as the facts of consciousness are concerned.* Some such case is what Jennings appears to have in mind when he insists that a stimulus depends essentially on a change in condition. When an organism moves in a straight line toward or away from a point midway between two lights of equal intensity that are equidistant from the organism itself, it does so, he believes, because in such an orientation it is subjected to no general stimulation, which is no more than saying it then possesses no feeling of discomfort. In the face of the facts which have been presented to show that light induces definite reactions of definite muscles, just as definite as the complex but unconscious reactions of a decapitated frog to, let us say, acetic acid applied to the skin of its back, he insists upon an interpretation of organic behavior by means of general changes in internal states that are psychical rather than physiological. Here, as it seems to me, he has abandoned one attempt at explanation for an alleged explanation which itself assumes the facts most in need of elucidation.

It will not be necessary to delay further by examining the phenomena of geotropism. Organisms respond to the stimulus of gravity by reactions essentially similar to those which characterize their reactions to light. No new elements are introduced. It may be well, however, to summarize the discussion up to this point before entering upon a somewhat different line of criticism.

Jennings has applied to the facts of behavior a general explanation in the form of two principles. According to these principles, no definitely directive or fixed reactions, such as reflexes, tropisms, habits and instincts are primary, but result from the selection from random movements of such as are advantageous to the organism, and the gradual development of these advantageous reactions in the individual by the law of the readier resolution of physiological states, in the race by the operation of organic selection. The primary type of reaction is non-directive, and is illustrated by some such response as the motor reaction of *Paramecium*. The necessary condition of stimulation is an abrupt change in the environment, which leads to a general reaction of the whole organism. What the adherents of the tropism theory call a condition of symmetrical stimulation is, therefore, in reality a condition of no stimulation at all. The existence of constantly acting directive stimuli after orientation is explicitly denied.

In our examination of this general view and the propositions on which it is based, we have arrived at the following preliminary conclusions:

I. That the essential facts of galvanic stimulation are identical in widely different organisms, which suggests their fundamental character; that there exist among the phenomena of galvanic stimulation two types of reaction, (1) non-directive, dependent on sudden changes of current potential, and (2) directive, dependent upon the action of a constant current which, it was shown, produces, after orientation an observable effect on locomotion; further, that the very fact of the pronounced absence of galvanic stimuli in nature greatly increases the value of galvanic stimulation as an aid to analysis.

II. That organisms exhibit toward light (gravity as well) two types of reaction comparable with those typical of galvanic stimulation; that certain responses, in *Euglena* and *Anuræa,* which are readily analyzed on the basis of these two kinds of stimulation, afford no support for the trial and error schema; that in heliotropism as well as in galvanotropism, the oriented organism is in a condition of physiological stimulation, and that the response to stimulation is local; finally, that the interpretation of the behavior of heliotropic organisms on the basis of general changes concerning the whole organism, not only does not accord with the known facts, but is rather psychical than physiological in character.

If these conclusions be sound, it follows that the method of trial, however useful it may be in the interpretation of certain classes of facts relative to the behavior of organisms, lends no aid toward the analysis of certain other classes of facts in the same field; that it not only does not simplify the general problem which these facts present; but that it actually tends to divert inquiry from a line of investigation which has been shown by recent achievements to be not only promising but fertile.

To these conclusions I believe we may justly add another that has not yet been formulated in the discussion.

If all definite directive responses to stimuli have been produced by the selection of responses "that favor the normal life processes" as Jennings appears to believe, then such directive responses must be adaptive, must be of distinct advantage to the organism possessing them in the struggle for existence. There are, however, among certain organisms and in connection with certain classes of stimuli definite reactions which do not appear to serve the organism in any way.

In the first place, the phenomena of galvanotropism are obviously not in any way related to a possible adaptive value. In the second place, Professor Loeb mentioned long ago the caterpillar of the willow borer, and *Diastylis* (*Cuma*) *rathkii*, as two animals that live away from the light, the one buried in the wood of trees, the other in the mud of bays and lagoons, that yet react positively when exposed to light. Such instances are brushed aside as insignificant by Jennings, because few have been recorded. I feel confident, however, that instances of this sort will multiply. And far from being insignificant, it is most fortunate for the analysis of behavior that, in a world where the struggle for existence is so intense, even a few organisms have been found whose behavior has remained unaffected by it.

I do not think it is necessary to go farther into the facts to make it clear that the hypothesis advanced by Jennings is not sufficiently broad to encompass all the phenomena it is devised to explain. As a method of analysis, it is essentially historical. It seeks to derive all forms of organic behavior from a simple type or unit assumed to be fundamental. We have seen, however, that the assumed fundamental unit is really not fundamental physiologically, since it is based squarely upon a psychological conception. The method, therefore, prescribes the interpretation of purely physiological phenomena, such as reflexes and tropisms, in terms of psychology. From the standpoint of effective analysis, this is surely putting the cart before the horse. The trial and error program looks very much like a modern recrudescence of the attitude toward the problems of behavior that could tolerate the interpretation of the behavior of a moth toward a flame as an exhibition of curiosity.

We may now examine somewhat more closely than has been possible so far, another interpretation, known by the name of "tropism hypothesis," which has been applied to certain aspects of the behavior of organisms and has been sharply attacked by Jennings. Far from pretending to be a universal formula, it has been suggested in various forms by various investigators for the purpose of testing the applicability to the problems of organic behavior of the data of physics and chemistry. It is a guide for analysis along experimental rather than historical lines, and in accord with its reason for being, is dependent upon no psychological data of any sort.

It has appeared from the preceding discussion that there is ground for believing in the existence of two classes of stimuli in nature, and that according to the tropism hypothesis both may elicit primary responses.

The view that the definitely directive responses known as tropisms are primary does not rest, however, merely on whatever presumptive evidence the curtailment of the trial and error program may admit. There are numerous examples in nature of the dependence of the tropic reaction upon the physiological condition of the organism. The larvæ of *Polygordius*, a marine annelid worm, when taken, are negatively heliotropic. Two hours later, they may be positively heliotropic. This change may be obtained immediately by cooling them down to a temperature of 7° C. The response may again be reversed by suddenly diluting the salt water containing the larvæ with one third to two thirds its volume of fresh water. The sense of the resulting response may in turn be reversed by increasing the concentration of the water. I have already referred to the barnacle larvæ that are positively heliotropic immediately after hatching, but, after a certain limited exposure to light, become negative. Terrestrial amphipods which are positive, change the sense of their response when thrown into water. Many animals change the sense of their response to light with age and sexual condition. The larvæ of the king crab react positively in their earlier stages, negatively later. Maggots of the house-fly respond negatively at the end of their larval period, but are quite indifferent to light both before and after this stage in their existence. At the time of sexual maturity, both ants and bees have exhibited positive responses to light.

Further, it is a highly interesting fact that certain caterpillars, notably *Porthesia chrysorrhœa*, are positively heliotropic when starved, unresponsive when well fed. The suggestion at once arises that the diffusion of chemical substances into the body from the digestive canal may cause the modification of the reaction. Acting on the hint here given, Professor Loeb initiated a series of experiments to see whether the immediate effect of the light in causing the heliotropic reaction is of a chemical nature. Such a supposition could be put to the test by placing heliotropic organisms in an artificial chemical environment. The results of experimentation in this direction have been productive of the most important results. *Gammarus*, *Daphnia* and *Cyclops*, all freshwater crustacea, were used. *Gammarus pulex* is, if anything, negatively heliotropic. By the addition to the water containing a number of individuals of this species of slight amounts of various chemical substances—esters, hydrochloric, acetic, oxalic and carbonic acids (the last itself a product of the metabolism of the animal), alcohol, paraldehyde and ammonium salts—in each case the animals become positively heliotropic. Similarly, *Cyclops*, either negative or indifferent, may be made positive by the addition of hydrochloric acid or carbon dioxide.

It is clear from the facts just recited that the heliotropic reaction of an animal is not necessarily constant, but that it may vary widely and suddenly in sense, or disappear altogether, in accordance with internal changes which are immediately chemical in character. There is little in such phenomena to suggest that tropic reactions are products of carefully selected trial movements. On the contrary, they suggest most strongly the possibility of identifying such reactions with de Vriesian mutations.

With the demonstration that chemical changes are connected in an important way with the reactions of organisms to light, the analysis of the tropic reaction has only begun. Recent experiments have achieved further results. I may quote, in translation, from a recent paper by Professor Loeb:

It might be assumed that acids call forth positive heliotropism among fresh water organisms because they accelerate the formation of a certain substance upon which the positive heliotropism depends. This conjecture, however, can be disproved. We know, namely, that reaction velocity increases with the temperature, and that the temperature coefficient is in these cases very high, namely, in general for each 10° rise in temperature $\geqq 2$. Now I determined for freshwater copepods how large the minimal amount of carbonic or acetic acid is that is necessary to make indifferent animals positively heliotropic. It became apparent that for temperatures of about 10°–15°, not more but actually less acid is required to call forth positive heliotropism than at 20°–25°. That shows that the acid in this case can not act through the formation of a substance that conditions positive heliotropism. A similar experiment resulted even more strikingly for *Daphnia*. Here a fall in temperature below that of the room lessened in the clearest way the amount of acid necessary for the production of positive heliotropism. Now it appears to be generally the case, that when the temperature influences especially the sense of heliotropism in animals, this, so far as at present known, always happens in the sense of making it more positively heliotropic. We can accordingly draw the conclusion with absolute safety that the production of positive heliotropism is not due to an acceleration in the formation of a positive heliotropic substance—to use an expression which may be permitted for the sake of brevity. Rather are we forced by all these facts to the conclusion that the production of positive heliotropism in animals by means of acids rests upon the inhibition of the formation or action of an antipositive substance. It is conceivable that the conditions of positive heliotropism (therefore the positive heliotropic substance) are present in the organisms that here interest us, that, however, their (photochemic?) activity is inhibited by the continuous formation of certain stuffs in the body, *e. g.*, in the eyes. If, now, we assume that acid inhibits the formation of these latter antibodies, then the positive effect of the acid is intelligible. Just so is the positive effect of the fall in temperature intelligible, since thereby the rapidity of the formation of the inhibitive antibodies is diminished.

Though the nature of the substances connected with the heliotropic reaction is not definitely known at present, experiments have suggested strongly that they may be of the nature of oxidases. Researches soon to be published confirm this view in a striking manner.

These facts still further emphasize the improbability of the production of tropic reactions as the result of the selection of a series of trial movements; while they further emphasize the probability that such reactions, dependent upon the presence of definite chemical substances, have sprung suddenly into existence in the manner of the mutations of de Vries. As such, they provide material for natural selection, along with every other variation, whenever they tend to preserve the life of any organism in its struggle for existence.

It has already been said that both Unterschiedsempfindlichkeit and heliotropism (or some other tropism) may be associated in the same organism. Such cases are common, and in every one of them the possibility of confusing the two reactions (as shown for *Euglena*) exists. To cite but a single instance, certain positively heliotropic butterflies will not move toward the brightest light when their bodies chance to be in contact with a pane of glass under which they have crept. Furthermore, a weak light may produce no reaction upon organisms where a light of greater intensity would. It often happens that under a light stimulus too weak to produce its appropriate definite directive effect, an organism may waver about, swinging now toward, now away from the source of the stimulus. These have been called trial movements. I do not believe they belong in that category, for two reasons. In the first place, when the organism comes into a proper orientation for an organism whose line of least resistance runs toward the light, it does not stay so oriented. In the second place, when the light is sufficiently strengthened, the organism may make for it with the utmost directness.

The earthworm, a much used and abused animal in this connection, has recently afforded a case in point. *Perichæta* is an unusually active worm, and reacts, as all earthworms do, negatively to light. To quote from Harper:

2. The body is less sensitive to light when contracted than when extended, owing to the fact that when extended the sensitive elements are spread out over a greater surface and become more susceptible.

3. In locomotion, as there are alternate extensions and contractions, there is an alternation of the condition of lower and higher sensibility. This is important particularly in the sensitive anterior end.

4. As the worm begins each extension in a condition of lower sensibility, it may project its anterior end toward the source of light. This movement is checked as soon as the increased sensibility of the extended anterior end appreciates the stimulus. Movements away from the light do not meet such a check and so are prolonged farther. Orientation is the result of a trial and error method.

Up to this point the reaction comes under the head of Unterschiedsempfindlichkeit.

5. In strong enough light, random movements toward the light are suppressed altogether, and the worm appears to move directly away from the light without noticeable trial movements. This applies to worms which have been kept in the dark and are in a perfectly fresh condition, as after a time they lose their discrimination and begin to make random movements.

This section should be noted, especially the last sentence. Just as it has been seen that larvæ of barnacles may change their response when exposed for a time to light, so *Perichæta* becomes, after a certain exposure, indifferent to stimulation that produces a typical heliotropic reaction in the fresh worm. The animal remains, however, unterschiedsempfindlich. It contracts whenever, by extension of the anterior end, a sufficiently large sensitive area is exposed to the light. In *Perichæta,* therefore, not only do the two types of response occur, but prolonged exposure to light eliminates the possibility of one without interfering with the other. It is difficult to see how responses that are not different in kind could be distinguished in this manner.

In closing, it will not be necessary to summarize again the elements of the schema that Jennings has proposed for the interpretation of the behavior of organisms nor the objections which it has seemed to me could be urged against it. There is no doubt that by his very serious discussion of the problems of behavior, Professor Jennings has done the great service of focusing attention upon the essentials and the unessentials, understandings and misunderstandings in this field of investigation. And I offer the foregoing discussion, originally prepared for a non-biological audience of scientific men, in response to the invitation which is implied on many pages of his book.

Harry Beal Torrey
Zoological Laboratory,
University of California,
April 8, 1907

BOTANICAL NOTES

WOOD-STAINING FUNGI

In the September number of the *Journal of Mycology* George G. Hedgcock publishes a descriptive list of twenty fungi which stain different kinds of woods, in some cases so injuring the appearance as to cause much damage. Eight species of *Ceratostomella,* seven of *Graphium,* one of *Fusarium,* two of *Hormodendron,* one of *Hormiscium* and one of *Penicillium* are listed and described. The woods are species of pines, beech, sweet gum, oak, *Rubus* and elm, and in large part the staining takes place in the lumber piles after the trees have been sawn into boards, planks, etc.

NEW METHOD OF MOUNTING FUNGI

A new method of mounting culture-grown fungi for preservation in the herbarium is described in the July number (1906) of the *Journal of Mycology* by George G. Hedgcock and Perley Spaulding. Pure cultures on rather stiff agar supply the specimens, which are taken out in little blocks with a layer of agar adhering, dried on stiff cards, and then protected by pasting on perforated pieces of thick cardboard of the proper size, the specimens occupying the opening. These cards may be attached to herbarium sheets, and preserved in the usual way, or they may be kept for easy reference in the manner of library cards in ordinary card cases.

ELEMENTARY BOTANY OF FLOWERING PLANTS

Professor Mast has published in a booklet of 54 pages a series of "experiments" intended to cover the essentials as to the structure and physiology of flowering plants in an elementary course in high schools and colleges. Dr. Mast having had "unsatisfactory results in beginning the study of plants and animals with such forms as *Amoeba, Paramecium* and *Spirogyra,*" he prepared a set of directions for his students (in Hope College), beginning the work with the flowering plants, and taking up in succession, seeds, stems, roots, protoplasm, leaves, modified plant structures (tubers, tendrils, spines, aerial roots, etc.) and flowers. The subjects for these studies are well selected, and the directions are clear. For those who believe in beginning with the higher plants (which we do not) the book must prove helpful, as indeed it will be suggestive to those who prefer the more natural sequence from the simple structures to the more complex.

FOREST TREES OF NEW JERSEY

Dr. B. D. Halsted in a recent bulletin (No. 202) of the New Jersey Experiment Station publishes a useful annotated list of the forest trees of New Jersey. He enumerates 104 species, of which 98 are natives, the others being exotics which have become pretty well established. Of the native species 13 are conifers, leaving 85 broad-leaved species. The largest genus is *Quercus,* the oaks, with 16 species, followed by *Pinus* (pines), *Acer* (maples) and *Salix* (willows) with 6 each, *Populus* (poplars) with 5 native and 2 adventive. Of the ashes (*Fraxinus*) and hickories (*Hicoria*) there are 4 species each. It is significant that the author entirely omitted all of the hawthorns (*Crataegus*), apparently regarding the task of disentangling them as quite hopeless. Localities are given, and many notes are quoted from various state reports. Twenty-five of the species are illustrated by cuts borrowed from Sargent's "Manual of the Trees of North America."

THE GENUS CRATAEGUS IN AMERICA

Under this title, in the August number of the *Journal of Botany*, Professor Sargent publishes an interesting statement in regard to the new species of *Crataegus* (hawthorns), in which he refers to the small number known to Torrey and Gray (about fourteen), and says that some years ago it was noticed that trees grown from seeds from different parts of the country differed from the recorded descriptions in certain particulars. From this came a careful study of the genus in several states, the result being that about "five hundred species" have been described in the last eight years. "It is not surprising," he says, "that botanists, looking at the genus through the eyes of Torrey and Gray, or reaching their conclusions from the study of the scanty and generally incomplete material found in herbaria, have regarded the makers of all these species with pity, and have tried to throw ridicule on this investigation and its results." We are assured, however, that to those persons who engage in a study of these plants in the field "the fact is soon apparent that the genus contains many very distinct forms, whether these are to be called species or not."

Following this is a discussion of the groups (20) into which the species naturally fall, with notes on their geographical distribution. The study of the genus, as every one knows who has done anything with the species, is beset by many difficulties. Flowering specimens must be collected in the spring and fruiting specimens in the autumn, and since in many cases the trees look much alike, they must be marked carefully in order to avoid mistakes. After this must come the test through cultivation, of which a beginning has been made. On the grounds of the Arnold Arboretum nearly twenty-five hundred lots of *Crataegus* seeds have been planted, so that comparisons may be made of the seedlings with the trees from which they were derived in order "to determine the value of the field-work which has been done in this genus."

That the end is not yet in the matter of new species is evident from this sentence: "In every township of half a dozen states it is more than probable that forms exist which differ from those that have already been described, and many years will be needed to elucidate the characters and distribution of the genus in this country."

PHILIPPINE BOTANY

In the *Philippine Journal of Science*, under its new management, whereby the botanical articles constitute a separate series, there have appeared three numbers, namely, those for January, April and June. These have included articles as follows: "The Comparative Ecology of the San Ramon *Polypodiaceae*," by E. B. Copeland; "The *Cyperaceae* of the Philippines," by C. B. Clarke; "The Occurrence of *Antiaris* in the Philippines," by E. D. Merrill; "Philippine Myxogastres," by George Massee; "*Cibotium baranetz* and related Forms," by H. Christ; "Pteridophyta Halconenses," by E. B. Copeland; "Spicilgium filicum Philippinensium," by H. Christ; "The Philippine Species of *Dryopteris*," by H. Christ; "Notes on Philippine Palms, I.," by O. Beccari; "Index to Philippine Botanical Literature," by E. D. Merrill. The last-named paper is mainly an index to *recent* literature, and is quite evidently supplementary to Tavera's "Biblioteca Filipina," published in 1903 by the Library of Congress.

Charles E. Bessey
The University of Nebraska

EXPEDITIONS OF THE BERLIN ETHNOGRAPHICAL MUSEUM

The Ethnographical Museum of Berlin is organizing a number of important expeditions. Dr. Czekanowsky is going to visit the region of the Victoria Nyanza for the purpose of investigating the pygmy tribes of that area, the expenses of this expedition being largely defrayed by Duke Adolf of Mecklenburg. Dr. Ankermann, assistant director of the museum, is preparing for a visit to the northwestern part of the Cameroons. The museum possesses large collections from this district, which were obtained on one of the military expeditions against the natives of the interior; consequently little is known regarding the material. Scientific studies on the material and on related anthropological questions will be carried on by Dr. Ankermann. A third expedition, organized with the support of the secretary of the navy, is under the leadership of Dr. Stephan, who will be accompanied by Mr. Edgar Walden and Dr. Otto Schlaginhaufen, whose field of work will be German New Guinea, New Britain and New Ireland. This expedition will be accompanied by a photographer, Mr. Richard Schilling. Still another expedition is directed towards the investigation of Central America. This work will be in charge of Dr. Walter Lehmann, who expects to spend two years among the natives of Costa Rica and other Central American states. Two other expeditions of the museum have just come to a close—the one conducted by Dr. Theodor Preuss, who has spent two years among the Cora and Huichol Indians in northwestern Mexico; the other, by Professor Seler, who has just returned from a year's investigations in various parts of Mexico.

THE SAN DIEGO MARINE BIOLOGICAL LABORATORY

The city authorities and citizens of San Diego, California, have recently shown their interest in the San Diego Marine Biological Station in a very substantial way. It became obvious some months ago that the La Jolla Park, already given by the city for the use of the station, containing, as it does, less than four acres, was too small to permit the carrying out of the larger plans of the benefactors of the station, Miss E. B. Scripps and Mr. E. W. Scripps. Through a peculiar circumstance in its history the city is a large land owner. A pueblo lot of about 160 acres, having a full half mile of ocean front, was found to afford the most favorable site for the station. Under its organic law the city can not give away any of its public lands; it can only sell them at public auction to the highest bidder. An ordinance was consequently passed by the common council providing for the sale of this piece of land, it being understood both by the city officials and the citizens that the sale was for the purpose of giving the Biological Association a chance to buy the land at a minimum price. No other bidder appeared at the auction, and the association thus secured for $1,000 an unconditioned title to a tract of land with a present market value many times what was paid for it.

The *Alexander Agassiz,* the new boat of the San Diego Marine Biological Association, was recently launched from the Jensen yards in San Diego. The craft was designed expressly for the work of the station. She is an auxiliary, "ketch-rigged," center-board boat, with twin propellers driven by gasoline engines of 25 horse power each. Her length is 75 feet over all. She is broad, 20-foot beam, and low. Without centerboard her draft is four feet. She is expected to dredge and trawl to a depth of 1,000 fathoms, at least.

SCIENTIFIC NOTES AND NEWS

By the act of the last legislature, the professor of geology at the State University of Colorado became also, by virtue of his office, the state geologist. $5,000 is appropriated annually for this service. Professor Russell D. George, the new state geologist, is making his survey this summer, accompanied by Ralph D. Crawford, the instructor of the department, in the Poudre Valley region and in Routt County.

Edwin G. Dexter, A.M. (Brown, '92), Ph.D. (Columbia, '99), since 1900 professor of education in the University of Illinois, and since 1905 director of the School of Education, has been appointed commissioner of education in Porto Rico, to fill the vacancy caused by the resignation of Dr. Roland P. Falkener.

Professor Wilhelm Stumpf, the psychologist, has been elected rector of the University of Berlin.

Dr. Henry H. Rusby, dean of the New York College of Pharmacy, Columbia University, has been appointed official expert in drug products for the U. S. government.

Dr. T. F. Holgate, professor of mathematics and dean of the College of Liberal Arts of Northwestern University, has been granted a year's leave of absence, and Dr. U. S. Grant, professor of geology, has been appointed acting dean for one year. Dean Holgate sailed for Glasgow on September 5 and expects to spend most of the year at Cambridge.

Professor David P. Todd, in charge of the Lowell Expedition to the Andes, left Alianza in northern Chile on August 3, taking with him the 18-inch Amherst telescope to remount at a higher station in the Andes, near Lima, Peru. Mr. A. G. Ilse, chief mechanician of Alvan Clark & Sons, and Mr. Earl C. Slipher, of the Lowell Observatory, form part of the expedition, which has secured at the Alianza station photographs of the annular eclipse of July 10, drawings and photographs of the ringless phase of Saturn, and over 5,000 photographs of Mars, symmetrically placed at the late opposition, exhibiting every part of the planet's surface, and many of them showing clearly the much-disputed double canals.

Dr. N. L. Britton, director of the New York Botanical Garden, and Mrs. Britton, are now engaged in botanical explorations in Jamaica.

Professor J. Behrens, of the Experimental Station at Augustenburg, Baden, has been appointed director of the Biological Institute for Agriculture and Forestry at Dahlem, near Berlin.

Mr. Roe E. Remington, A.B. (Colorado, 1905), instructor in chemistry in the Iowa State University, has become chemist in charge of the fertilizing department of Armour and Co., Chicago.

The officers of the Esperanto Scientific Association, which met in connection with the recent Esperanto Congress at the University of Cambridge, are as follows: Professor Adolphe Schmidt, head of the Meteorological Observatory at Potsdam, as president; Professor J. J. Thomson, who holds the chair of experimental physics at Cambridge; and M. René Benoît, director of the International Office of Weights and Measures in Paris, as vice-presidents; and Professor René de Saussure (Geneva), as general secretary.

A monument to Mendeléef, the great Russian chemist, is to be erected by subscription on the grounds before the University of St. Petersburg.

The Place du Collège de France will, by decision of the Paris Municipal Council, hereafter be known as the Place Marcellin Berthelot.

Dr. Oren Root, professor of mathematics in Hamilton College, died on August 26, at the age of sixty-nine years. He succeeded his father as professor of mathematics at Hamilton in 1881.

Mr. Samuel Henshaw, who served for some years as head gardener of the New York Botanical Garden, died on Staten Island on July 16.

Professor Karl Vogel, director of the Astrophysical Observatory at Potsdam, died on August 13.

Dr. K. S. Storch, professor of chemistry in the Veterinary School of Vienna, died on July 22, at the age of fifty-five years.

We regret also to see announcements of the death of Dr. John Kerr, F.R.S., formerly professor of mathematics in the Glasgow Free Church Training College, and of Sir William Robertson Copeland, a Glasgow engineer, who had made a special study of drainage and water supply.

The U. S. Civil Service Commission invites attention to the examination scheduled to be held on September 11, 1907, for the position of acting assistant surgeon in the Public Health and Marine Hospital Service.

The emperor of China has established a zoological garden in the Imperial Gardens at Pekin, and animals, said to be of the value of $2,000,000, have been purchased by the Chinese minister at Berlin.

THE seventh International Physiological Congress met in Heidelberg last month, with Professor Kossel as president. *Nature* states that about 300 members were present, and 200 communications were made in the four sections into which the congress was divided. At the opening meeting Professor Kronecker paid a tribute to the late Sir Michael Foster. Professor Dastre, of Paris, gave a short biography of the late Sir J. Burdon-Sanderson, while Professor Sherrington spoke of the loss sustained by the congress through the deaths of Professor Errera, of Brussels, and Professor A. Herzen, of Lausanne. By order of Grand Duke Friedrich of Baden each member of the congress was given a bronze medal in memory of the meeting.

THE Vienna correspondent of *The British Medical Journal* states that a magnificent building has just been completed which will serve as part of the new institutes devoted to the researches required by the extension of modern science. At a distance of a few minutes' walk from the general hospital, a four-floor building with three large fronts has been erected. Therein will be situated the hygienic institute, with Professor Schattenfroh's lecture hall, the institute for the history of pathology with a large museum, the serum therapeutic institute (under Professor Paltauf), and the institute for examination of foodstuffs. In the center block are two large lecture halls, each accommodating 250 students. In the courtyards and also on the top floors, and under the roofs of the house, stables for the animals used for experiments have been erected. The arrangements are the result of very extensive studies of similar institutions made during the last five years. The cost amounts to upwards of $750,000. During this autumn and winter only a few of the buildings will be used, but next spring all the institutes will be ready for use and they will then be formally opened.

The British Medical Journal states that the French Congress of Medicine will be held in Paris under the presidency of Professor Debove. The opening meeting will take place on October 14, and will be continued on the 15th and 16th. Reports will be presented by MM. Linossier and Castaigne on the treatment of simple ulcer of the stomach; by MM. Gilbert Ballet and Delhelm and M. Sainton on the pathogeny and treatment of exophthalmic goitre; and by MM. Carrière and Marcel Labbé on hæmophilia. Among the subjects proposed for discussion are the surgical treatment of simple ulcer of the stomach; is pulmonary tuberculosis of aerial or intestinal origin? acid-resistant bacilli; the therapeutic action of radium; ionic medication; the use of collargol; the therapeutic value of tuberculin; the serumtherapy of dysentery and cutaneous sporotrichoses.

WE learn from the same journal that an Italian Medico-Legal Society has lately been founded. Its headquarters are in Rome. Professor Lombroso is honorary president, the actual president being Professor S. Ottolenghi. The aims of the society are the development of "a true and healthy medico-social conscience," the furtherance of scientific researches on medico-legal subjects, and the enlightenment of public opinion on such questions. The first problem with which the society proposes to grapple is the necessity of establishing intermediate institutions for the reception of offenders who can neither be imprisoned nor admitted into a lunatic asylum.

IN the Scottish National Exhibition to be held in Edinburgh in 1908 there will be, says *Nature*, sections devoted to fine arts, education and history, arts and crafts, mining, engineering and metallurgy, transportation and motive power, shipbuilding and waterways construction, chemistry and scientific appliances, lighting, heating and ventilation, agriculture, horticulture and sylviculture, domestic economy, sports and pastimes, botany and zoology, artisans' work, women's section, urban and rural improvements.

UNIVERSITY AND EDUCATIONAL NEWS

THE Massachusetts Agricultural College will celebrate the fortieth anniversary of its opening from October 2 to 5. The speakers include Dr. A. C. True, director of the Division of Experiment Stations, Department of Agriculture; Dr. Carroll D. Wright, president of Clark College; and Dr. F. W. Rane, state forester of Massachusetts.

The permanent advisory committee of the treasury on the allocation of the money provided by parliament in aid of university colleges in Great Britain recommends grants as follows:

	Grant, 1906-7	Proposed Grant
Victoria University of Manchester	£12,000	£10,000
University of Liverpool	10,000	10,000
University College, London	10,000	10,000
University of Birmingham	9,000	9,000
University of Leeds	8,000	8,000
King's College, London	7,800	7,800
Armstrong College, Newcastle-on-Tyne	6,000	6,000
University College, Nottingham	5,800	5,000
University of Sheffield	4,600	5,000
Bedford College for Women, London	4,000	4,000
University College, Bristol	4,000	4,000
University College, Reading	3,400	3,400
Hartley University College, Southampton	3,400	2,250
London School of Economics		500

The grants proposed above amount in all to £84,950, leaving, if a grant of £1,000 to University College, Dundee, is continued, a balance of £14,050 available for grants for special purposes.

The Philip Walker studentship of pathology at Oxford will be filled in October. The studentship was founded "for the furtherance of original research in pathology." It is of the annual value of £200 (payable quarterly in advance), and is tenable for three years. The student may be of either sex, and need not necessarily be a member of the University of Oxford.

Professor William L. Bray, of the University of Texas, has been appointed to the chair of botany at Syracuse University, vacant by the resignation of Professor J. E. Kirkwood.

Dr. Oliver C. Lester, A.B. (Central College, Mo., 1897), Ph.D. (Yale, 1904), instructor in the Sheffield Scientific School of Yale University, has been appointed professor of physics in the University of Colorado, to fill the position vacant by the resignation of Professor Duane, who, as already announced, goes to the Curie Radium Laboratory of the University of Paris.

Frank Eugene Thompson, instructor in education at Stanford University, with leave of absence to carry on research work at Columbia University, has been appointed professor of education in the University of Colorado.

Professor George W. Bissell, M.E. (Cornell, '88), professor of mechanical engineering in the Ohio State College since 1892 and vice-dean of engineering since 1904, has been appointed dean of engineering in the Michigan Agricultural College.

Howard C. Ford, instructor in civil engineering in the University of Colorado, has been appointed assistant professor of irrigation engineering at the Iowa State University.

Mr. Thomas D. Eason, graduate of the Clemson Agricultural College, has accepted an appointment as assistant in botany in the North Carolina Agricultural College.

Dr. Frank W. Reed, of the University of Virginia, has been appointed instructor of astronomy in the University of Illinois.

Dr. W. A. Wilkins has retired from the chair of pathology in McGill University.

Dr. Friedrich Berwerth has been promoted to a professorship of petrography a the University of Vienna.

At the University of Lille, M. Clairin has been appointed professor of mathematics; M. Mallaquin, professor of zoology, and M. Hallez, professor of comparative anatomy; at the University of Nancy, M. Minguin has been appointed professor of chemistry and M. Nicklès professor of geology; at the University of Lyon, M. Vavasseur has been appointed professor of the differential and integral calculus; at the University of Toulouse, M. Paraf has been appointed professor of mathematics; at the University of Poitiers, M. Turpain has been appointed professor of physics.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, SEPTEMBER 13, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ADDRESS AT THE DEDICATION OF THE WALKER LABORATORY OF THE RENSSELAER POLYTECHNIC INSTITUTE

I CONSIDER it an honored privilege to be allowed to take part in the ceremony of dedication of this beautiful building devoted to the study and promotion of the science of chemistry in its application to the arts and industries. In this connection it behooves us I think to consider briefly the history of the movement which brings us together, to ponder the purposes of the great institute, of which the work to be done in this building constitutes an integral and important part.

Thinking over what I might be able to present on this occasion it occurred to me to make some inspection of the historic archives of the city of Troy, particularly as they relate to the founding of this, which has taken such a proud position among the educational institutions of the world. In my search I learned that in 1823 Hon. Stephen Van Rensselaer made, most wisely in his lifetime, provision for a school to be located on the outskirts of the city of Troy to be known as the Rensselaer School, and the history of this fact written by Weise offers a copy of the first circular issued to announce that the institution was ready for practical operation, as follows:

Hon. Stephen Van Rensselaer having established a school near the northern limits of Troy for teaching the physical sciences with their applications to the arts of life, having appointed Professors A. S. Eaton and L. C. Beck to give courses of instruction, particularly calculated to prepare operative chemists and practical naturalists properly qualified to act as teachers in villages and school districts; having appointed an agent and furnished him with funds for procuring apparatus and fitting up laboratories and a library room, etc., and the agent having given notice to the president of the institution that the requisite collections and preparations are completed, it seems proper to give public notice of the circumstances. Accordingly, the public is respectfully notified that everything is in readiness at the Rensselaer School for giving instruction in chemistry, experimental philosophy and natural history, with their applications to agriculture, domestic economy and the arts, and also for teaching land surveying and all the branches of learning set forth in the circular which was issued in November last, subscribed by the founder and by the president and secretary of the board of trustees. The first term will commence, according to the appointment of the founder, on the first Monday in January, 1825, and continue fifteen weeks.

An evening course by the senior professor in chemistry and experimental philosophy will commence on the third Wednesday in January and continue, three lectures a week, for ten weeks.

(Signed) Samuel Blatchford

Rensselaer School, December 28, 1824.

And so the school was launched, to provide for the study of chemistry, experimental philosophy and natural history with their applications to agriculture, domestic economy and the arts and for teaching land surveying and other branches of learning set forth in this circular. What prophetic vision Van Rensselaer possessed! He saw among other things the importance of liberal education to the life work of every man, and so provided for, in addition to the professional or technical branches of study, training in other branches of learning, presumably the culture studies, essential to the training of every educated man. But note further, that special provision was made first, for the study of chemistry; then for the study of experimental philosophy, or what we now know as physics; and after that natural history, or what we now class generally as biology. These three, chemistry, physics and biology; what better, could have, then or now, been imagined for the broad training of one who should make a life work of the essential arts of life? Van Rensselaer had trouble also to sharply differentiate between chemistry and physics and to give one precedence over the other. For as chemistry applied in the arts is chemical technology, so physics applied in the arts, in a large way, is engineering; and as the dividing line between chemistry and physics is obscure, so, as Van Rensselaer, even in his day, recognized, chemistry and engineering must go hand in hand if progress in the arts is to be assured.

No better illustration of this is to be found than appears around us here. We stand to-day upon historic ground. Here the great engineer Ericsson found his first financial encouragement and support at the hands of those captains of industry and finance, Griswold and Winslow. Encouraged and guided by these master minds, Ericsson was able to complete the historic *Monitor* and make the white squadron possible. Here was the cradle of the Bessemer process, which made the steel industry of the United States possible and enabled our country to develop the great United States Steel Corporation and lead the world in the manufacture of steel.

There are those, doubtless, who will question what I have just said regarding the priority of Troy in the effective establishment of the Bessemer process for manufacture of steel, but such high authority as R. W. Hunt, one of the pioneers in the industry in this country, says ("Life of Sir Henry Bessemer," *Sibley Journal of Engineering,* 1904, 161): "Hence the honor of the first heat of Bessemer steel in America belongs to the Wyandotte Works." But he also said (History of the Bessemer Steel Manufacture in America, American Institute of Mining Engineers, Vol. V., 1876–1877): "While at the Wyandotte Works steel was made at an earlier date, the Troy establishment was the first to bring the process to a commercial success."

A great chemist once said that the measure of a nation's civilization is its consumption of soap. While this has in the passing years lost none of its truth, the more modern expression becomes—the measure of a nation's civilization is its consumption of fuel and its production and utilization of steel. This is a measure of the supremacy of the United States and we may be proud to-day that we stand in the cradle of the industry which makes this declaration effective. For history tells us that Holley, returning from a trip abroad, where he had made a study of the new and recent discovery of Sir Henry Bessemer and Mushet, associated with him the two enterprising and farsighted gentlemen already mentioned, Griswold and Winslow, in the establishment of the new process on American soil at Troy. As Bessemer had worked out the physical and engineering part of the work, Mushet had seen and worked out the chemical part of the process, and thus made perfection possible. Chemistry and engineering working together, moving forward hand in hand, had brought forth this realization of the greatest step in the world's progress.

What a splendid illustration of the suggestion of the great Tyndall, "the scientific use of the imagination." The imagination of Bessemer saw the possibilities of the new process and the means whereby it could be carried out mechanically; the imagination of Mushet saw the chemical difficulties in the way of ultimate successful operation and how they should be removed. Holley, after the installation of the process on the soil of the United States, saw in imagination the changes necessary to the more perfect realization of the dreams of Bessemer and gave to the industry an impetus which carried it with a terrific rush throughout the length and breadth of our land. For the knowledge and experience of Bessemer were limited to mechanics and engineering. He had noticed that a blast of air across a bath of molten iron changed the physical properties of the product to those of wrought iron and steel. He saw in the old puddling process the importance of access of air to the molten metal to effect the necessary change in its physical properties to change it to wrought iron and steel. His imagination showed him the possibility of improved mechanical means for effecting these necessary changes by a blast of air through the hot metal, but his imagination was limited by his knowledge and it was not possible for him to determine when his treatment should be stopped. The knowledge of chemistry of Mushet told him that oxidation of the carbon was the cause of the change in physical properties already noted and his imagination led him to the thought that the practical end of Bessemer's process, to get exact results, would be to burn away all the carbon of the iron and add afterward to the bath a definite quantity of carbon, dependent upon the quality of steel desired. So he devised the addition of spiegeleisen at the end of the blow, when the flame of carbon had disappeared from the mouth of the converter, the addition of a substance rich in carbon to supply this essential element, accompanied by manganese capable of reducing the iron oxidized in the converter after oxidation of the carbon of the original iron, and so to relieve the steel of the "shortness" so fatal to its future use. The Bessemer steel process must have, therefore, chemical control as well as engineering direction.

The necessity Van Rensselaer saw has been realized, and his munificence has made just such combinations possible. The imaginations of Holley and Roebling and Collingwood and Boller and Hodge have made possible the wonderful bridges spanning the great rivers of the world, the network of railroads stretched across the continent, which insures transportation and commerce, but the products which afford realization of these imaginations must have the care and control of the chemist from the earth, from which the raw material sprung, to the wires and bars which constitute the great structures which excite wonder and admiration.

But the founder of the institute saw more in the arts of life. He saw necessity for provision for the immediate wants of mankind, the food and raiment, the removal and utilization of wastes, and if the former may seem to have been neglected by the institute, the latter surely have not. Here is another measure of the civilization of a nation, the utilization of its wastes. Nowhere in the world, perhaps, has this had more intelligent and effective study than in the department of chemistry of the institute. The purity and abundance of the domestic water supply and the healthful and economic disposal of human wastes have in all ages of the world been of the highest public importance. The function of the municipal engineer has been called into activity, and the world is beginning to reap the fruits of its practical application. It is not always true that "fools rush in where angels fear to tread," but rather that wisdom of knowledge courageously leads in untried paths where ignorance blindly follows. The known leads to the unknown. The present builds upon the experience of the past. It is thus that knowledge brings progress, and study, however obscure, brings help and comfort to mankind.

The value of the special knowledge of natural forces and their laws, which Van Rensselaer foresaw, is coming to be more and more appreciated in the commercial world. During the present year the most important representative of the financial interests, *The Wall Street Journal,* said, editorially, under the caption "Science as a Financial Asset," inspired doubtless by the address lately delivered by Dr. A. D. Little, of Boston, before the American Chemical Society in annual meeting:

Science as a source of strength in promoting private wealth and public welfare is the one thing that draws the line of demarkation between ancient and modern times. That was a belated medieval, not a modern, outburst of popular wrath against which Lavoisier's friends appealed for his life on the ground of his scientific service to the French state. The powers then in control replied that "the republic had no use for chemists." Far more like modernity is the declaration of a German chemist that "scientific research is the greatest financial asset of the fatherland." Germany's economic progress proves that he was at least much nearer right. The sciences in general have been among the greatest emancipating forces, because they have helped to overcome man's fear of nature, which kept him from utilizing the forces of the world about him, and because they disclosed elements of the highest value to the world in their most practical forms: It has been well said "that if we were to take away what the chemists have contributed, the whole structure of modern society would break down at once. Every commercial transaction in the civilized world is based on the chemist's certificate as to the fineness of gold, which forms our ultimate measure of values. Faith may remove mountains, but modern society relies on dynamite. Without explosives our great engineering works must cease and the Panama Canal, no less than modern warfare, become impossible."

The late Abraham S. Hewitt estimated that the Bessemer process of manufacturing steel added directly and indirectly two thousand million dollars a year to the world's wealth. Bessemer himself retained only about ten million dollars out of this total annual increment. Without chemistry no such dreams could have been realized. Chemistry has made possible the transportation systems which span the leading countries of the world. It has made it possible to turn to man's service the wealth of the mineral world. By analysis of plants and soils, the waste materials of the world have been brought to the growing of crops. Indeed, every great industry, whether it be farming, manufacturing, transportation or mining, would almost immediately relapse to barbarism if the secrets of the chemist and physicist, the geologist and mineralogist could be gathered up and cast into the sea.

The work of science which probably needs most development in the present day, however, is not so much the application of knowledge already acquired to the increase of wealth as the promotion of research in fields whereby the enormous wastes may be checked and the utilized resources of the world immediately around us be won for man's uses. Fundamental research is by far our greatest need. Common clay is full of a commodity which, if it could only be extracted economically, would probably solve for centuries the question of a metal supply for a large part of the needs of mankind.

It was this thought that led an American journal to say that the accidental killing of Professor Curie, the discoverer of radium, in the streets of Paris last April, was a greater loss to the world than the earthquake in San Francisco, where more than a thousand people lost their lives, a quarter of a million persons were rendered homeless by conflagration and property losses estimated at $500,000,000 occurred. If that be true, it is neither numbers nor wealth, but scientific talent that gives the power of mastery to nations because of its capacity to unlock the secrets of nature, in which are hid the sources of material welfare.

These are words which must bring much of both comfort and encouragement to those who are just entering upon their life work, as well as to those who have had to work and answer the hard questions offered by the industries. Knowledge is a good financial asset, but it must be exact and accurate knowledge. The hard questions submitted to the educated technologist must be answered promptly but accurately. And many, if not most, of the questions now pressing for answer are as much chemical as mechanical. For instance, who shall answer the question as to the cause of, and remedy for, the broken rail? Shall it be the engineer or the chemist? Shall the answer be found in the intense speed and the overload of trains, or in the excess of carbon necessary to provide resistance to wear rail surface, or made necessary by an overweening desire to increase tonnage at expense of quality? or shall it be found in the nitrogen introduced in the steel and now found like phosphorus, to have a profound influence upon the physical property of the product? The world, and particularly the United States, is looking anxiously for the correct answer to this question. Will Troy and her men rise to the situation and now, as in the decade '65 to '75, bring forth a new Bessemer process to supply the new demand? There are those here present, no doubt, who will take inspiration from this question and do their share to supply this instant demand and do it thoroughly. It is for this that the Rensselaer School was founded, and the Walker laboratory generously provided. And failure and disappointment are surely words which do not belong in the local vocabulary.

The value of the study of chemistry in the training of educated technical men has been realized since the time of Van Rensselaer as well as before. In his address on "The Functions of Technical Education" the late Professor Thurston said: "When the pupil is to go directly into business and his precise line of work is not settled, or when it is evident that he is of that large class in this country liable to pass from one vocation to another, the technical studies for the curriculum should be in general, mathematics and the science of physics and particularly of chemistry."

This dictum from the great head of the Sibley School of Engineering is impressive and worthy of careful consideration. It fully justifies our presence here to-day for the purpose in hand and confirms the judgment of the founder of this institute and the purpose of the generous donors of the Walker Laboratory we here and now dedicate to the study of chemistry.

We may heartily join in congratulations to the administrators of the will of Mr. Van Rensselaer, who have so faithfully carried out the purpose of the founder, and to the graduates, who have so well seconded the efforts of these able and conscientious men who have brought the Rensselaer Polytechnic Institute to that great eminence in the public esteem, from which they may look backward with pride and forward in earnest and confident hope of an even brighter and more prosperous future.

Wm. McMurtrie.

THE RATIONAL BASIS OF MATHEMATICAL PEDAGOGY[1]

The rapid development of special methods of teaching special subjects has drawn attention of late to the hitherto neglected field of mathematical pedagogy. The fact that mathematics is the last to respond to improved pedagogical methods is due chiefly to the unusual weight of precedent which attaches to the subject. This inertia of age is, in reality, the chief difficulty to be overcome, for the great antiquity of elementary mathematics and the diversity of the sources from which it originated make it extremely difficult to harmonize the subject with the spirit of modern civilization.

Various plans have recently been proposed for adapting mathematical instruction to modern conditions, but so far they have been without results of special importance, as no general principle of mathematical pedagogy seems as yet to be recognized. Many of these plans are the results of attempts to meet local conditions and therefore have no general application. Others, however, such as the attempt to correlate mathematics and physics, are intended to stimulate interest in mathematics by establishing more points of contact between it and the other subjects of instruction, thus producing a greater organic unity in the curriculum than has hitherto existed. Such efforts are in line with the constructive and synthetic spirit which characterizes modern scientific thought, and for this reason are worthy of special consideration.

Without going into a detailed analysis of pedagogical methods, it may be well to consider briefly the fundamental principles on which general pedagogy is based, as these principles are well established and apply with peculiar force to mathematics.

The primary consideration in all branches of pedagogy is the aim of education. This has been variously defined, the Herbartian definition of it being that it is "the cultivation of virtue based on many sidedness of interest." By the cultivation of virtue in this connection must be understood the proper exercise and control of all the faculties. With this understanding the definition fits in, probably as well as any other, with modern ethical and religious ideals. The second half of the definition which bases the development of virtue on the cultivation of wide and varied interests fulfills practical requirements and at the same time affords the proper pedagogical basis for apperception. The most important feature of this definition is that it recognizes both the practical and the cultural aims of education. In other words, it implies that no training can properly be

[1] Read before American Mathematical Society, New York, December 28, 1906.

called educative in which esoteric development does not result in exoteric manifestation. This is especially important in the case of mathematical instruction which exhibits an unfortunate tendency to run to the extremes of either pure logic or empiricism.

Having defined the aim of education, the most efficient means of attaining it becomes the great problem of pedagogy. The first step towards the solution of this problem may be said to have been taken by biology in the establishment of the law of physical evolution. Following out the analogy thus suggested, modern psychology has practically solved the problem by studying the content of the child mind at different ages, thus determining the natural course of mental evolution. In this way it has been conclusively shown that mental processes follow the historical order of development, or, as Herbert Spencer expressed it, that "the genesis of knowledge in the individual follows the same course as the genesis of knowledge in the race." More recently modern psychologists have found even in the most minute activities of the child psychic atavisms as remarkable as convincing, proving conclusively that the natural course of mental evolution is but a repetition of civilization in miniature.

Since pedagogy, like engineering, is chiefly concerned with the utilization of natural forces and their direction in the proper channels, it follows that the fundamental principle underlying general pedagogy must necessarily be the historical method of presentation. In the case of mathematics this is the logical as well as the psychological sequence of development, which obviates many of the difficulties encountered in applying the historical method to other branches of instruction. The historical method thus fulfills the prime requisites for a practical working theory in being simple in application as well as powerful in results.

A notable instance of the application of the historical method to general pedagogy has already been made, and is embodied in the well-known "culture epoch" theory, originated by Pestalozzi and Herbart and elaborated by their disciples.[2] This theory consists, in brief, in applying the evolutionary idea with the utmost detail to the elementary school curriculum, with the purpose of leading the child successively through each stage of culture occupied by the race in the evolution of modern civilization. As a typical instance of the application of this method, Ziller's interpretation of the culture-epoch theory may be cited, as it is now well established in Germany on a practical footing.

In outline Ziller's method consists in arbitrarily selecting eight great historical culture epochs, corresponding as nearly as possible to the first eight years of school life. Material is then selected to embody the culture of each epoch, that chosen by Ziller being as follows: (1) epic fairy tales; (2) Robinson Crusoe; (3) history of the patriarchs; (4) history of the judges in Israel; (5) history of the kings in Israel; (6) life of Christ; (7) acts of the Apostles; (8) history of the Reformation. The subjects thus selected are known as "concentration centers" for the reason that each is used as a nucleus around which to group supplementary courses in language, science, etc. These supplementary courses are then so chosen that each group shall form a unit, representing, so far as possible, a complete stage of civilization in miniature.

The results of Ziller's method are in the main satisfactory, and at least afford a sug-

[2] See any of the numerous treatises on Herbart's educational theories, *e. g.*, "Ufer's Pedagogy of Herbart," by De Garmo; or "Introduction to Herbart's Science and Practise of Education," by Felkin.

gestive instance of the application of the historical method. It is evident, however, that Ziller's interpretation of the dual theory of the culture epochs and concentration centers is open to criticism. This is apparent in the arbitrary selection of the culture epochs, as they only partly typify the great epochs of history. Furthermore, the concentration material selected by Ziller by no means embodies the total experience of the race in any particular epoch, and for this reason is inconsistent with the principle by which it was selected. In applying the theory this weakness has also made itself felt by reason of the impossibility of reproducing historical environment, and the difficulty of adequately presenting the notable characters of ancient civilization without it. These objections have led to severe criticism of the whole culture-epoch theory, and in some cases to its entire rejection.

It should be noted, however, that the difficulties attending the culture-epoch theory are inherent in this theory and not in the historical method. In the case of mathematics the question of environment does not arise, and thus the chief difficulty is at once removed. Moreover, the nature of the subject matter in elementary mathematics is such that none of it can be omitted, thus obviating all possibility of error in the selection of proper materials.

Perhaps the most convincing proof of the applicability of the historical method to mathematics is furnished by the practical methods attained by teachers as the result of long experience. Special aptitude for teaching consists largely in the ability to assume the mental attitude of the pupil, and establish the connection between the ideas already formed and those which it is desired to communicate; or, more briefly, in the ability to stimulate apperception. By long and earnest efforts of this kind such noted teachers as De Morgan, Grube and others have arrived at methods of presentation which in the main follow the historical sequence of development, thus affording a strong inductive proof of the validity of this method. The recognition of the historical method as the universal principle underlying experience by means of which these results may be codified and extended, is, then, all that is necessary to furnish a rational basis for mathematical pedagogy.

In applying the historical method to mathematics, one of the most interesting results is the light which is thrown on the nature of the difficulties encountered in studying the subject. From the fact that mathematics has formed the basis of all civilization, and has developed independently among nations widely separated, it may be assumed that it possesses a certain universality akin to that of mind itself. This is by no means true, however, of the special branches of the subject. Thus it is by no means merely fortuitons that the Greeks excelled in geometry but produced no great algebraists, and that the reverse was the case with the Semitic races. The mathematical attainments of any nation are, in fact, an integral part of its national culture, and may, therefore, be expected to differ in direction with the latter. In so far, then, as mathematics satisfy the common needs of humanity they may justly lay claim to universality, but beyond this point are characterized by the spirit and aims of the nation which gave them birth.

It is not surprising, therefore, that those reared under modern conditions should experience difficulty in assimilating results attained hundreds or thousands of years ago and expressive of a culture entirely foreign to our own; or that they should at times fail to recognize the value of certain branches of the subject. For instance, geometry is still taught in practically the same form in which it was left by Euclid 2,200 years ago. The great Greek mathematicians, Pythagoras, Plato and Aristotle were, however, primarily philosophers, and the geometry they originated is instinct with Greek idealism. In fact the era of Greek culture may be characterized as the adolescent stage in the intellectual development of humanity. With the Greeks the worship of the ideal and the beautiful rose to the height of a religious cult, and the chief boast of the founders of geometry was that they had raised it above the common needs of humanity, and elevated it to the dignity of pure logic. This view of geometry as typical of the adolescence of the race explains why it appeals to youth and at the same time is criticized as unpractical by those of greater maturity. Euclidean geometry, however, should not be viewed from a practical standpoint only, for since the full power of maturity is only attained by the proper unfolding of the preceding stages of childhood and youth, geometry is an important factor in development, and should not give place to more utilitarian subjects until it has fully served its purpose as a mental stimulus.

As geometry is a characteristic expression of Greek culture, so algebra sprung from, and fitly symbolizes, the mystic spirit of the Hindoos and their Aryan conquerors. For the modern youth, therefore, the difficulties met with in geometry are by no means so great as those encountered in algebra, for the Greek spirit in its two chief features of freedom and individuality has much in common with our own, whereas that of the Hindoos is its exact antithesis. Fettered by the bonds of caste, the Hindoo spirit could not attain objective realization and became lost in a maze of abstraction; the highest good becoming a mere negation of existence both physical and intellectual. Moreover, the divinity ascribed to the Brahmin caste resulted in the degradation of religion, and the absorption of the spiritual in the merely physical. Thus the morality involved in respect for life and its Creator was lost, and the ideal of virtue was abstraction from all activity. In short, concrete reality gave way to abstraction, imagination became dominant, and spirit was characterized by the fanciful imaginings of dreams. The difficulties met with in algebra are therefore inherent in the thought processes involved and can only be lessened by establishing relations with more familiar ideas by the frequent introduction of concrete numerical illustrations.

Besides explaining the nature of the difficulties encountered, the historical method also furnishes a means of estimating their relative magnitude. In other words, the historical method affords a criterion for making a quantitative as well as a qualitative estimate of the intellectual content of the subjects considered. Thus the long period of time occupied by the Egyptians in reducing fractions to a working basis is significant as being the prototype of the serious difficulty experienced by the modern youth in attaining an equal proficiency in the subject. The pause which frequently intervenes between two successive stages of development is also significant, and is analogous to that which occurs at intervals in the growth of the child. As in the case of physical growth, so here, the pause marks a drop in potential due to accelerated development, and its length indicates the importance of the next successive advance. It is in fact a sort of hysteresis due to the mental inertia of the race. Political and religious conditions are not sufficient to account for such halts in progress. Although social conditions must be recognized as powerful factors in aiding or arresting development, yet from the standpoint of universal history such external relations can not be considered as conditioning the evolution of spirit, but rather as reflecting its trend.

To illustrate the meaning of a pause such as mentioned, the hiatus of sixteen centuries which intervened between the statics of Archimedes and the dynamics of Stevinus and Galileo may be cited. The difficulty experienced by students in passing from statics to kinetics has frequently been remarked by teachers, and has led to a revision of instruction in mechanics by beginning the subject with kinematics and treating statics as a special case of dynamics. This order of development might, however, have been inferred from the historic relation of the subjects, for the history of mechanics shows that the statics of Archimedes consisted in little more than the law of the lever, and that no advance was made until the subject was approached from the standpoint of motion. In fact such an elementary principle of statics as the parallelogram of forces was not proved or even commonly accepted until after the enunciation of Newton's laws of motion. In this case, then, the pause emphasizes the degree of attainment essential to a proper understanding of the laws of motion, and also the necessity of approaching the subject from the proper direction, both of which are of the greatest pedagogical importance.

The long interval of time, approximating 4,000 years, which was spent by the ancients in acquiring the fundamental ideas of number is another instance in point, and indicates the necessity of thoroughness in the first stages of instruction. Here again theory has been anticipated by experience in the method proposed by Grube, which consists in spending the entire two first years of mathematical instruction in exhaustive number analysis. There is no doubt but that under the present forcing system too little time is devoted to this basic work, the result being that ability to make numerical calculations with ease and facility is the exception rather than the rule. This also explains the reason for the unfavorable comparison sometimes drawn between our modern schools with their multiplicity of subjects and too often superficial treatment, and the old red schoolhouse of the last generation, where instruction was limited to the three R's, but where each was taught with such thoroughness as to leave a permanent impress on the character of the scholar.

The movement recently inaugurated in Germany and England with a view to revising the present instruction in mathematics indicates the lack of harmony between ancient and modern civilization. A characteristic expression of this dissatisfaction with existing methods of instruction is found in the so-called "Perry movement" and its rapid spread throughout England and America. The chief feature of the modification proposed by Professor Perry is the laboratory method of instruction, which may be characterized as an attempt to visualize mathematics, at the same time making it utilitarian as well as concrete. It is, therefore, a reversion to the basic needs of humanity and the means which were used for supplying them. Thus arithmetic originated with the Phœnicians and Chaldeans to supply their commercial needs, while even with the Greeks the beginnings of geometry may be traced to the attempt to solve certain practical problems in mensuration. It is, in fact, a general truth that the chief stimulus to the development of mathematics has always been found in the attempt to explain natural phenomena, and make them subservient to the physical needs of humanity. The laboratory method, then, may be used as a basis for the inductive development of mathematics, and if used for this purpose in the lower grades of instruction will prove a valuable adjunct to the methods ordinarily followed. So far from being unique in its inception and aims, however, it is merely a corollary of the historical method, and can only be used to advantage when it is recognized as such.

Another corollary of the historical method is what is known as the "spiral method" of instruction. This consists in taking the pupil several times over the same ground, but each time reaching a higher level and attaining a more general point of view. The method is founded mainly on experience, but its theoretical basis is evidently historical.

The specific application of the historical method to mathematical pedagogy consists primarily in obtaining the proper historical perspective. From this aspect its principal use is in arranging the details of a curriculum, and a few suggestions follow relative to its application for this purpose.

Perhaps the most obvious suggestion is that subjects which developed simultaneously should form parallel courses instead of being taught serially, as is now common in all mathematical instruction. For instance, algebra and geometry originated simultaneously and served as a mutual stimulus to growth and development. It is evident, therefore, that it is possible to teach these subjects in the same academic grade, and that they can undoubtedly be made mutually helpful by so doing. This opinion is verified by the fact that this method has been used for some time in the higher schools of Prussia with results which indicate a decided advantage for such correlation of subjects.[3]

Following out the historical idea, the curriculum should be based on a thorough grounding in the principles of number, the amount of time devoted to the several subjects being proportionate to their relative difficulty as indicated by their historical rate of development. This should be followed by a course in elementary algebra, taught as a generalization of arithmetical ideas, and accompanied by a parallel course in elementary geometry. The course in elementary algebra would naturally consist in a logical development of the six fundamental processes, including logarithms. At present the latter usually follows quadratic equations and the binomial theorem, whereas historically it precedes both. The natural sequence is, in fact, to teach multiplication as an abbreviation of addition, thus leading to the theory of exponents, and then passing to logarithms as an abbreviation of multiplication. Historically the subject of logarithms arose in this connection, having been invented by Napier about 1614 for the purpose of facilitating the long numerical calculations fashionable in his day..

Conforming to the natural lines of demarkation, these elementary courses would be succeeded by advanced courses in algebra and solid geometry, the former beginning with simple equations and emphasizing chiefly the theory of equations. At present the natural sequence is not followed in teaching algebra, at least three subjects, namely, proportion, logarithms and series being out of proper historical perspective. Proportion, or the old-fashioned "rule of three," was developed by the Hindoos for the solution of numerical equations by the "rule of false assumption," and as it is now obsolete for this purpose, does not properly belong in algebra, and should be reserved for arithmetic and geometry, where it properly has a place. The proper setting for logarithms has already been mentioned. As

[3] J. W. A. Young, "The Teaching of Mathematics in the Higher Schools of Prussia."

regards series, great difficulty is usually experienced in grasping the idea of convergency and divergency at the point where it ordinarily occurs in current text-books, the reason being that it involves the idea of functionality which is of comparatively recent development. Euler first noticed in 1748 that convergency of series was necessary for computation and partly developed the idea of functionality, but the subject did not receive adequate consideration until demanded by the development of the calculus.

Two other points may be noted in connection with the teaching of algebra. The first is that the graphical method of representing an equation was originated by Descartes, who was also one of the foremost in developing the theory of equations. The inference is that graphs may be advantageously used to illustrate the theory of equations, and will also serve as a natural transition to analytic geometry. In this way the historical method meets the objection sometimes raised to our present method of instruction as being conducted in "water-tight compartments."

The second point is that the examples used to illustrate principles should be so chosen as to stimulate interest, and in order to accomplish this purpose must reflect modern life and local conditions. That this principle of selection was formerly recognized, or at least followed, is shown by some of the time-honored problems which unfortunately still survive. Thus the length of time required to fill or empty a vessel by several pipes had a practical bearing when time was measured by a clepsydra, while such problems as that of the couriers, and the length of time required by several men to complete a piece of work, were exceeding useful and interesting a century ago, but, now, have no vital interest except perhaps for the historian. The retention of such problems in modern elementary texts is evidence that the spirit of scholasticism is not yet extinct, and largely accounts for the growing chasm between mathematics and the humanities. Modern life in its growing complexity is teeming with possibilities of mathematical illustration, constantly presenting new problems far greater in cultural value and more wide-reaching in practical significance than any that have yet appeared. To revitalize instruction in elementary mathematics the pupil must be taught to recognize the true significance of mathematics, as the most powerful instrument yet devised by man for ameliorating his physical condition and reconciling cause with effect. Philosophy can never be the proper food for childhood and youth; in elementary instruction the essential feature is that it shall be instinct with life and experience.

It is beyond the scope of this article to do more than point out the chief features of the historical method and its application to mathematics. In mathematical pedagogy the present problem is one of adjustment to modern conditions. This demands for its general solution a wide outlook over the history of the past as well as an intimate knowledge of the needs of the present. The routine of teaching too often proves fatal to this breadth of view, leading the teacher into the error of measuring his success by the facility acquired by his pupils in the subject taught. The true criterion of success in instruction is whether or not it leads the pupil to his highest individual development, refining his spirit and enlarging his field of usefulness. Like other fine arts, teaching can never be made amenable to fixed rules and rigid methods. There are, however, certain general underlying principles which distinguish the art from pure caprice, and of these the historical method of presentation is fundamental.

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SCIENTIFIC BOOKS

A Student's Manual of a Laboratory Course in Physical Measurements. By Professor W. C. Sabine. Ginn & Co. 1906. 8vo, pp. 97.

A Text-book of Practical Physics. By W. Watson. London, Longmans, Green & Co. 1906. 8vo, pp. 626.

Elementary physical laboratory work in American universities has to fulfill two requirements, namely, to complement the first lecture course in general physics and to teach accuracy of observation. While it is desirable that the number of experiments to be performed should not be too limited, the characteristic value of physics as a culture study lies in the training of accuracy of expression and observation. In order to enable the student to perform a sufficiently large number of experiments—which is unfortunately often made the test of ability—and to give him the necessary training in accuracy, it has become the custom to describe only those exercises which he is expected to perform, and avoid a possible "waste of time" by rather minute descriptions of apparatus.

The selection of a few out of a large number of instructive experiments is always a difficult task and will lead to a different choice, according to the tastes of the author and the equipment of the school in which the book is to be used.

Sabine's well-known manual which has now appeared in its second edition shows this elasticity of selection in the omission of many exercises found in the former edition and the introduction of several new ones. Their number has been reduced from about seventy to thirty. Mechanics has practically remained unchanged. In sound a qualitative experiment, "Quality by the manometric flame," has been added. All the former experiments in heat have been omitted and a single one substituted for them, namely, "the determination of the mechanical equivalent of heat." Without questioning the great importance of this exercise it seems to the reviewer that some of the discarded experiments, as "specific heat, heat of fusion, or expansion" are better adapted, at least for an elementary course which is expected to teach only the rudiments of physical manipulations. In light also important changes have been made. "Equivalent focal length of compound lenses" takes the place of several exercises on radii of curvature and focal length of mirrors and lenses. "Wave-length of light by Newton's rings and the diffraction grating," also "Rotation of polarized light" are new. In the electrical part a good descriptive chapter on galvanometers adds much to the value of the book. The work with cells (internal resistance, different arrangement of cells, etc.) has been considerably condensed and an experiment with the dynamo added.

On the whole the changes made for the new edition are good; each exercise illustrates an important principle and a repetition of the same in other parts of the book has been carefully avoided. The instructions given for each experiment are more specific than in the first edition, but this has not been carried so far as to prevent a certain independence of the student and a possible variation of the apparatus used in the course.

Watson's "text-book" is of an entirely different character. It is more of the nature of Kohlrausch's "Leitfaden" and contains nearly 200 experiments. An introduction of forty pages treats of general methods used in the reduction and discussion of the results of physical measurements, and an appendix of twenty pages contains short practical information as to glass blowing, work with fused quartz, silvering glass, mounting of cross wires in telescopes and microscopes and the use of manganin wire for the construction of standard coils.

The book is intended for students who "have already spent a little time in the laboratory," and for such it is an excellent reference book with its wealth of information and the emphasis laid upon influences of errors. It is, of course, not expected that any class should work through all the experiments described, but that the teacher will make a selection from them.

The book is distinctly for undergraduate instruction, including the most elementary exercises given in any physical laboratory. Probably on account of its elementary character no measurements of dielectric constants and no experiments in atmospheric electricity or with electric waves are given.

While a manual of the "American" type, as Sabine's, seems more suited for beginners in laboratory work, especially in our colleges where large classes must be handled by one instructor, Watson's text-book would be particularly suited for a course in which not all time is spent in practical work, but where some collateral reading is required. Any student specializing in physics ought to be acquainted with the contents of the book.

K. E. Guthe

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SOCIETIES AND ACADEMIES

SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

Twenty-second Meeting

The twenty-second meeting of the Society for Experimental Biology and Medicine was held at the Rockefeller Institute for Medical Research, on Wednesday evening, April 17. The president, Simon Flexner, was in the chair.

Members present—Auer, Beebe, Burton-Opitz, Calkins, Carrel, Emerson, Ewing, Field, Flexner, Gibson, Gies, Hatcher, Kast, Levene, Loeb (L.), Meltzer, Morgan, Noguchi, Richards, Salant, Shaffer, Teague, Torrey, Wadsworth, Wallace, Wolf, Wood.

Members elected—R. R. Bensley, William T. Councilman, Ludwig Kast, Waldemar Koch, W. J. MacNeal, F. P. Mall, T. Brailsford Robertson, Oscar Teague, Richard Weil.

Abstracts of the Communications[2]

Wounds of the Pregnant Uterus: Leo Loeb.

Experiments were carried out on twenty-six guinea-pigs at different stages of pregnancy. Wounds were made in various directions in the uterus, or part of the wall of the uterus was inverted so that the mucous membrane was turned outside. It was found that at a certain stage of pregnancy, namely, from the fourth to the sixth day, nodules of decidual tissue were formed at places where the continuity of the uterus had been interrupted or where the mucous membrane had been inverted. Serial sections of these nodules showed that they consisted of typical decidual tissue, which did not include a developing ovum. Between the third and fourth weeks after impregnation, such nodules became necrotic.

These experiments were also of interest in seeming to show that under ordinary conditions it is not possible to produce an abdominal pregnancy in the guinea-pig by various injuries of the uterus.

The Effect of Light on the Staining of Cells: Leo Loeb.

In solutions of dyes (neutral red, eosin, methylene blue, methyl violet and others), cells (eggs of Asterias) are stained differently, according to whether the cells and solutions are exposed to the light or kept in the dark.

The difference in the staining of cells in the light and dark is caused by at least two different effects of the light. (*a*) The light causes primary changes in the cells, and the difference in the staining of cells in the light and in the dark is caused by those primary changes which the light produces in the cells. This applies to staining with eosin, neutral red, and with certain mixtures of eosin and methylene blue, and eosin and neutral red. (*b*) The light changes primarily the staining

[2] The abstracts presented in this account of the proceedings have been greatly condensed from abstracts prepared by the authors themselves. The latter abstracts of the communications may be found in Number 5 of Volume IV. of the society's proceedings, which may be obtained from the secretary.

solutions and the staining of the cells corresponds to the primary changes in the staining solution. This applies to staining with pure methylene blue and to such mixtures of methylene blue and eosin as contain much methylene blue. It also applies, perhaps, to solutions of hematoxylin. The staining of the cells in the light as well as in the dark depends also upon the proportions in which both dyes are present in the mixture.

It is possible to distinguish the two factors stated under *a* and *b* by killing the cells with heat. The effect of light upon the cells which is caused by its direct action upon them, disappears if the cells have been previously killed. The changes, on the contrary, which are secondary to the primary changes in the staining solutions still occur.

Means which diminish the oxidative processes in the cells (*e. g.*, addition of KCN) and also saturation of the solution with oxygen, do not modify markedly the differences in the staining of the cells in the light and in the dark.

The Abolition of Visceral Pain by Intramuscular Injection of Cocaine: a Demonstration: Ludwig Kast and S. J. Meltzer.

It was shown that the intestines of a normal dog under slight ether anesthesia were not devoid of the sensation of pain and that cocaine (intramuscular injection) abolished the pain through a remote anesthetic effect.

The Effect of Nephrectomy upon the Toxicity of Magnesium Sulphate when given by Mouth: a Demonstration: S. J. Meltzer.

It was shown that in nephrectomized rabbits, magnesium sulphate produces a profound general effect even when given by mouth, and that the absence of such an effect after the usual administration of the compound is due to the comparatively prompt elimination through the kidneys of a large part of the absorbed salt, thus preventing at any given time the accumulation within the organism of a quantity equal to a toxic dose.

Observations on a Rabbit for Thirty Months after the Removal of the Superior Cervical Ganglion: S. J. Meltzer.

The left superior cervical ganglion of a full-grown gray male rabbit was removed October 14, 1904. The animal died April 23, 1907. During the last eighteen months of its life *the blood vessels of both ears were never very wide and showed but little of the usual rhythmical changes.*

After removal of the ganglion, a subcutaneous injection or an instillation of adrenalin into the conjunctival sacs of the rabbit caused dilation of the pupil on the side from which the ganglion was removed. *This biological test for the absence of the ganglion* was frequently made within the two and a half years of the animal's life and it was found that a *subcutaneous or intramuscular injection or an instillation of adrenalin invariably caused a long lasting dilation of the left pupil.* In further harmony with this proof that the ganglion was not regenerated, or at least the post-ganglionic and preganglionic nerve fibers did not grow together, it was found that while stimulation of the right sympathetic easily caused the usual effects upon the ear vessels and pupil of the corresponding side, *stimulation of the left cervical sympathetic caused no changes whatever in the left pupil or in the vessels of the left ear.*

During the last twelve months of the rabbit's life, the dilation of the left pupil never attained the same degree as during the earlier period. Further, an intramuscular injection of adrenalin, which in the early period caused dilation of the pupil within two or three minutes, lately developed its effect very slowly. Finally the constricting effect of eserin was only partly overcome by an injection or instillation of adrenalin, whereas in the early period the effect of eserin was completely overcome by adrenalin.

Within the last ten months the *right pupil was permanently distinctly larger than normal and responded sluggishly to light. An injection of adrenalin caused a distinct constriction,* which lasted about fifteen minutes. After the above-mentioned stimulation of the cervical sympathetics, *the permanent dilation of the right pupil disappeared for about five weeks and an injection of adrenalin had no effect upon the pupil.*

At the autopsy, no sign of a ganglion could be discovered on the left side.

Intra-abdominal Pressures: HAVEN EMERSON.

In dogs the pressure varied from 2 to 45 mm. of water above atmospheric, *i. e.*, positive; in cats from 2 to 20 mm. positive; in rabbits from 2 to 25 mm. positive; in calves from 2 to 10 mm. positive.

The causes of this persistent but fluctuating positive pressure within the free peritoneal cavity are the tone of the muscular walls of the peritoneal cavity, including the diaphragm and the pelvic floor. The contraction of the diaphragm is the chief, if not the only factor in the normal rise in pressure during inspiration.

Debilitated states show a low pressure. Ether anesthesia causes a gradual drop in pressure until, with complete loss of muscular tone, the pressure reaches zero. Curare likewise causes a progressive fall to zero pressure. Asphyxia develops great rises in pressure during inspiration until muscular relaxation allows a drop to zero just before death.

Excessive pressure artificially produced within the peritoneal cavity causes death from cardiac failure before the obstruction to respiratory excursion has developed a marked asphyxia. The pressure is the same at all points of the peritoneal cavity, and is subject to identical variations wherever the recording trocar is placed.

The physiological function of these pressure conditions seems to be chiefly in assisting the circulation of blood and lymph, thereby playing an important rôle in the processes of absorption and elimination, which take place within the abdomen.

On the Influence of CO_2 on the Viscosity of the Blood: RUSSELL BURTON-OPITZ.

The dogs used in these experiments received alternately a supply of normal air and air charged with CO_2. During the period of inhalation of the air plus CO_2 the arterial blood showed a somewhat greater viscosity than during the time when the animal breathed normal air. The changes appeared very promptly, but were never very conspicuous. The specific gravity of the blood pursued a course parallel to that of the viscosity.

Agglutinins and Precipitins in Anti-gonococcic serum: JOHN C. TORREY.

Rabbits and other laboratory animals, when inoculated with cultures of gonococcus, raise specific agglutinins and precipitins.

Normal rabbit serums contain different amounts of agglutinin for gonococcus. Strains of gonococci differ greatly in the titer of their agglutination with various gonococcic immune serums. After one inoculation with a certain culture, a large amount of agglutinin was produced for some strains, but none for others.

Absorption experiments indicate that an anti-gonococcic serum may contain, in addition to the specific homologous agglutinins, several groups of agglutinins which act on the different cultures quite independently of one another. At least three groups were found, whose major or specific agglutinins are not removed by inter-absorptions. This indicates that as far as agglutination is concerned, there are specific differences between these groups. The family gonococcus is, accordingly, heterogeneous rather than homogeneous, and in that respect resembles the dysentery, colon and streptococcus families. In making a serum for therapeutic purposes, this fact should be borne in mind.

The passage of a culture of gonococcus through a guinea-pig caused a very marked decrease in its agglutinability. With the exception of one serum, meningococcus agglutinated only in low dilutions of the anti-gonococcic serums.

Anti-gonococcic serum contains specific precipitins for gonococcus. There appeared to be no relation between the precipitating and the agglutinating properties of an anti-gonococcic serum for a culture of gonococcus.

Anti-gonococcic serums contain, as a rule, some precipitins for meningococcus, but none for *m. catarrhalis* or *staphylococcus*.

There is evidence of a relationship between gonococcus and meningococcus, but not of as close a one as has been described by some investigators.

On the Separate Determination of Acetone and Diacetic Acid in Diabetic Urines: Otto Folin.

Measure 20–25 c.c. of acetone solution or urine into an aerometer cylinder and add 0.2–0.3 gm. of oxalic acid or a few drops of 10-per-cent. phosphoric acid, 8–10 gm. of sodium chloride and a little petroleum. Connect with the absorbing bottle (as in the ammonia determination), in which has been placed water and 40 per cent. KOH solution (about 10 c.c. of the latter to 150 c.c. of the former) and an excess of a standardized solution of iodine. Connect the whole with a Chapman pump and run the air current through for 20–25 minutes. (The air current should be fairly strong, but not as strong as for the ammonia determination.) Every trace of the acetone will now have been converted into iodoform in the receiving bottle. Acidify the contents of the latter by the addition of concentrated hydrochloric acid (10 c.c. for each 10 c.c. of the strong alkali used) and titrate the excess of the iodine, as in the Messinger-Huppert method, with standardized thiosulphate solution and starch.

The estimation of the acetone can be made simultaneously with the determination of the ammonia, by the use of the same air current and even in the same sample of urine, but the author does not recommend such simultaneous determinations except for cases where the amount of available urine is small.

On Magnesium and Contractile Tissues: Percy G. Stiles.

The author extended and confirmed the findings of Meltzer and Auer. Magnesium was found to have a direct inhibitory effect on automatic tissue (plain and cardiac muscle) and a depressing effect upon the irritability of the non-automatic striped muscle. This influence is slow to wear off after the application, but seems generally to favor the longer activity of the muscle—in other words, it is conserving in character. Magnesium appears to be the element to which we may look with most reason when seeking an agent that shall suspend katabolic changes without permanently damaging living structures. It is clearly less hurtful than potassium in like concentration. Comparison of magnesium with potassium shows that the former is not so distinctly the antagonist of calcium as is the latter. It also seems probable that the power to mediate vagus inhibition, which Howell fixed upon potassium, is a unique property of that element and not shared by magnesium.

On the Extracellular and Intracellular Venom Activators, with Special Reference to Lecithin, Fatty Acids and their Compounds: Hideyo Noguchi.

Calcium chloride stops venom hemolysis caused in the presence of oleic acid or soluble oleate soaps, but not that induced by lecithin. In the majority of serums, including those of man, horse, guinea-pig, rabbit, cat, rat, hen, pigeon and goose, there exist greater or less amounts of venom activators, and they can be completely inactivated by calcium chloride. Judging from the fact that lecithin in an available form is not affected by this salt, it is not likely that these serums owe their venom activating property to lecithin. As these activators are also extractable with ether they probably are nothing else than certain fatty acids, and, probably, soluble soaps. Dog's serum offers an exception to this, and contains, besides fatty acids and soaps, also activators of the nature of lecithin, for calcium chloride fails to stop completely its venom activating property. This lecithin-like activator is not extractable with ether, but is precipitable together with the serumglobulin by half saturation with ammonium sulphate. While the serum globulin falls out as a precipitate during dialysis, this activator remains in the solution, from which a large percentage of lecithin is extractable with warm alcohol. In many respects this appears to be a protein compound of lecithin and possibly is identical with Chabrie's albumin, which seems to be absent from the majority of normal serums, which develops in any serum heated to coagulation, and which renders all serums equally venom activating. Ovovitellin is another form of protein compound containing lecithin in available form for venom. On the other hand, pure serum globulins or serum albumins are not venom activating, notwithstanding their content of alcohol-extractable lecithin. Non-activating serum can be made activating by adding small quantities of oleic acid or oleate soaps.

The degrees of susceptibility of corpuscles are parallel to the amounts of fatty acids which they contain. The absence of fatty acids is associated with total insusceptibility of the corpuscles to the hemolytic agent of venom. The amounts of lecithin extractable from corpuscles are about the same in different bloods and bear absolutely no relation to susceptibility. The addition of adequate amounts of calcium chloride stops venom hemolysis with washed corpuscles of susceptible species. A previous addition of a small amount of lecithin annuls protection by this salt. A small amount of oleic acid or soluble oleate soap, which is insufficient to produce hemolysis alone, can render the corpuscles of insusceptible species hemolyzable by venom. An oily substance can be extracted with ether from the stoma of susceptible corpuscles, but not from the insusceptible varieties. This oily mass is venom-activating, but contains no lecithin.

On the Influence of the Reaction, and of Desiccation, upon Opsonins: Hideyo Noguchi.

The author found that opsonins were most active in neutral liquids. An alkalinity exceeding $n/20$ KOH prevented opsonization. An acidity of $n/30$ HCl was sufficient to stop the opsonic function of serum. Neutralization of excessive alkalinity or acidity caused reäppearance of opsonic activity. On the other hand, an alkalinity or an acidity approaching that of the normal alkali or acid produced a condition of irreversibility of the inactivation. The opsonic index, estimated in the normal alkaline reacting serum, was far lower than that in a neutral medium.

The high stability of opsonins against desiccation and the high thermostability of dried opsonins are very striking. Almost no reduction of opsonic strength is evidenced after a serum is completely dried at 23° C. within a few hours. In the dry state, opsonins are well preserved even after two years. Temperatures below 150° C. do not destroy opsonins in the dry state. After heating at 150° C., dry serum becomes difficult to dissolve, but opsonins may still be detected in it.

Complements withstand desiccation and dry heat in a manner similar to the resistance of opsonins.

On Decomposition of Uric Acid by Animal Tissues: P. A. Levene and W. A. Beatty.

In these experiments uric acid was subjected to the action of spleen pulp in the presence of 2-per-cent. of ammonium hydroxide and 2 per cent. of acetic acid. Under both conditions 50 per cent. of the uric acid present was decomposed. Allantoin was one of the decomposition products.

On the Diuretic Action of Thymin: P. A. Levene.

The experiments were carried out on a dog with an Eck fistula. The dog had been kept on a purin free diet many weeks before the experiment was begun. For three weeks preceding the experiment the water consumed by the dog and the urine eliminated were carefully measured. It was noted that administration of thymin was followed by marked diuresis.

On Lysinglycyl obtained in the Tryptic Digestion of Egg Alumen: P. A. Levene and W. A. Beatty.

In the process devised by the writers a year ago for preparing the peptid, prolinglycyl, a substance was produced from egg albumen, which, on further cleavage, yielded only lysin and glycocoll. The substance could not be crystallized. The authors called attention to the fact that peptids of the hexon bases obtained by Fischer and Suzuki synthetically also failed to crystallize.

William J. Gies,
Secretary

DISCUSSION AND CORRESPONDENCE

THE PARASITISM OF NEOCOSMOSPORA—INFERENCE VERSUS FACT

In May of last year an article by Howard S. Reed, now of the Bureau of Soils, United States Department of Agriculture, appeared in Science (page 751), entitled "The Parasitism of Neocosmospora," this being made up largely out of a bulletin soon after published by the Experiment Station of Missouri. The article in Science and the bulletin are based on some confessedly incomplete work (bulletin, page 64) done at the University of Missouri with a *Fusarium* isolated from diseased ginseng plants. The contribution in Science is occupied chiefly with a criticism of some of my own conclusions published several years ago in a Department of Agriculture bulletin. This tardy reply is due to the fact that I have only recently read the article.

My first thought was that I must go all over my own work to see how I could have fallen into such an absurd error. On consultation, however, with one of my colleagues, who has been much engaged in recent years with diseases of this class, I found he had saved me this labor. Also on a second more careful reading of Dr. Reed's article in Science, and especially on reading his bulletin, I found so many unwarranted inferences that it seemed hardly worth while to consider his criticisms seriously. However, as his statements have entered into literature with the same face value as my own, especially for those who do not look into scientific writings very closely, I am compelled to make this answer.

I am not specially interested one way or another in the ginseng fungus as such. It may be a weak facultative parasite entering exclusively through wounds made by other fungi, as Dr. Reed asserts; although nothing in his writings clearly establishes this fact. The points at variance between us will be better understood if I first summarize the author's actual facts and then his inferences.

First as to the facts or supposed facts.

1. He found a *Fusarium* wilt of ginseng and also an anthracnose of ginseng. He states that wilting ginseng plants in all cases were previously attacked by the stem anthracnose, and further that the *Fusarium* entered the ginseng plants exclusively through stem-wounds made by this anthracnose.

2. He states further that on inoculating soils with the ginseng fungus, which soils were then planted with watermelon-seeds, he obtained a wilt of the melon-seedlings and found a *Fusarium* inside the stems (one experiment, three pots). Ginseng fungus, perhaps (?). When, however, he sterilized the soil in the autoclave and then inoculated it with his fungus and planted watermelon-seeds in it, the seedlings remained healthy for twelve weeks, although the fungus (ginseng fungus, be it remembered) grew abundantly in the soil.

3. He sprayed a "thoroughly underdrained" field of ginseng with Bordeaux mixture, and neither disease appeared in it. The *Fusarium* wilt appeared in a neighboring unsprayed field, which, however, belonged to another man and was not underdrained. From this he concludes that Bordeaux mixture is a remedy for the disease.

Some of the inferences I think unwarranted are the following:

1. The ginseng-fungus belongs to the genus *Neocosmospora.*

2. This ginseng-fungus and the watermelon-fungus first described by the writer as *Fusarium niveum* are identical.

3. The watermelon-fungus can enter the plant only when a way has been opened for it by other fungi, *e. g.*, by *Thielavia.*

4. Other *Fusaria* are in the same case. My conclusions, therefore, respecting the parasitism of the melon-fungus and similar forms for which I made the genus *Neocosmospora,* are erroneous.

This sufficiently outlines the points of difference between us.

Before passing to the manifest inferences, it may be remarked that neither from the article in Science nor from Dr. Reed's bulletin can it be concluded with any certainty how his fungus enters the plant (bulletin, page 50), or whether, as he asserts, spraying with Bordeaux mixture will prevent the disease, either acting directly or indirectly. He states that the ginseng fungus is a wound parasite, but, so far as I can see from any facts advanced, this is only an assumption which may or may not be true. I should like to know whether this is entirely a *post hoc* conclusion or something which was actually demonstrated, and if so, how demonstrated, and why he has not published his proofs? He nowhere says that he actually found the *Fusarium* entering the plant through wounds in the stem caused by the anthracnose, although this, from the standpoint of his hypothesis, was one of the first things to look for and to be made out *conclusively*, not *inferentially*, especially if he proposed to use it as a basis for criticism.

To come now to those things which relate specially to my own work and are manifestly unwarranted inferences:

1. How does he know that the organism he worked with belongs to the genus *Neocosmospora?* He states distinctly that he did not find any perithecia. We know that not all members of the form-genus *Fusarium* belong to *Neocosmospora*, and also that inspection of the imperfect stages does not suffice to tell. This then is an uncertain inference put forward as a fact.

2. How does he know that his identification of the ginseng-*Fusarium* with the watermelon-fungus is correct? I doubt it. He did not make any comparative study of the two fungi, although it would have been easy for him to obtain the melon-fungus, since the disease is widespread in the southern United States, and probably occurs in Missouri, possibly in some of the soils he worked with. Why did he not make comparison between the two organisms rather than between his organism and my description?

3. How does he know from his very limited experiments with one species that all *Fusaria*, and the *Neocosmosporas* in particular, are weak parasites? He states that he found the ginseng fungus to be a weak parasite, but I have just pointed out that even this is not established conclusively from his papers. How, then, can the much larger inference be sustained? One can not reach general conclusions from a single particular. It does not need any very extensive course in logic to convince one of this.

4. How can inferences of any value respecting this group of fungi be based on such a sandy foundation? From his statements the reader is led to think that the watermelon fungus must be a weak parasite and that the plant must first be attacked by *Thielavia basicola* or some other fungus before the *Fusarium* can possibly find an entrance into it, although Dr. Reed probably never saw the melon-fungus, and has not *proved* that the ginseng-fungus can not enter the plant in the absence of wounds.

When this paper of Dr. Reed's first came out, I was in Europe, but my colleague, Mr. Orton, obtained cultures of the ginseng-fungus from Dr. Reed and carefully compared it on various culture media with the watermelon-fungus which we had in culture in the laboratory, and found that they behaved differently and were probably not identical organisms. This is the sort of work Dr. Reed ought to have done and not left for some one else to do.

Mr. Orton also made in one of our hothouses the following three sets of inoculation experiments, using autoclaved soil:

1. Watermelon-plants; the soil inoculated with the ginseng-*Fusarium*, obtained from Dr. Reed. Ten inoculated pots and ten control pots.

2. Watermelon-plants; the soil inoculated with the cotton-*Fusarium*. Ten inoculated pots and ten control pots.

3. Watermelon-plants; the soil inoculated with the watermelon-*Fusarium*. Ten inoculated pots and ten control pots.

The results were as follows:

1. No cases of melon-wilt in the pots inoculated with the ginseng-organism. (Experiment agrees with Dr. Reed's corresponding experiment.)

2. No cases of melon-wilt in the pots inoculated with the cotton-organism. (Experi-

ment agrees with Smith's earlier statements; Bulletin 17.)

3. Typical watermelon-wilt in the pots inoculated with the watermelon-*Fusarium*. All of the ten plants growing in this autoclaved soil contracted the disease. They were watered with distilled water until the plants began to develop the wilt, and then they were watered with ordinary hydrant water.

(4) All the uninoculated plants (30 pots) remained free from disease.

Because one fungus in a group is a feeble parasite, it does not follow that all are, and especially in the absence of experimental data. The writer never maintained that all species of the form-genus *Fusarium* were active producers of disease. In fact, when he began to study this group, all of them were supposed to be saprophytes, and he was, I believe, the first one to maintain and *to demonstrate* that certain members of the group are among our most destructive fungi. This work has been built upon largely in certain quarters, with very scant credit to the writer. Such matters, however, even themselves up in the long run and credit finally goes where it belongs.

The moral of all this is that when one assumes the rôle of critic he ought to be reasonably certain of his facts.

Erwin F. Smith

August, 1907

ENGLISH AS SHE IS WRITTEN

Ever since it was authoritatively decided that "The United States is," and not "are," there has been increasing departure from what was not long ago considered good grammar, especially in the newspapers. We do not expect the "dailies" to lead in correct diction, however desirable this would be from the fact that the reading of the bulk of our population is done in their columns, and serves the younger generations as their preferred literary food. We are so accustomed to having the papers pervert the nation's English that we rather expect to see all kinds of grammatical and syntactic horrors perpetrated in our morning papers. And Science could hardly be expected to bring much pressure to bear upon the journalistic world in inducing them, *e. g.*, to use the nominative instead of the accusative case when stating that "whom it is well known has been," etc., a form to be found in every daily for the last two or three years. But when Science, as well as some other journals of high standing, admits into its columns such statements as that "the underlying strata was a soft limestone," and that "this phenomena was closely observed by us," and that "we owe this data to the courtesy of Mr. ——," it does seem that the restriction of the scientific curriculum to so much language study as is provided for iu the high schools is proving unfortunate. Perhaps the inauguration of the much-needed spelling reform, which is considered by some as obliterating important landmarks, has contributed to the feeling of linguistic irresponsibility on the part of juvenile specialists in particular. But would it not be proper to consider the correction of such palpable mistakes as part of the duty editors owe to the public; if only to prevent us from being charged with illiterate perversion of the language by our cousins across the Atlantic?

E. W. Hilgard

Berkeley, Cal.,
August, 1907

[The proofs of Science are read each week by three professional proofreaders, and most, though unfortunately not all, grammatical errors are corrected. Errors such as those quoted by our correspondent are like infringements of the etiquette of polite society—they are especially dreaded; but they are minor matters, and may indeed be in the line of linguistic evolution. It must be admitted that the English language is used with greater correctness and skill by men of science in Great Britain than in the United States. This is probably due to the fact that English men of science come as a rule from a comparatively small class in which the use of correct English is a social tradition.—Editor.]

THE ARTIFICIAL PRODUCTION OF MUTANTS

In Science for July 19 Professor T. D. A. Cockerell gives an appreciative review of Tower's "Investigation of Evolution in Beetles of the Genus *Leptinotarsa*," a recent publication of the Carnegie Institution, and in a closing paragraph says:

> One of the truest tests of the intellectual status of a country is found in its ability to quickly realize the importance of a work of the first class. Since this book came out I have asked a number of naturalists whether they had read it, and so far have failed to find one who has given it more than superficial attention.

It had appeared to me for some time that botanists in the United States were in something the same case as the zoologists in regard, on their part, to the one successful series of demonstrations that have yet been made of the production of mutants of plant species by means of definite chemical stimuli. It was, therefore, a pleasure in reading SCIENCE for June 7 to find that Dr. James B. Pollock (presidential address before the Michigan Academy of Science) had clearly recognized the significance of recent experimental work with plants, which, perhaps, still more fully than Tower's work on beetles, has established the mode of origin of certain species. To quote from Pollock: "De Vries offers no explanation as to how these new characters are produced, but MacDougal has succeeded in producing new modifications by artificial means . . . injecting various substances into the capsules of plants experimented upon, before the eggs were fertilized," leading to the "important conclusion that in an early stage of development of the plant egg it may be so profoundly modified that the adult plant resulting from it is decidedly different from what it would have been had the egg not been so modified, and the modifications thus produced are transmitted to the next generation through the seeds."

With this very definite presentation of the subject I am disposed to assume that the work referred to is, after all, well known to botanists, but that thus far only here and there one has taken occasion to refer to it in generally accessible publications. Be this as it may, I wish to heartily second the efforts of Professor Cockerell in calling attention to the epoch-making character of Tower's experimental study of the potato beetles and their allies, and to place with them the equally important work of MacDougal, recording at the same time my conviction that there is no line of biological investigation, with which I am acquainted, that better deserves support or the abandonment of which would be a greater loss to science. I can hardly think, however, that the Carnegie Institution, one of the chief functions of which is to discover just such "leads" and provide for their following through to a successful issue, will abandon either of these investigations, already the most fruitful in actual results that have been undertaken since the "Origin of Species" appeared.

V. M. SPALDING

TUCSON, ARIZ.

SPECIAL ARTICLES

PATAGONIA AND ANTARCTICA[1]

IT seems that the study of the fossil fauna of South America should attract the attention of the congress, at this time when increasing efforts are being made to enter into touch with the problems of the antarctic world.

Since the discoveries of Carlos and Florentino Ameghino, numerous works on the fossil fauna of Patagonia have been published. We have been enabled to add some contributions to this literature from the rich collections sent by A. Tournoüer to the Jardin des Plantes.

Up to the present time, the researches in the northern hemisphere, whether in the United States or in Europe and Asia, have shown an agreement in the development of life. The progress of evolution has been so uniform that we find beings of the same epoch in almost the same stage of evolution on different parts of our hemisphere. Thus, from the stage of the development of fossil animals and knowing their genus or species, we can often estimate for geologists the age of the deposit (terrain) in which they are found.

Patagonia has just shown us that this is

[1] Paper read before the seventh International Zoological Congress, translated by L. M. F.

not the case in the southern hemisphere. The fauna of Casarmagu (or of Cerro Negro) is related to that of Torrejon and Puerco, about which the scientists of the United States have made some remarkable revelations, and also bears a resemblance to the fauna of de Cernay near Reims, discovered by the late Dr. Lemoine. The fauna of later epochs, the Deseado, Coli-Huapi, Santa Cruzian and Pampean, has not a single genus comparable to those on our hemisphere, and shows an arrest in the development. No mammal has become a paridigitate pachyderm, a ruminant, a soliped like ours, a proboscidian, a placental carnivore or an anthropoid ape. To be sure, the bones are homologous and many of them resemble the bones of our animals. But the association of the characters is very different. For example, in *Pyrotherium* the hind quarters resemble those of proboscidians, but the forelegs show an entirely different attitude. In limb structure *Astrapotherium* recalls the dinoceros of the United States, but its dentition is different. *Colpodon* and *Nesodon* differ less in their dentition from our Ungulata than from other animals, but they have carnivore limbs and their tridactyl hind foot is plantigrade. The gigantic *Homalodontherium* shows still better the association of ungulate and carnivore characters. Many more examples could be given showing to what extent the fossil mammals of South America are specialized and how little they resemble in appearance the fauna of the northern hemisphere.

This statement is of considerable importance to explorers of the antarctic world. When the Institute of France commissioned some of its members to collect information for the next voyage of Dr. Jean Charcot, I published a note in which I pointed out what they might expect to discover in Antarctica, judging from what we know of the paleontology of South America.[2]

I noted that the existence of the various large animals of Patagonia can not be accounted for in conditions analogous to the actual ones. In the Eocene period, the Deseado has powerful quadrupeds: *Pyrotherium, Astrapotherium, Homalodontherium, Colpodon, Palæopeltis* and many other herbivorous genera. This presupposes a luxuriant vegetation and hence a degree of warmth which is in marked contrast to the present cold climate. Furthermore, it presupposes an extent of territory very different from the present narrow space of Patagonia; for it is an admitted fact in zoology that the size of mammals is in direct proportion to that of their habitat. The fauna of Deseado and of Coli-Huapi, which came immediately after, can not be explained unless Patagonia is the remnant of a vast antarctic continent.

In the Miocene period appeared the fauna of the Santa Cruzien with its quantities of large *Nesodon, Astropotherium, Homalodontherium,* diversified Edentates and so forth. It is equally impossible to understand this fauna if it did not live on an antarctic continent.

In the period of the Pampas the terrestrial fauna became more powerful than all the former ones. *Megatherium, Mylodon, Lestodon, Scelidotherium, Glyptodon, Toxodon* and *Macrauchenia* in life size must have constituted one of the most imposing sights in the history of the world. This fauna is the most difficult of all to account for, if it did not live on an immense antarctic continent with a rich vegetation and warm climate. Since South America is only 1,000 kilometers from Antarctica, it is improbable that this region was at that time under ice and submerged. In his report of the expedition of the *Belgica,* Mr. Cook has written: "*The Soundings taken between South America and the South Shetlands and those made in Antarctica show clearly the existence of a continental plateau.*"[3]

Hence a determination of the age of the Pampas is of great importance for a closer knowledge of the antarctic continent; this

[2] Institut de France, Académie des sciences, "Instructions pour l'Expédition antarctique organisé par le Dr. Jean Charcot. Palæontologie," par Albert Gaudry, p. 19, 1907.

[3] Cook, "Kis le Pole Súd, Expédition de la Belgica," 1897–9, p. 8.

should give us information about the time when the antarctic lands sank for the last time and became covered with ice.

The age of the Pampas is difficult to determine by means of the mammals indigenous to Southern America since they differ so much from those of our country that a comparison of the two teaches us nothing. However, among so many remarkable facts shown by the paleontology of the new world, one of the most singular is the invasion of the genera of the northern hemisphere, the Mastodons, *Hippidium*, tapir, llama, peccary, *Machairodus*, bear, etc., among the animals of the Argentine Republic which show an absolutely different physiognomy.

The best known of the new comers, *Mastodon Andium* is not quaternary in Europe nor in the United States. Cope found it in the Pliocene of Blanco, Texas. The *Mastodon angustidens* and *Pentelici* of the European Tertiary are not far removed from it.

Hippidium neogœum and the species of *Hippidium* with eye-pockets (?) known as *Onohippidium*, are more nearly related to the pliocene forms of our country (*Equus stenonis*), than to the Quaternary horses. Dr. Matthew has said: "*The teeth of Hippidium are like those of Phiohippus (upper Miocene) from which it is supposed to be descended.*"[4]

The genus Tapir, unknown in the quaternary, is well distributed in the European Pliocene; it might have sprung from *Tapiravus* of the upper Miocene.

In the simplicity of the dentition of its molars the peccary is an archaic type; it is found in the upper Miocene.[5]

The llama (*Auchenia*) is possibly derived from the *Pliauchenia* of the Pliocene of Blanco.

Machairodus, in the United States and in Europe, has left numerous tertiary remains. Mr. Boule has reported on the *Machairodus aphanistes* of Pikermi and *Machairodus neogœus*.[6]

Ursus bonariensis which has persistent præmolars and shortened molars differs less from the tertiary bear of our country than from *Ursus priscus* and *U. spelœus* of the quaternary.

If to these citations we add the fact that no elephant has appeared in Southern America, we may suppose that the invasion of the forms of the northern hemisphere took place in the pliocene and not in the quaternary. Dr. Osborn has pointed out recently that the invasion of the Edentates of South America and the migration of the North American mammalia into South America, was quite characteristic of the pliocene phase in the United States.[7] It is important to note that, according to the lists of fossils, divided into numerous stages by Mr. F. Ameghino, it is only from the time of the lower Pampéen that the animals of the north multiplied.[8] They are not present in the beds of Mt. Hermoso.

The greater part of the Pampéen beds are Pliocene, but this is no reason why the uppermost should not belong to the quaternary. Mr. Ameghino attributes the lowest beds of the Pampéen which he calls Lujanean (?) to this deposit (terrain). Now in these beds the American animal world shows still more strength, since the quadrupeds from the United States are there side by side with the gigantic animals born in the southern regions. If the age attributed to the Lujanean is correct we must conclude, from our remarks above, that, at the beginning of the quaternary, that is to say in the epoch when Man was living in Europe, the antarctic territory could not have been completely separated from America. It would not be impossible to find buried

[4] Matthew, "Illustrations of Evolution among Fossil Mammals," *Bull. Am. Mus. of Nat. Hist.*, Vol. III., Extr. 1903, p. 24.

[5] Blainville in his "Osteographie" has said that the peccary is the *Sus* with the simplest and most normal dentition.

[6] Boule, "Revision des espèces Européennes de Machairodus," *Bull. de la Soc. géol. de France*, 4me Séries, vol. 1, p. 572, 1901.

[7] Osborn, "Tertiary Mammal Horizons of North America," *Bull. Am. Mus. Nat. Hist.*, Vol. XXIII., p. 251, 1907.

[8] Florentino Ameghéne, "Les formations Sédimentaires du Crétacé Supérieur et du Tertiares de Patagonie," no. 8, pp. 480–498, Buenos Aires, 1906.

there *Megatherium, Mylodon, Macrauchenia, Hippidium, Mastodon* and many other quadrupeds. Mr. Otto Nordenskjöld has found tertiary plants there; remains of quadrupeds, will also be met with.

The Antarctic world offers a magnificent field for discovery to explorers.

Albert Gaudry

QUOTATIONS

THE PHYSICIAN IN THE SCHOOL

The International Conference on School Hygiene, held in London this month, raised many questions which should search the hearts of teachers, parents, and taxpayers in America. Some of these questions we have already been debating. In this city last winter Superintendent Maxwell urged that the eyes of school children be examined, and that glasses be provided—if necessary at public expense—for those whose sight is defective. The shortest way with such a proposal is to give it a bad name and damn it. Accordingly, the plan was received by a part of the press with jeers and cries of "Socialism!" Mr. Maxwell's reply was in effect that we are spending millions a year for teachers, buildings, text-books, and apparatus; and that it is worth while to lay out a little more in order to enable all the children to profit by these facilities. In an article in our own columns last April he said:

> It seems folly to supply books to children who can not read them, or to place children in classrooms when they can not see what is written or drawn on the blackboard. If the sight is defective, the child is hopelessly handicapped. The expenditure of a few thousand dollars for glasses would enable thousands of children who are now unable to do their school work to stand on the same level with their fellows.

These words sum up briefly the whole argument for the physical examination of school children and the attempt to keep them in such health that they can fairly avail themselves of the advantages offered. We can not dismiss the matter with a question-begging epithet. Our American school boards must consider the project on its merits, and decide whether, in justice to the children as well as to the community as a whole, we should not devote more attention to the physical well-being of pupils.—The New York *Evening Post*.

CURRENT NOTES ON LAND FORMS

OTAGO PENINSULA, NEW ZEALAND

Otago Peninsula is a land-tied island on the east coast of southern New Zealand. An interesting account of its features is given by P. Marshall, professor of geology in Otago University at Dunedin, near the head of the Otago Bay, which the peninsula encloses. ("The Geology of Dunedin, New Zealand," *Quart. Journ. Geol. Soc.*, LXII., 1906, 381–424). The peninsula is a complex mass of volcanic rocks, which, while the district stood towards 1,000 feet higher than now, was submaturely dissected; that is, the valleys, still narrow and of rapid descent in their upper courses, became more open and of gentler descent in their middle and lower courses; and the slopes came to have only moderate declivity. During submergence to its present level, the mountainous mass was cut off from the mainland by the drowning of a connecting ridge on its northwestern side; it thus became an island, about 14 miles long northeast-southwest, and not more than six miles wide, with summits still reaching more than 1,000 feet above the sea, and with much irregularity of outline as would be expected. Since the district assumed this attitude, the exposed headlands, on the mainland as well as on the island, have been cut back in strong cliffs, from 300 to 800 feet high; the smaller reentrants have been filled with beach-fronted sands; the larger reentrants have been more or less completely enclosed by bay-mouth spits and bars; and Otago strait, as the original water passage back of the island might be called, has been closed at its southwest end, under the guidance of the prevailing long-shore current from the southwest, by a beach-fronted sand-isthmus, which converts the strait into a long bay. The southward direction of growth of several bay-mouth spits and reefs suggests that they are controlled by backset eddies, which sweep around the new-built shore lines between the projecting headlands in a direction opposite to that of the main, long-shore current. Otago peninsula would thus in several respects resemble Banks peninsula, on the same coast farther north; for this is again a dissected and formerly insular volcanic mass with a ragged and cliffed outer shore line, now transformed into a peninsula not only by the flying northeast stretch of Ninety-mile beach, but apparently also by the forward growth of the fluviatile Canterbury plains in the sheltered waters back of the former island.

Marshall's account of Otago peninsula proceeds on the "two bites of a cherry" method of first describing the various surface features, and then explaining their origin. So cautious a method may be appropriated in treating land forms of uncertain origin; but its employment in so simple a case as this one would seem to indicate an undue consideration for those who even in this day need to have it explained that bays are half-drowned valleys. Much space might be saved if the peninsula were briefly described as having been submaturely dissected in a former cycle of normal erosion, and as, after a depression of towards a thousand feet, being now vigorously attacked by the sea on the new shore line which is already advancing towards maturity on its seaward side. It is a great advantage to the reader to have the essence of the story thus presented in condensed form at the outset; the details can then be easily apprehended in their proper relations as they are reached in further reading.

THE FAYÛM DEPRESSION, EGYPT

Imagine a series of strata, of which certain members, *J* to *P*, are 700 meters in thickness, dipping very gently to the northwest. Let the lower formation, *J*, be a resistant limestone, 30 m. thick; the next formation, *K*, a series of weak clays and marls, 70 m. thick; and the following members, *L* to *P*, a succession of alternately resistant and weak strata, 480 m. thick. Conceive the whole series worn down nearly to baselevel in a desert climate, thus producing a broad peneplain on which the beveled strata appear in belts trending northeast-southwest. Now let the peneplain be uplifted with a gradual slope to the north, so as to gain an altitude of 300 or 400 m. in the district here especially considered; and in consequence of this uplift imagine the barren surface to be dissected to a stage of maximum relief by the winds and occasional rains. The weak belt, *K*, will thus be irregularly excavated as a subsequent depression along the strike of the guiding formation; the depression will be bordered on the southeast by a structural or "dip" plain of the underlying limestone, *J*; and enclosed on the north by three cuestas, rising in ragged escarpments, *L*, *N*, *P*, and separated by broad steps, *M*, *O*. The upland beyond the highest escarpment will gradually descend far northward to the sea, younger and younger formations being crossed on the way; while in the opposite direction the rising plain of the underlying limestone cuesta, *J*, will presumably break off in a southeast-facing escarpment overlooking another subsequent lowland eroded on underlying strata; . . . and so on to the basement oldland.

The waste from the depression eroded on the weak belt, *K*, having been largely exported as dust by the winds, the floor of the depression will sink here and there in enclosed basins, which may be excavated even below sea level; and the basins will be separated by low residual portions of the weak strata, which will form what may be described as transverse barriers or ridges—there being as yet no technical name for such features. Along the eastern side of the district, toward which the uplifted peneplain may have had a faint slope, imagine an additional uplift by faulting or monoclinal bending; and along the trough thus defined let a large north-flowing river erode a mature valley through the desert. The western side of the valley will vary in height as it obliquely cuts the several cuestas; with the eastern side we are not especially concerned. While the main valley is worn down contemporaneously with the general dissection of the peneplain, the river happens, by lateral erosion, to wear through the first transverse barrier in the weak beds, *K*, that separates the valley from a neighboring subsequent basin; a branch of the river then flows into the basin and forms a lake; but as the river continues to deepen its valley, it fails after a time to supply the lake, which thereupon disappears by evaporation; only to be formed again later when the river, having aggraded its valley, supplies an artificial canal that is led into the ancient lake-bed for irrigation, with the result of forming a small lake in the bottom of the depression.

Such, in generalized terms, is the impression gained from reading "The topography and geology of the Fayûm province of Egypt," by H. L. Beadnell (Survey Dept. Egypt, Cairo, 1905, maps, sections and fine plates). The river is the Nile. The north-sloping upland is "the great undulating high-lying gravelly desert-plateau which stretches with little change of character to the Mediterranean" (p. 15). Its southern margin is the uppermost escarpment (*P*), Jebel el Qatrani, capped with basalt, which supplies a black talus to the slopes below; it is in these slopes and in those of the next lower escarpment (*N*), that the strata have recently (1901) been found to contain numerous mammalian fossils, for which Osborn's American Museum party has recently searched (see Science, March 29, 1907). Where the Nile valley cuts the next cuesta (*L*), the corner of the escarpment stands forth in a commanding bluff, Elwat Hialla, from which one may gain a broad view up and down the river, with Cairo and the Pyramids in the north, the yet higher escarpment of the uplifted desert plateau on the east, and the first of the subsequent basin-depressions to the southwest, holding the oasis of the Fayûm, watered by the Bahr el Yusef from 200 kil. up the Nile, and the shallow lake, Birket el Qurun, some 40 kil. long, with its bottom about 50 m. below sea-level; while the dip plain of the lower limestone (I, Eocene) ascends slowly in the southern distance. In ancient historic times, the depression contained the much larger Lake Moeris, which then served to regulate the flow of the lower Nile; and in still earlier, pre-historic times here stood a similar lake, now recognized by its silts. Additional small basins occur farther southwest. Still farther away in the same direction, the weak strata rise to "the ordinary desert plateau, on which the outcrops of the beds of successive rock stages follow one another in regular order from south to north, but without forming well-marked topographic features" (p. 27): it is on the strength of this brief statement regarding the beveling of the rock series that we have inferred the (Miocene) peneplanation of the region; possibly an insufficient foundation for a broad generalization. The winds are still effective agents of erosion and transportation; rock ledges are described as wonderfully carved by sand blast (p. 85); and long sand-dune windrows are common, a remarkable one being shown in plate XV.; nevertheless, the occasional action of wet-weather streams is evidently dominant in determining the details of the ragged escarpments, which repeat bad-land forms, familiar in our western country.

Whether the generalized statement given above is correct or not, it is not easy to say; for translations from the topographic description of an observer acquainted with the ground, into systematic physiographic description by a reviewer who has not seen the ground, is admittedly difficult. There need be no question as to the stratigraphic sequence, for that is set forth in the systematic fashion of established geological terminology; but the topographic features produced by the work of desert erosion are not described in terms of standardized type forms, hence the translation from empirical to systematic language is somewhat uncertain.

Shall the linear depressions and reliefs of the Fayûm basin and the escarpments to the northwest be called "vales" and "wolds," as suggested by Veatch (see these notes for June 14, 1907)? The ragged escarpments of the cuestas have no likeness to the softly rounded forms of the Lincolnshire and Yorkshire "wolds"; and the barren misery of the unirrigated desert depressions is strongly at variance with the connotation of an agreeable landscape, usually suggested by "vale."

THE ARID CYCLE IN EGYPT

H. T. Ferrar, lately of the British Antarctic expedition and now of the Geological

Survey of Egypt, briefly inquires under the above title (Survey Notes, Cairo, 1906, 18–20), whether the deserts bordering the Nile offer illustrations of "the geographical cycle in an arid climate" (see *Journ. Geol.*, xiii., 1905, 381–407), and suggests that forms in various stages of arid development are recognizable at many localities. He offers a number of examples of independent basins with local centripetal drainage, which are taken to represent the youthful stage of the arid cycle. "Most members of the Geological Survey [of Egypt] have shown that the Nile valley was once occupied by a series of fresh-water lakes in which calcareous travertine and other lacustrine products were deposited"; but the brief text does not suffice to show whether these basins were "initial," that is, due to inequalities in the originally uplifted land surface, or whether they were due to the long-continued desert erosion of such a surface, the basins being temporarily occupied by lakes during a moist climatic epoch of brief duration. The probability of the survival to-day of any initial basins in the region of the Nile is contradicted by the evidence of long-continued erosion presented in the preceding note. Examples of the disintegration of drainage, supposed to be characteristic of an advanced stage of the arid cycle, are also instanced by Ferrar; but the disintegration here noted is due to obstruction by invading sand dunes, and not to the excavation of shallow basins by wind action, as suggested in the general scheme of the arid cycle.

The interest thus manifested in the physiographic study of desert forms leads us to hope that their detailed and systematic description may be forthcoming in the publications of the Egyptian survey; but the possibility of finding, even in the deserts that border the Nile, the results of arid erosion, not dominated by the occasional action of flooded streams, is made improbable by the account of the sudden rain-floods ("seils") given by H. G. Lyons, director general of the survey department of Egypt in his admirable report on "The physiography of the River Nile and its basin" (Cairo, 1906). A few local rainstorms occur every winter east of the Nile, where the slope from the desert plateau toward the river is well marked. "In about every second year one or other of the larger wadies comes down in flood, sometimes so suddenly as to carry away camels and sheep. . . . Their effect in eroding the desert is immense. . . . These 'seils' are less rare than is usually supposed, and the dry arid appearance of the desert, together with the rareness of rain, cause the effect of such storms as do occur to be underestimated." Yet on the lower desert upland west of the Nile, it appears that the occasional rainfall "drains into shallow windworn depressions and there soaks into the rock or is soon evaporated" (p. 293, 294).

The reviewer finds difficulty here, as in the preceding note, in the attempt to translate a general descriptive account into a systematic account, in terms of structure, process and stage. W. M. D.

INTERNATIONAL CONFERENCE ON PLANT HARDINESS AND ACCLIMATIZATION

An important conference will be held under the auspices of the Horticultural Society of New York on October 1, 2 and 3 in rooms of the American Institute and the Museum building of the New York Botanical Garden.

The preliminary list of papers to be presented is as follows:

D. T. MacDougal, Tucson, Ariz.: "The Determining Factors in the Seasonable Activity of Plants."

Henry C. Cowles, University of Chicago: "Factors that control Acclimatization."

B. L. Livingston, Tucson, Ariz.: "Evaporation as a Climatic Factor influencing Vegetation."

Ernst A. Bessey, Subtropical Laboratory, Miami, Fla.: "Air Drainage as affecting Hardiness of Plants."

Frederic E. Clements, University of Nebraska: "The Real Factors in Acclimatization."

W. M. Hays, Assistant Secretary of Agriculture: "Plant Improvements needed in Specific Cases."

J. C. Whitten, Missouri: "Comparative Hardiness of Plants of the same Variety from Northern and Southern Points."

M. Robert, Algeria: "Observations on Eucalyptus Hybrids; The Japanese Loquat in Algeria; Truth to Seed of Eastern and African Varieties of *Vitis vinifera*."

D. W. May, Porto Rico: "Temperate Zone Plants in the Tropics."

D. Morris, Imperial Department of Agriculture for the West Indies: "Acclimatization of Economic and other Plants in the West Indies."

H. L. Hutt, Guelph, Canada: "Cooperative Testing to ascertain Hardiness in Fruits."

T. V. Munson, Texas: "Resistance to Cold, Heat, Wet, Drought, Soil, etc., in Grapes."

Samuel B. Green, Ohio: "Developing Hardy Fruits for the North Mississippi Valley."

U. P. Hedrick, Geneva, N. Y.: "Hardiness of the Peach."

O. M. Morris, Oklahoma: "Hardiness of Apples."

W. S. Thornber, Washington: "Fruits and Trees in the Northwest."

B. C. Buffum, Wyoming: "Hardiness and Acclimatization of Alfalfa."

S. Fraser, Geneseo, N. Y.: "Some Work with Timothy and Awnless Brome Grasses."

Anthony U. Morrell, Minnesota: "Hardiness of Ornamental Plants in the Middle Northwest."

L. H. Pammel, Iowa: "Studies on the Acclimatization of Plants in the Prairie Regions."

Jens Jensen, Chicago, Ill.: "Observations in the Region at the Head of Lake Michigan."

Walker H. Evans, U. S. Department of Agriculture: "Experiments in Plant Acclimatization in Alaska."

D. F. Franceschi, Santa Barbara, Cal.: "Fifteen Years' Experience in Southern California."

Andrew J. Soule, Blacksburg, Va.: "Some Experiences with Field Crops in Virginia."

Geo. V. Nash, New York Botanical Garden: "Observations on Hardiness of Plants cultivated at the New York Botanical Garden."

W. Trelease, Missouri Botanical Garden, St. Louis, Mo.: "Some Anomalous Observations in St. Louis."

J. E. Higgins, Hawaii: "Problems of Hawaii."

THE BRITISH MUSEUM

The return giving the accounts of the British Museum, the number of visitors, and the progress made in arranging and adding to the collections for the year ended March 31 last, has been issued. Sir E. Maunde Thompson, director, is quoted in the London *Times*. "It is a matter for regret that a further decline in the number of visits to the Museum has to be recorded for the year 1906. The total number was 691,950, a falling off of nearly 122,000 from the number in 1905. Nor has the decline been confined to week-day visits, as it was in the previous year. The 57,738 visits on Sundays were less by 4,269 than those in 1905. We must go back to the year 1900, with its 689,249 visits, before finding a total to compare with that of the year 1906. At the same time, it is an indication of a steady growth of intelligent interest in the collections that, while the numbers of visits decrease, the sale of guide-books generally tends to increase. The number of visits of students to the reading-room has also been reduced by 2,000, the total for the year being 212,997, as against 214,940 in 1905. The daily average was 702. The average number of persons in the room, counted at the later hours of the afternoon, were: 4 p.m., 349; 5 p.m., 256; 6 p.m., 172; 6:30 p.m., 119. The number of visits of students to particular departments in 1906 was 55,513, as against 57,557 in 1905. The number of visits to the newspaper-room decreased by 2,000; while, as regards other fluctuations, there were 1,200 fewer visits in the sculpure galleries, but 800 more in the department of manuscripts and nearly 1,100 more in the department of British and medieval antiquities."

Sir E. Ray Lankester, the director of the Natural History Museum, says in his report that the total number of visits recorded as having been made to the museum by the public during the year 1906 was 472,557, compared with 566,313 in 1905. This number included 61,151 visitors on Sunday afternoons, as against 70,084 in the previous year. The average daily attendance for all open days was 1,301.8; for week-days only, 1,322.8; and for Sunday afternoons, 1,176. He records presents to the number of 2,057, compared with 2,092 in 1905, the principal donors being the Government of India (collections of Tibetan insects), the Duke of Bedford (zoological specimens from Japan and Korea), Mr. C. D. Rudd (specimens in continuation of his systematic survey of South African fauna), and Mr. W. E. Balston (natural history specimens from Western Australia).

SCIENTIFIC NOTES AND NEWS

Dr. E. Ray Lankester will retire from the directorship of the Natural History Museum, London, in October. It is understood that the inadequate pension originally proposed by the trustees has been about doubled. The trustees have decided not to appoint a new director, though it is possible that this plan may be changed.

Lord Kelvin will open the new science buildings of Queen's College, Belfast, on September 20.

Professor J. P. Iddings, of the University of Chicago, Dr. John M. Clarke, director of the Science Division of the New York Education Department, and Professor R. S. Tarr, of Cornell University, will represent the American Association for the Advancement of Science at the celebration of the centenary of the Geological Society of London to be held this month.

Among the honorary degrees conferred on the occasion of the celebration of the three hundredth anniversary of the University of Giessen, was that of doctor of philosophy on Dr. Ernest W. Rutherford, professor of physics at Manchester, and doctor of medicine on Dr. A. A. W. Hubrecht, professor of zoology at Utrecht. Dr. Hubrecht is at present in this country as delegate to the International Zoological Congress.

An honorary doctorate of medicine has been conferred by the medical faculty of Heidelberg on Baron J. v. Uexküll for his researches on the processes of stimulation in nerves and muscles.

The John Scott legacy medal and premium of the Franklin Institute of Philadelphia has been awarded to Professor J. A. Ewing, F.R.S., and Mr. L. H. Walter for their method of detecting electrical oscillations.

Dr. C. de Bruyn, professor of botany and zoology at Ghent, is president of the Flemish Congress of Naturalists, which meets this month at Malines.

President William DeWitt Hyde, of Bowdoin College, will, owing to the state of his health, probably be unable to return to this country to resume his duties during the present year.

News has been received from the expedition under Mr. Vilhjalmur Stefansson, which in the schooner *Dutchess of Bedford* has been exploring north of the Mackenzie River, that all the members of the expedition are safe.

The daily papers state that Professor Carl C. Lorentzen, of New York University, has arrived at Copenhagen with the object of furthering a scheme for an exchange of professors between Danish and American universities similar to that in vogue between Germany and the United States. Count Raben, the foreign minister, expressed sympathy with the idea and said he would present the proposal at the next session of Parliament.

Under the auspices of the New York Academy of Sciences Dr. D. Le Soüef, director of the Zoological Gardens, Melbourne, Australia, gave an illustrated lecture on "The Wild Animal Life of Australia" at the American Museum of Natural History, on Monday evening, September 9.

Professor Gaylord P. Clark, A.M., M.D., dean of the College of Medicine, Syracuse University, died very suddenly at his residence on September 1. He had but recently returned from several months absence in Europe, and was actively organizing the work of his college for the coming opening. His death is a serious loss to the college and to the university, as well as to the community, and will be greatly regretted by a large circle of his collaborators in physiology.

The deaths are also announced of Dr. E. Petersen, docent in chemistry at the University of Copenhagen, at the age of fifty-one years, and of Giuseppe Grattarola, professor of mineralogy in the Institute for Higher Studies at Florence.

The U. S. Civil Service Commission announces an examination on October 23–24, 1907, to fill a vacancy in the position of anatomist (male), at $1,600 per annum, in the Army Medical Museum, office of the Surgeon General, and other similar vacancies as they may occur there.

THE Royal Botanic Society has received a legacy of about $1,000 from the estate of Mr. Edward Baker, of The Cedars, Clapham-common, for thirty-six years a fellow of the society.

DR. A. GRAHAM BELL has erected at his place at Baddeck, N. S., a tower, eighty feet in height, built of the tetrahedral cells which he invented to secure great strength and lightness in the construction of kites. The engineer was Mr. F. W. Baldwin, of Toronto. It is said that the tower weighs less than five tons and will carry a weight of 50,000 pounds.

AN electrical exhibition has been held in Montreal, commencing on September 2, and from September 11 to 13 the Canadian Electrical Association meets in that city.

THE employees of the Pennsylvania Railroad, numbering 198,000, are to be given a course of practical instruction in first aid to the injured. For this purpose a series of lectures will be delivered at various points along the lines under the direction of the company's medical examiner.

Nature states that two sums, each of 250*l.*, have been received by the Institution of Mechanical Engineers from the Metropolitan Water Board and the chairman of the Court of Arbitration (under the Metropolitan Water Act, 1902), which the donors desire to be used for some engineering purpose connected with the institution. The council have invested the amount—500*l.*—in a trustee security, the income from which they have decided, after consultation with Sir Edward Fry, shall be offered biennially for a paper submitted in accordance with prescribed conditions. It has been further decided that the prize shall be known as the "Water Arbitration Prize," and shall be offered for a paper on an engineering subject to be announced by the council one year before the time for sending in the papers. The prize, which will have a value of approximately 30*l.*, will take any form which the council may from time to time decide.

Nature says: As illustrating further the want of sympathy with scientific research shown by the Indian administrative authorities, to which Professor Ronald Ross, F.R.S., directed attention in an exhaustive article contributed to our issue of June 13, an Indian correspondent writes concerning the rules of the India Office regulating the supply of apparatus to government colleges. According to these rules, our correspondent states, any piece of apparatus of European manufacture—costing more than 3*l.* 7*s.*—can only be obtained by requisitioning through the secretary of state. Requisitions are prepared once a year, and, as a rule, eighteen months elapse between writing a demand and the arrival of the apparatus. It is nearly impossible to foresee everything that may be required during the prosecution of a research, and it happens sometimes that a man of science must wait three years for necessary material. The reasonable contention is made that professors in India should be permitted to spend their laboratory funds themselves and to deal with manufacturers direct. It is surely not taking too much for granted to suppose that men in responsible positions, who presumably have been selected for their posts with great care, may be trusted to administer their funds honestly and to the best advantage of the institutions with which they are connected. The system of having to requisition scientific instruments and materials a year or more in advance is not confined to India, and it is both discouraging to scientific work and wasteful in practise.

MR. FRANCIS FREMANTLE, late plague medical officer in the Punjab writes as follows in the London *Times:* "For nine years," says Lord Curzon, "the Government of India has conducted an unrelenting campaign against the plague . . . by every method, in fine, that science or experience could suggest." As one of the officers employed in that campaign I venture to say that "science" will repudiate the statement. We know the difficulties were immense and that the Indian government did all that occurred to them to do. But, like all governments, they failed to realize that the scientific method of preventing disease is founded on exact knowledge, obtainable only by research. No one knew how plague was spread. Did they from the first set apart a representative body of experts to give up their whole time to the investigation of this sole problem? The answer is No. It is only now that this has been done, on far too limited a scale, that, as shown me by Captain Lisbon, I.M.S., in 1904, the rat-flea is being proved to play a chief part in spreading the disease. If this is corroborated by further research, a fresh campaign may be devised with considerable hope of success. The moral for all departments of government is the constant cry of "science"—more research.

We learn from *The British Medical Journal* that the eighth session of the Australasian Medical Congress will be held in Melbourne from October 19 to October 24, 1908. The president is Professor H. B. Allen, M.D.; the treasurer, Mr. G. A. Syme, M.B., F.R.C.S., and the general secretary, Dr. H. C. Maudsley, F.R.C.P. The vice-presidents include many leading members of the profession in South Australia, New South Wales, Western Australia, Tasmania, and New Zealand, and there is a secretary in each of the states of the Australian commonwealth, and in the north and south islands of New Zealand. The council of the University of Melbourne has granted the use of its buildings, and the government of Victoria has undertaken to print the transactions of the congress. Addresses will be given at the plenary sessions of the congress by the presidents of the Sections of Medicine (Dr. G. E. Rennie, of Sydney), Surgery (Dr. B. Poulton, of Adelaide), Pathology and Bacteriology (Dr. F. Tidswell, of Sydney) and Public Health (Dr. J. C. Mason, of Wellington, New Zealand). Special meetings will be devoted to the discussion of (*a*) the relations of the medical profession to hospitals, and (*b*) syphilis. There will be eleven sections, the total being completed by the sections of obstetrics and gynecology; anatomy and physiology, with experimental pharmacology; diseases of the eye, ear and throat; neurology and psychiatry; diseases of children; naval and military medicine and surgery; diseases of the skin, radiotherapy and radiography.

UNIVERSITY AND EDUCATIONAL NEWS

A further £2,000 has been given by Sir Donald Currie towards the equipment fund of Queen's College, Belfast, bringing up his contributions to the sum of £22,000.

Lord Selborne laid the foundation stone of Transvaal University College at Johannesburg on August 29.

Foreign journals state that the Governor General of Algeria has brought a proposal for the founding of an Algerian university before the financial delegates, who have adopted it. It will be remembered the late M. Moissan and Professor Bouchard, having inspected the secondary schools in Algiers, reported favorably on the founding of a university. They proposed the establishment of an institute of natural science, experimental botany, zoology and hygiene, and pointed out the political and social effects of the foundation of a university which would form a powerful link between the various races which form the population of Algeria.

The barns of the new agricultural college at St. Anne de Bellevue, near Montreal, were struck by lightning on September 5 and destroyed. The loss is said to be $50,000.

In the medical school of the University of Colorado, Dr. Edward F. Deane has been appointed professor of anatomy; Dr. John Andrew, Jr., demonstrator in anatomy, and Dr. Ross C. Whitman, professor of pathology.

At the University of Chicago, Reuben M. Strong has been appointed instructor in zoology; Victor E. Shelford, associate in zoology, and Frank H. Pike, associate in physiology.

Arthur L. Tatum, of the Ohio State University, has been appointed instructor in chemistry in the University of Colorado.

Harry J. Kesner, B.A., B.S. (Colorado), has been appointed instructor in bridge engineering at the University of Minnesota.

Reginald E. Hore, A.B. (Toronto, '05), formerly demonstrator of mineralogy and petrography in the University of Toronto and member of the staff of the Bureau of Mines of Ontario, has been appointed instructor in petrography in the University of Michigan.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, SEPTEMBER 20, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN COLLEGE FOR GERMANY[1]

IT seems so natural and so delightful to listen on such festival days of college joy and of college pride to the voices of men whose memories are intertwined with the noble traditions of the celebrating college. Those who passed the happy days of inner growth from the immaturity of school work to the maturity of life work on the lovely campus of Lafayette are the welcome speakers, indeed, at this symposium on college ideals, and their words, filled with gratitude, transform this huge assembly into a mighty family circle. But harsh and disturbing seems in such hours of intimacy the word of an outsider who never before enjoyed the charm and the inspiration of this place. If you are yet generous enough to invite the stranger's intrusion into your assembly of alumni; yes, if you kindly welcome the messenger of the Harvard faculty, your motive, it seems, can be only one: on such a day of historic retrospection Lafayette College desires to acknowledge the unity of the country's growth and academic development, desires to remember, venerable to-day herself, those places of learning which were venerable when she began her successful career, and therefore looks back in friendly fellowship to the oldest university of the land. Simple arithmetic leads us quickly back to those ancient days. It was seventy-five years ago that Lafayette College was born; if we double the figure, exactly 150 years ago, in 1757, the gallant Frenchman was born for whom this college was named; and if we double that figure, exactly 300 years ago, in 1607, was born the pious Englishman who founded the first American college, John Harvard. What a glorious national development in the life-

[1] Address at the celebration of the seventy-fifth anniversary of the founding of Lafayette College.

time of a few generations! John Harvard's foundation is flourishing to-day in the midst of hundreds of other colleges, of which even the least stands higher than the Harvard of the old days. And Harvard College never looked with misgivings on the wonderful growth of her young rivals; on the contrary, Harvard knew that her own steady progress resulted first of all from the spreading of the collegiate spirit over the country; every college which devotes itself with earnestness to the high task helps every other college, and if a younger institution can prove that through three quarters of a century it has lived up to the noblest ambitions and to the most idealistic hopes, then it is a matter for sincere rejoicing to the older colleges, and for none more than to the oldest. To be allowed to bring to you to-day the message of such Harvard sentiments and the sincere congratulations of America's largest university, is the privilege which makes me most grateful.

But I feel that your choice of a speaker must have been influenced by still another motive. To bring on such collegiate occasion the greetings of another college, you would have hardly selected a man who, as you know, never went through an American college at all. You ask a foreigner, and I can not help feeling that he was meant to come to-day as such a messenger from the non-American world. On your celebration day, which is in any case a day of pride for all American colleges, you desire not to miss in the chorus a voice of appreciation from those lands which never knew, and do not know to-day, a counterpart of the American college in their own educational systems. "To see ourselves as others see us" is always a most natural desire—natural when we are dissatisfied and want the criticism of the outsider in the service of reform, but still more natural when, as to-day, the work has been tested and has been found successful beyond hope. It seems to me, therefore, that I may enter best into the spirit of this hour if I emphasize less that I am a teacher in another American college, and emphasize more that I was a student of no college whatever; in short, that I come to you as a German with an education "made in Germany," and thus with an inborn tendency to look on every new life experience from the German standpoint and with German prejudices.

And yet I come to sing a song of praise for the American college. I believe in its mission, and, in spite of the pressure from the high schools below and from the professional schools above, I believe in its essentially unchanged future. I see in the college the most characteristic expression of the American genius, the most important condition for the healthy development of the national life. I can calmly use such high-pitched phrases, as I am weaponed against the suspicion that my enthusiasm may be invented for this special occasion. I have sufficient witnesses in print to prove that this is not flattery made up for my commencement part. No, whenever I have spoken to my German countrymen, for instance, in my book on the Americans, written entirely for German consumption, I have said in definite words, "The college is the soul of the American nation."

Of course, I am not blind to the wonderful achievements in all the other parts of the educational system, from the kindergarten of the city suburb to the professional institution of the large university. The energy with which the American primary school shapes the little descendants of a score of races into the uniform product of the future American citizen, is admirable and marvelous. And the progress which in the last two decades scientific research and productive scholarship have made in the highest graduate schools of the New World, justly surprises the Old World. Yet the most beautiful feature remains, after all, the quiet intellectual and moral work done in the college halls from the Atlantic to the Pacific. It was my growing acquaintance with the college life that gave me ever new inspiration to tell my countrymen the story of American idealism. You know the traditional European prejudice did not admit that idealism could be at home here. America seemed the land of commerce and industry, and all for the sake of gold; the wild chase for outer gain seemed the whole meaning of American effort. No wonder that every educated European who comes with open eyes and has a chance to see not only the outer, but the inner life, feels still to-day like a belated Columbus, who has yet to discover the true America, the land of ideal desires and ideal energies. And certainly, of all idealistic emotions of this people, there is none deeper, none purer, none more blessed, than the demand for instruction, for learning, for self-perfection, with its climax in the desire for collegiate education.

I do not want to be misunderstood, as seeing no fault in the American system of instruction. There are not a few wrong tones in the symphony, wrong tones which hurt the ear of the newcomer, discords to which he will never become insensible. But those fundamental errors belong rather to the school than to the college. It is enough to point to the most devastating one: the lack of mental discipline at the very beginning of intellectual growth. The school methods appeal to the natural desires, and do not train in overcoming desire; they plead instead of commanding, they teach one to follow the path of least resistance instead of teaching to obey. The result is a flabby inefficiency, a loose vagueness and inaccuracy, an acquaintance with a hundred things and a mastery of none. Public life has to suffer for it; a community which did not get a rigid mental discipline through home and school influence must always remain the plaything of the lower instincts. Such a community will continue to follow without check its untrained impulse; it will prefer the yellow, big headline paper to the serious newspaper which appeals to sober thought; it will prefer on the stage of the theater and on the stage of life the vulgar vaudeville and the cheap melodrama to the refined and the noble play; it will be impressed by every glaring outer success and by showy size, by quantity instead of quality and value; it will be swept by every passion of the crowd, applauding mediocrities, enthusiastic for every one who poses for the uncritical, and a quick victim of every short-sighted fancy. And yet can there be any doubt that it is just a political democracy which ought to be protected against such an inner foe? And no one has to suffer more from these sins of the school than the college. How much more the American college might have been able to produce if it could have received into its freshman class young disciplined minds, trained in accurate and careful learning, and in the restraint of primitive impulses. The college would not have been burdened by wasting much of its costly time in repeating the elements of learning and patching up the slang-disfigured English language. It would not have been vexed by the hysterical excitement which so often turns the recreating pleasure of sport into a ruinous passion.

But I would rather contemplate, and must admire the more, what, in spite of all these hindrances, the American college has made and makes to-day and will make in the future out of the entering freshman in the few years until he receives his bachelor diploma. He came as a boy and goes out as a man. He came from a school where ready-made knowledge was imparted to a passive immature mind; and, when he leaves, he goes out into the world for practical work or professional schooling with that senior maturity which relies on independent judgment. Secluded from the rough battle of the outer world, he can pass four years of inner growth and self-development, of learning and comradeship under the influence of scholars who devote their lives with ever-young enthusiasm to all that is true and good and beautiful. He does not seek there, and ought not to seek there, the specialized research work which belongs to the graduate school. Certainly investigation, which focuses the energies of a whole man on a circumscribed field, is the highest aim of scientific study; but it fits a professional specialist only, who has completed his broad course of general culture. This broad culture alone is the abounding gift of the college, secured by those methods which can not be those of the school-teacher nor of the researcher. Neither the time before the college, nor that after the college years, can open the heart and widen the mind, can inspire enthusiasm and deepen the personality like college days passed in living contact with true college teachers—and no one is a true college teacher who does not make even the most abstract science a living and refreshing source of culture and humanity.

It is this breadth of culture gained in work and in play, in the class room and in the club, in the laboratory and in the chapel, which gives unity and community to all who have had the good fortune of collegiate education. Whether their way leads on to law or medicine, to banking or railroading, to teaching or preaching, to politics or commerce, makes no essential difference; essential remains only that which is common to all of them. The professional work seems, then, only like a garment which can be laid off; the collegiate work belongs to the personality itself. It is this phalanx of the collegiate alumni which has to represent the educated public opinion, imparting to the nation the thoughtfulness and earnestness without which the trivial instincts of the crowd would be unchecked. When the masses, misled by the coddling education of early youth into a happy-go-lucky spirit, rush into the path of the cheap and vulgar, it is the collegiate community which has to prove its belief in lasting values. When the masses act in the laissez-faire temper, which begins with the lack of discipline in the schools and ends with the indulgence of public graft and corruption, it is the collegiate community which must show its training in the spirit of civic duty and lofty ideals.

You all know that there is one way of praise which is more eloquent and significant than any words of enthusiasm, and it is the effort of imitation. The value which belongs, in my opinion, to this unity of collegiate culture and to this national community of the best educated men, independent of their various activities in later life, can easily be measured by this strongest test. With sincere devotion I have upheld the, at first sight, revolutionary proposal that Germany should imitate the American example and found colleges on German ground. What is the situation over there at present? Every one knows that the German universities are not surpassed by any scholarly institutions the world over. It is not by chance that for nearly a century a steadily growing stream of young American scholars has poured through Göttingen and Heidelberg and Giessen and, later, through Leipzig and Munich and Berlin. And those young scholars brought back with their German Ph.D. the spirit of sacred devotion to the true advancement of knowledge and to productive research; that spirit which founded in the last three decades the famous graduate schools of Johns Hopkins and Harvard, of Columbia and Yale and Chicago, and which spread thence to all the graduate departments of the large universities. But these model universities of Germany are not and were never intended to be colleges in the American sense, and whoever, misled by the loose application of the word university in this country, carelessly plays with the comparison needs only to be reminded that the strong intellectual life of Germany is satisfied with twenty academic institutions, while the United States has nearly six hundred. The kingdom of Saxony has only one, the University of Leipzig; while the city of New Orleans alone has four. It is evident, therefore, that institutions are in question which are not to be compared. The German university is a system of professional schools, conducted by the state for the intellectual training of the future physicians and lawyers, ministers, teachers and scholars. They have been just that for nearly six hundred years. Their unity lies in their method; the teachers are productive scholars who impart to their students not information, but the critical attitude and scholarly independence of judgment. But this method presupposes intellectual maturity and expansive knowledge. The entrance conditions presuppose, therefore, an amount of information which about equals that which the average junior of the better American college is expected to acquire. This goal is reached two years earlier than in America through the stricter mental discipline in the schools, and it is reached entirely by school methods.

All this has necessary consequences. There is no middle ground between the school and the professional or graduate university department. The boy, who at nineteen leaves the gymnasium in his native town with all its school discipline, enters the freedom of the university only to study law or medicine, science or divinity. The freedom of academic life comes thus exclusively to those who enter the so-called professional careers. Those, on the other hand, who want to go over into practical life, perhaps into industry or commerce, have no opportunity for contact with the university. They are confined to the limitations of the schoolroom, and, as they do not aim at the entrance examinations to the university, they are inclined to prefer from the first schools with a simpler curriculum.

If we consider that this has been the situation for centuries, it becomes evident that the result must be a public situation entirely different from that of the United States. Here in America it was, of course, also from the first necessary to have schools for ministers and lawyers and so forth, but they were considered as private affairs, and every one had a right to enter practically without any previous education. Public opinion was thus imbued with the correct idea that these professional studies did not in themselves guarantee a high level of culture. The real culture, on the other hand, the making of a gentleman, was left to the college, which was taken over from England. The collegiate alumnus is thus the cultural leader. He may be later a preacher or a banker, a physician or a railroad man. Of course, the entrance condition to the professions was slowly raised. The highest professional schools to-day demand the bachelor degree at their threshold. Yet the old historical conviction has remained; not the professional, but the collegiate study gives to a man the stamp of the highest education. How could it be otherwise in a country which had to bend all its massive energies toward the opening of the gigantic land, toward the building up of its democratic commonwealth, and which had thus for a long while little leisure for science and art, for scholarship and literature? How could it be that the business men and the men of affairs would be ranked there behind the professional specialist?

In Germany the opposite development has led historically to the opposite valuation. The professional men, who alone through centuries had the privilege of widening their minds in the atmosphere of the university, had to stand, therefore, in public opinion high above the men of practical interests who had nothing but a school diploma. To go into business or industry and practical affairs thus meant a second-class occupation, with which those had to be satisfied whose brain or whose pocketbook did not allow those years of university study. Every social premium and every social ambition became attached to these learned professions, in common only with the position of the nobleman and the army officer, who, for historic reasons of another sphere, seemed equally exalted beyond the masses of those pitied money-makers. And this traditional prejudice was in good harmony with the Germany of the day before yesterday, when the population was poor and their leaders were poets and thinkers.

But the times have changed. Just as America has added to its material culture a rapidly growing ambition to rival the Old World in the production of science and art, so Germany has added commercial and industrial ambition to its spiritual aims. Germany has grown prosperous, a mighty rival in the markets of the world. There may be not a few who complain of this rapid Americanization of the world, but they can not change the fact that the Germany of William II. is no longer the Germany of Schiller and Kant. With political unity, with the inheritance of Bismarck's constructive work, with the triumphs of Germany's technique and industry, a thorough change in the social estimate has set in. The practical walks of life are more honored day by day; the sons of the best families press on more and more into the economic life, and thus it becomes daily more incongruous that the inspiring influence of academic life should be withheld from all those who do not seek a professional career. To attend the present universities and technical schools with their specializing professional work would be, indeed, inappropriate for them. That which is needed for the Germany of to-day, and still more for the Germany of tomorrow, is an academic institute of a new type—a university where the full freedom of academic life can be joined to studies of purely cultural character, where young men may enter two years before they have reached the present goal of the professional university, and where a three or four years' course would prepare them for the duties of life without any thought of their later occupation; in short, what is needed to-day is, in its essentials, an American college.

Of course, there would be hardly any chance for new experiments in the famous old universities. They are certainly rejuvenating themselves steadily by adding new departments and introducing new methods, by admitting women as regular students, and so forth; but the development must remain an internal one without an external change of the classical form and of the framework of the four professional faculties. The whole state organization is too closely bound up with the system of the university and the gratitude of the nation too much attached to its time-honored features to allow any tampering in the interest of the unprofessional disciplines. A new foundation would thus be the better opportunity, and, if possible, a foundation in one of the smallest federal states in which no other university exists and in which, therefore, no traditions are to be broken and no academic inequalities to be feared. Good luck seemed to open such opportunity. The little state of Hamburg, which is practically the large old Hansa city and its surroundings, has no university. It is the greatest commercial place of the country, and the vivid pulsation of its economic life seems to have excluded for centuries the idea of a real university. But in recent years a sentiment has grown among her leading citizens that Hamburg ought to become not only the center of seafaring, but a center of intellectual influence as well. Large donations from rich Hamburgians were in sight, and the state government seemed inclined to yield to the public demand. In this situation the president of the supreme court, who was the soul of the whole movement, invited me in the name of friends to make suggestions for the new university and to elaborate a plan. I did so, and the gentlemen over there published my voluminous memoranda as a pamphlet last year. It has been discussed beyond expectation. It has been heartily welcomed by many and has been sharply attacked by not a few who wish the new university in Hamburg to follow exactly in the path of the old ones. Wealthy citizens have given millions during the last year and there is now no doubt that Hamburg will have a university in a not far distant time.

Whether that new institution of the future will realize some of these suggestions, no one can say to-day. But if I had to bring the plans which I sketched for it into a short form, I should say: my scheme proposed to erect a German university with the substructure of an American college. My model was naturally Harvard, not only because I knew her best, but because Harvard is the only American university which has, besides its college, a graduate school of arts and science, a law school, a medical school and a divinity school, and which demands for all four of these professional faculties a bachelor degree as entrance condition. The idea was that in Hamburg, just as in Harvard, the youth ought to get in common in years of academic freedom the inspiration of cultural work in history and economics, in literature and philosophy, in art and natural science, before their ways are divided to go either to the professional schools of the typical German university or to the practical enterprises which commerce or industry or agriculture or politics may offer. While many new technical schools have sprung up with the new requirements of our practical age, Germany has not founded a university anew for a whole generation. The spirit of the Germany of to-day has not yet found its real characteristic expression. If Hamburg really has the courage to add to the old German plan an American college, then its university will be significant for the German Empire of to-day just as the foundation of the University of Berlin a hundred years ago was an expression of the new moral energies of the ascending Prussia.

But those ideas have found too much root in the sentiments of the German nation to be lost even if in Hamburg, as it well may be, the old traditions shall once more prevail. It was, indeed, only in connection with the Hamburg project that I wanted to see an American college in the Harvard way in immediate contact with the upper parts of the university. But I used from the first many an opportunity to urge that, just as in America, the college itself be added to the national system as a free and independent institution. Hamburg would need a real Harvard, but I know many a lovely town in my Fatherland where an

Amherst or a Lafayette would be a blessing for the true progress of the nation, and I never forget to add with enthusiastic heart that a Bryn Mawr and a Wellesley and a Vassar must follow. I know the time for all that will come, and if not to-morrow, the day after to-morrow will bring it surely. And from Germany it will spread all over the European continent.

That will be at last a gift of the New World to the Old, which will return the stimulation and impulse that the United States received from Germany. The German influence gave to America the method of research, the Ph.D. work, the graduate school. America will now give to Germany in return the college with its broadening influence and with its democratic spirit, which imparts culture to all alike, within and without the scholarly professions. We hear so much, and sometimes perhaps too much, of the exchange of professors between the United States and Germany. Such exchange of persons may be well. It has gone on, after all, for decades, as German scholars have come to this country in a steady flow, and American scholars have always visited German universities. But more important than the exchange of men is the exchange of institutions. The German graduate school, once imported here, has had an influence which can be felt in every corner of the intellectual life of America. And thus, I trust that the American college, once imported to Europe, will never cease in its beneficial influence for the culture of the non-professional men and women. In this sense I feel that I can add in my congratulations, brought to one of the most successful colleges of the country, a new dignity to the many claims of the American college. Each true college has been, and will be in the future, not only the stimulating benefactor of its students, not only the helpful comrade of the other colleges of the land, but, at the same time, an inspiring guide for the collegeless countries of Europe. May Lafayette flourish and grow in that threefold renown through the last quarter of its first century and for many generations of happy students thereafter.

Hugo Münsterberg
Harvard University

THE AMERICAN COLLEGE[1]

When Lafayette College opened its doors seventy-five years ago, Harvard College had ten professors and two hundred and sixteen students; Columbia College, six professors and one hundred and twenty-five students. Harvard was then one hundred and ninety-six years old, Columbia sixty-eight years old. To-day Lafayette has twenty-three professors and four hundred and eleven students. Should Lafayette grow as Harvard and Columbia have grown, then when our grandchildren and great-grandchildren gather to celebrate the hundred and fiftieth anniversary, they would find here five hundred professors and ten thousand students. The alumni would be invited to contribute toward an additional endowment of twenty million dollars.

The days to be, even more than the times of the past, are for us a book with seven seals. None knows what things lie on the knees of the gods; it is more than we can do to re-collect what has been strewn from their hands. But we at least believe that the American college was an important factor in the higher life of our country during the nineteenth century, and that the part of Lafayette, in the days of its adversity and in the days of its prosperity, has been no mean one.

The citizens of Easton who met at

[1] Address at the celebration of the seventy-fifth anniversary of the founding of Lafayette College.

White's Hotel on December 27, 1824, and resolved to establish an institution of learning in their beautiful village had foresight and courage. They were men of patriotism, naming the institution Lafayette College in recognition of "the signal service of General Lafayette in the great cause of freedom," and resolving that military engineering and tactics should be taught, because, as they said, "a freeman's arm can best defend a freeman's home." In the annual report of the trustees following the death of Lafayette, they said:

> We record an event unparalleled in the annals of the world's history, of one man's death arraying in the habiliments of mourning, all the friends of freedom on the globe. . . . Let ours be the sacred duty of imitating his illustrious example and holding it up for admiration to the wondering gaze of the dear youth of this institution, which bears his venerable name.

There were difficulties to overcome, but in 1832 George Junkin, a true leader of men, was elected president and three professors were called. Two of them were in mathematics and the sciences, one of whom, Samuel P. Gross, became a great surgeon of the last century. The traditional curriculum of Latin, Greek and mathematics was, however, adopted, and in its simplest form. The first half-year was devoted to the first book of Euclid; the third half-year to the fourth, fifth and sixth books. More than a year was given to Horace. There is in retrospect a curious incongruity between the gentle epicureanism of the Odes, and the lives of these young men, who had morning prayers at five o'clock and drank coffee for breakfast because milk was too expensive.

At the instance of President Junkin manual labor was substituted for military training. The early reports lay stress on the importance of the movement—how it assured the health of the students, gave them honorable independence and broke down class distinctions and class jealousies. The plan failed; to the misfortune of the college it may be. The existence of an agricultural department and of a mechanical department then and there is not without interest for the history of our educational system.

Another plan that failed was the course for teachers established at the beginning and seven years before the first normal schools of Massachusetts. In their second annual report the trustees wrote:

> As to elevating the standard of common school instruction, we propose to effect it by training teachers to that business as a profession. . . . Incompetent teachers very frequently receive inadequate support; and the inadequacy of the support secures and perpetuates the incompetency of the teachers. . . . Let teachers be well educated, that is, let them be taught thoroughly the branches which they will be called upon to teach, and, which is the principal thing, the art of *communicating* instruction and *governing* a school; and let their services be secured permanently in that business, by adequate pay.

In still another direction the founders of Lafayette notably anticipated educational development, namely, in advocating the study of English and modern languages. By the terms of the charter—one of its two definite provisions—a professorship of German was to be established. In their original memorial to the legislature, the founders said that it is to be regretted that students commonly limit their attention to the dead languages. They pointed to the ease with which the romance languages can be acquired after Latin, and said that German and Anglo-Saxon ought long since to have been made a part of education. They add:

> But the language most neglected in our seminaries of learning is the English. It is, we think, one of the follies of the learned to expend time and toil and money in minute investigation of the languages of other times and other people, at the expense of omitting the equally curious and more useful investigation of their own.

While these ideas do not seem to have affected the early curriculum, they are a prevision of the most important contribution made to education by Lafayette under the leadership of the great teacher, the great scholar and the great man, who just fifty years ago became professor of the English language and comparative philology, and introduced into our colleges the scientific study of English and Anglo-Saxon.

The Cambridge College, transplanted to the new Cambridge in 1636, and later to Virginia, Connecticut, New Jersey, Pennsylvania and New York, brought hither its organization and its curriculum; and these have been slowly and partially adapted to an industrial democracy. The curriculum and culture of the English College were esoteric. The church of the semi-reformation and the dead languages were in nominal control, but they touched lightly the young gentlemen destined to manage their feudal estates and to extend the British empire. The aristocratic English college of church and state with its classical curriculum was transplanted to scenes not excessively caricatured in Martin Chuzzlewit or by Mrs. Trollope, yet not alien to men such as Franklin or Jefferson, not lacking tendencies such as those expressed by Emerson or Whitman. The new colleges, following closely on the footsteps of the pioneers, were naïve, not crude; simple and narrow, but not philistine; lacking in perspective, but rich in ideals.

The American College has performed a great service. The statistics which show that college graduates are more likely than others to succeed in certain professions are not in themselves significant. One might as well argue for compressed feet, because Chinese women who follow the practise are more likely than others to marry mandarins. The ablest and most energetic men have gone to college, and the college has been the normal gateway to certain careers. It was, however, a gain to bring together many of the more promising young men and to give them such training and culture as might be. The college was the natural threshold to the church, to law and to medicine, so long as adequate professional schools were lacking. But when to these professional schools others in engineering, education, journalism and business have been added, it is not obvious how the old college of liberal arts will maintain its place. Technical studies should begin in the high school and liberal studies should be continued in the professional school. The college must adjust itself to these conditions.

Nothing in our educational history, indeed nothing in our whole civilization, is more hopeful than the increase of public high schools from 2,500 in 1890 to more than 8,000 to-day; of the students from 200,000 to more than 700,000. Nothing is more scandalous than the circumstance that seventy-five per cent. of the boys who enter the high school are driven away by its futility and feminization. The obsolescent culture of the college imposes itself on the high-school curriculum, even though of twelve boys who enter the high school only one proceeds to the college. The high school should and must primarily give training for the life work of the student, but with this should be united sympathetic appreciation of what is best in the past and present of the world, and the impulse to improve and create. We shall have 10,000 centers for training, culture and research, as soon as we produce educational leaders to man them. And the high school will educate its students so far as is possible without specialization beyond the capacity of the community in which it is placed.

Students who complete the work of the high school at the age of eighteen can not to advantage spend the four subsequent years in a country club, where what time can be spared from athletics and social enjoyments may be given to studies that are irrelevant to their work in life. Such a system may be proper for a hereditary aristocracy of wealth, but it no longer obtains even in Great Britain. The newer universities are primarily professional schools, and Oxford and Cambridge are continually moving in this direction. The colleges of Oxford and Cambridge have on the whole maintained high standards of thinking and living, and many leaders have gone forth from their gates. But Oxford and Cambridge are great universities, not as the result of their curriculum or their monastic life, but because the English are a great race. Besides it is not now the "poll" course, but the highly specialized honor courses which attract the best men. We may hope that our educational system will ultimately set standards for other nations, but we must first learn from the experience of England, France and Germany.

Nearly all our colleges have been founded and fostered by religious denominations. Our common schools have been supported by taxation, and sectarian influences have been carefully excluded, whereas our institutions of higher learning have been dependent on private charity for which denominational zeal appears to have been requisite. Another circumstance accounting for this somewhat anomalous condition is the fact that the colleges were largely training-schools for the gospel ministry, the only profession that usually required an academic course. Of the first 277 alumni of Lafayette 112 became clergymen.

Lafayette was established under Presbyterian influences, but by the act of incorporation the college was strictly undenominational, and the governor of the state was empowered to appoint visitors, whose reports should be laid before the legislature. In 1833 the legislature made an appropriation of $4,000, and $2,000 a year for four years. Financial need rather than religious devotion led Lafayette to place itself under the care of the synod of Philadelphia in 1854. But it is not certain that this step led to increased support. The entire income of the college in 1862 was $3,240. When in 1866 an urgent appeal was made by the synod to the churches for funds to erect a chapel, the sum of $360.21 was collected. In the same year Lehigh University—whose funds now amount to two and a half million dollars—was established. It was at this time that the states west of Pennsylvania were awakening to the need of supporting higher education, and it was in 1862 that the federal government established the land-grant colleges of agricultural and mechanic arts, which now have an income from the nation and the states of ten million dollars.

If the resources of Lafayette and Lehigh could have been united, and if the state of Pennsylvania had learned the wisdom of doing for higher education what the central and western states have done, we might have had here one of the great universities of the world. Nor need religious or even denominational training have been neglected, for each sect might have established and supported its own college. It is not necessary that each of the thirty-four colleges of Pennsylvania should become a great university, but seven million people could well afford to devote annually a million dollars to each of seven universities, placed say at

Philadelphia, Pittsburg, Easton, Harrisburg, Williamsport, Johnstown and Erie.

A school or a college is self-supporting in the sense that the individual profits more than his education costs; a university is self-supporting in this sense and in addition it is economically the most profitable investment that a people can make. A million dollars spent on the highest education and on research add more than a million dollars to the actual wealth of the country. And if this research is not supported by public funds, it will not be undertaken, for its main benefit is not to the individual, but to the whole people. In a way we are consuming the capital of our country—the natural fertility of the soil, the forests, the coal and iron. Coal is mined in Pennsylvania to the annual value of $200,000,000. We are indeed thriftless if the value of the coal is not reinvested, on the one hand, in foundries, railways, and other material and ephemeral uses, and, on the other hand, in education and research, which are the most permanent of all investments. There are but few fathers who will leave their children less educated than themselves, and research and discovery are endowment policies whose dividends never cease.

But while we need great universities, we need equally high schools, colleges and technical schools. Mere size is entirely unimportant. If the spirit of scholarship and research can be maintained in small institutions, several of them may be more useful than one amorphous university. There is a certain psychological limit of size, beyond which organization becomes increasingly difficult. Perhaps twenty-five professors and three hundred students may be taken as the maximum of efficiency. The faculty in such an institution forms a homogeneous body competent to guide the policy of the institution and to select their successors. Each professor is responsible for the whole and to the whole. He can be the friend of the students whom he teaches, and each student is an integral part of the institution.

Such a college should have buildings and grounds of the value of about a million dollars and an income of at least $100,000. The parks, libraries, museums, art galleries, theaters and lecture halls are not for the professors and students only, but for the whole community. The work of the professors and instructors is not only the teaching of the students, but perhaps half of it, more or less, in accord with the ability and interests of the individual, should be for the advancement and diffusion of knowledge, for leadership in all that concerns the higher life of the community.

A college of this character can not cover equally the whole field of knowledge; it should be eminent in some direction. This might be civil engineering. In this case the best possible training would be given to professional engineers, not only expert knowledge and facility in their trade, but broad culture and the impulse to investigate, the tendency to treat conventions lightly, the power to break new paths and advance along them. Students frequenting this college might use civil engineering as a basis for law, medicine, architecture, business or any work in life, a new combination of interests leading to new advances and new professions. Or a college might be eminent in the teaching and investigation of the English language, as Lafayette has been, and this would be the center of its work and its influence. There would be half a dozen great investigators and teachers cooperating in all movements to maintain and improve our language, its grammar and dictionaries, the methods of spelling and printing, studying and making accessible to study its origins, its classics and its contemporary tendencies. Young investigators would gather here, and the students from the start would base their training, their culture and their research on mastery of the English language, it being the basis in after life for work in literature, scholarship, journalism, teaching, the church, or any other profession whatever.

Lafayette is both a school of technology and a college of liberal arts. It has this year 225 students of engineering and 176 students in the arts courses. The future of the work in engineering appears to be more definite and assured than the classical and general courses, due not to any deficiencies in these courses, but to the general tendencies of our civilization. Lafayette may become a great university; it now ranks midway among the hundred leading institutions of the country, and we need at least so many universities. Its situation, as well as its history, gives promise to which no limit need be set. But a man can not by taking thought add one cubit unto his stature, nor would it necessarily be desirable to do so if he could. Loyalty to Lafayette depends on what it was and is, not on what it is not. And it is one of the glories of the American college that it so completely conquers the affection of its students and alumni. Like Job, a man may find new flocks and a new wife and new children; but he can not choose a new college. The associations and memories of the unreturning past are awakened as we come to these festivals—whether as prodigal sons or as wise men bringing gifts—and the renewed piety enables each of us to go back to bear with better courage his share of the Atlantean load.

J. McKeen Cattell
Columbia University

SCIENTIFIC BOOKS

H. M. BERNARD'S WORK ON THE PORITID CORALS

Catalogue of the Madreporarian Corals in the British Museum (Natural History). Volume VI. The Family Poritidæ. II. The Genus Porites. Part II. Porites of the Atlantic and West Indies, with the European Fossil Forms. The Genus Goniopora, a Supplement to Vol. IV. By Henry M. Bernard, M.A. London, 1906.

This is the third and concluding volume by Mr. Bernard on the Poritidæ. Volume IV. of the British Museum Catalogue of the Madreporaria treats the genus *Goniopora;* Vol. V. contains the *Porites* of the Indo-Pacific region, and the one under review gives an account of the *Porites* of the Atlantic and West Indies, with the European fossil forms, and a supplement to the genus *Goniopora.* These volumes represent an enormous amount of work, Vol. IV. containing pp. viii + 206, pls. xiv; Vol. V., pp. vi + 303, pls. xxxv; Vol. VI., pp. vi + 173, pls. xvii, making a total of 699 pages and 66 plates on this one family.

Two phases of Mr. Bernard's work deserve especial consideration: (1) His contributions to the morphology of the hard parts of the Poritidæ, (2) his peculiar method of arranging and designating the various forms or variations of the corals that he has studied.

Contributions to the Morphology of the Hard Parts.—Mr. Bernard was the first to point out that the septa are bilaterally arranged in the genus *Goniopora.* There are in each calice two solitary directive septa, opposite each other, one at each end of the calice. These belong to the primary cycle; the other four primaries are fused to secondaries; the tertiaries are shorter and fuse to the sides of the secondaries.[1] The pali occur on the inner ends of the secondaries or at the points of fusion of the primaries and secondaries. *Porites* is supposed to be derived from *Goniopora* by the disappearance of the tertiary septa. The growth form is elaborately discussed. It is stated,

> So far as growth form is concerned Goniopora (and Porites) may be regarded as astreiform perforates.
>
> Starting from what we have described as the primitive form of colony, viz., the circular slightly convex astræiform stock which would result from the normal budding of the primitive parent calicle,

[1] "The Genus Goniopora," p. 21.

we find two clear lines of departure from this form:

(*a*) They have become less convex, and growth has gone on round the edges, and the colony has become explanate.

(*b*) They have become more convex, and the colonies have become hemispherical and columnar.[2]

Each of these types of growth undergoes further modifications. Under (*a*) two secondary modifications are recognized, one in which small areas by stimulation into rapid budding form irregular columns, that can immediately readopt the explanate method of growth if they come into contact with any body that they can incrust; the other, the edges may run out into lobes, which by curling around form knobs or cylinders, that are left behind on the surface by further growth of the edge. Five variations of the massive growth-form are recognized, the principal ones of which are designated, pulvinate, expanding sheaf formation, and branching. The remarks on growth-form apply to both *Goniopora* and *Porites*.

In Volume VI. the interesting observation is recorded, that metameric growth is usual in poritid corals, *i. e.*, the first distinctive growth form repeats itself in the later development of the corallum.

Porites differs from *Goniopora* chiefly by lacking the third cycle of septa. The calices of the genus are bilaterally symmetrical; at each end of the plane of symmetry is a directive septum; one directive, the dorsal, being solitary, not taking part in the formation of a septal group, while the opposite one, the ventral, may be free or have a secondary fused to each of its sides; this directive and the two adjacent secondaries are designated the "triplet."

On each side of the plane of symmetry are two lateral pairs of septa; each pair is composed of a primary and a secondary septum fused by their inner ends. The details of the arrangement of the pali have been worked out with care. These structures occur, when the formula is complete, before each lateral pair, at the points of the septal fusion, on the solitary directive and on each member of the triplet, *i. e.*, there are eight pali. The variations of the palar scheme are numerous. The members of the triplet may fuse together by their inner ends, then a single palus, developed at the point of fusion, stands before the group, reducing the number of pali to six. The pali may be absent from the laterals of the triplet, when they are free from the directive, or they may be present on the laterals but none on the directive; there may or may not be one on the dorsal directive. Those before the lateral pairs are the most persistent, but in deep calices all pali may be obsolete. The elucidation of the various types of palar formulæ is one of Bernard's most important contributions.

Bernard's account of the structure of the septa and wall will next be discussed. He considers that the septum of *Porites* is composed of upright trabeculæ, joined together by radial horizontal bars and by tangential bars, the latter known as synapticula. In the ideal calice, there is the vertical columellar tubercle; outside it, each septum is composed of three trabeculæ, which, named in order from the center outward, are the palar, the septal and the mural. These trabeculæ by projection on the septal margin produce respectively the pali, the septal granules and the mural ridge. When the calices are crowded, the mural trabeculæ of adjacent calices may alternate in position with each other and produce zigzag walls. In the ideal calice there is only one septal trabecula, and consequently only one septal granule between the palus and the wall for each septum. Sometimes, however, there appear to be two granules, corresponding to two trabeculæ, between each palus and the apparent wall, the outer trabeculæ being joined by a synapticular ring. Bernard here considers that there is only one septal trabecula, the one next the palus, and that the next outer trabecula is in reality the wall trabecula; the third trabecula outward from the palus is homologically to be regarded as costal. These homologies of Bernard are based upon the assumption that the trabeculæ of *Porites* are parallel in their courses, and in general perpendicular to the outer surface of the corallum, an assumption with which the reviewer

[2] "The Genus Goniopora," p. 23.

does not agree. The number of granules on the septal margins of many *Porites* is variable, varying, however, within narrow limits, from one to two, or at most three or four. Specimens broken so as to permit the study of septal faces through considerable distances, several centimeters, show that the wall trabecula is persistently vertical and continuous, and the columellar trabecula is often definitely persistent throughout the length of the corallite. The intermediate trabeculæ, however, are not always vertical, but often incline inwardly, new trabeculæ arising in the angle between the outermost septal trabeculæ and the mural trabeculæ of a given calice. The innermost of these trabeculæ form the pali, those outside the palar ring form the septal granules, which sometimes vary in number for the same calice. Typical *Porites* has septa entirely homologous with those of the other *Madreporaria* in which the line of trabecular divergence is coincident in position with the wall, but in which the outer portion of the septum is suppressed.[8] Although the reviewer does not agree with Bernard in his conclusions on the morphology of the *Porites* septum, it should be emphasized that he was the first one to call attention to the importance of studying the granules on the septal margins and the details of the walls in the genus.

Synaræa Verrill is referred to the synonymy of *Porites;* the cœnenchyma of the former is regarded as formed by fused costal prolongation of the septa.

An hypothesis, proposed to explain the relationship of tabulæ to gemmation, may be briefly expressed as follows: a corallite divided into sections by transverse tabulæ was not occupied by a single individual, but by a succession of individuals. Each segment, bounded above and below by a tabula, was occupied by an individual which had originated by gemmation from the individual that occupied the immediately preceding segment. The strobilation of *Aurelia* and the peculiar budding of such forms as *Ptychophyllum* (the name of this genus is not mentioned) are cited to sustain the hypothesis. The discussion is continued with the remarks:

> If this is a true account of the phenomenon, that the earlier cruder form of metamerism with its piles of obviously discrete calices, passes gradually into a continuous skeleton, the original segments of which are now so disguised as to be seen only in the succession of the tabulæ, we shall have, in the formation of every such coral, to distinguish *two methods of growth.* In the earliest stages of its individual development the growth will be normal growth *de novo* from the larva, with the gradual withdrawal of the expanding polyp from the cup which is progressively too small for it. This results in the deposition of *one* series of tabulæ. When the normal size of the adult is reached the growth is different, and can no longer be described as a growth of the individual with withdrawal of the enlarging polyp from too small a skeleton, but the deposition of a new skeleton upon the framework of the old, the new skeleton belonging to a new individual polyp which comes into existence in some way by gemmation from the old, but the only visible sign is still seen in *another* series of tabulæ, differing from the first in that there is now no increase in the diameter of the stock.

Calicinal budding and the rejuvenation in both solitary and compound corals are well-known phenomena. The presence of tabulæ and dissepiments (tabulæ are only horizontal dissepiments) in a corallite in which the septa and walls are definitely continuous, is explained by the polyp's needing a new basal support after the septal and mural margins have been built to a certain height, therefore the polyp draws upward and forms a new bottom to the calice. To hypothecate successive budding to explain the occurrence of tabulæ and dissepiments in coralla of the type indicated is unnecessary.

Bernard's opinion on the phylogeny of the Poritidæ may be introduced here: they are considered to have a common ancestry with the Madreporidæ and Eupsammidæ.

Bernard's Method of Arranging and Designating his Specimens.—The extreme difficulty of recognizing and defining species of the Madreporaria is known to practically every one who has given serious attention to the

[8] This subject is more specifically discussed in the reviewer's "Madreporaria of the Hawaiian Islands and Laysan." Bulletin 59, U. S. National Museum, pp. 169, 170, 1907.

group; some even doubt whether it can be divided into species as are the mammals, birds, mollusks, etc. The solitary Madreporaria are probably not very much more difficult to study than other lowly organisms that secrete exoskeletons; but it is different with the compound forms. The difficulty in the way of making adequate studies is increased by the usual insufficiency of material, which has almost never been collected in such a way as to furnish data on the physical environment under which it lived, and the entire absence of any information obtained through experiment. In working over collections as they are usually submitted for determination and report, one is often entirely at a loss whether to refer certain specimens to previously described species, or to consider them new. As the specimens may not exactly fit any hitherto characterized species, there is, naturally, hesitancy to apply an already established name; should they be described as new, subsequent collections may render the name applied invalid. As matters now stand, we know a large number of characters of the Madreporaria, but we often do not know the taxonomic values of these characters. Bernard in order to escape from the species dilemma, proposed to give the various forms recognized by him geographic designations: the collection from each area is divided into as many forms as possible; each one of these forms is given the genus name, followed by the name of the geographic area from which it comes; this in turn is followed by two numbers; the first, in parentheses, indicates the number of forms known from the area; the second, which particular form of the series is meant. To illustrate the method, in Volume V. of the "Catalogue" six kinds of *Goniopora* are recorded from northwest Australia; these are designated *Goniopora* Northwest Australia (6) 1, (6) 2, (6) 3, (6) 4, (6) 5 and (6) 6. Each form is described in detail, and when possible, figures are given. No attempt is made to determine the systematic value of the forms; that is left to future work. This method can be commended, as it furnishes a certain number of detailed descriptions and figures and accurate geographic data to subsequent students, and thus will aid them in unraveling problems of coral systematics.

In looking over Bernard's work, it appears that he has not by the careful study of the variation of different characters in the same specimen, nor has he by carefully comparing the variation of characters in different specimens, attempted to discover the systematic importance of the structural features described by him. As the whole problem of systematic zoology can be resolved into the ascertaining of the relative values of the characters possessed by the organisms under investigation, the reviewer feels that more in the line of determining these values was to have been expected of Bernard's work.

In the opinion of the reviewer, Bernard in his last volume carries his geographic idea entirely too far. He says:

> It is in keeping with the conclusion at which our work has brought us: that while free-living organisms with highly developed powers of locomotion, such as fish or birds, may spread over the surface of the globe, and thus be largely independent of locality, this is not the case with sessile forms as highly developed as the corals. Whatever the "species" of corals may be, we know nothing about them, and can know nothing about them until we study them by means of experimental cultivation. We only know the local forms. Hence local forms are the only available units with which we can do solid work. We have to study them with a view to arranging them into larger groups extending over larger areas. * * *
>
> It now seems probable that the forms of the Indo-Pacific region will ultimately have to be divided into smaller groups corresponding to definite areas: for instance the Red Sea forms will be found to have characters peculiarly their own. A dim perception of this was pointed out by the author—but, as he now thinks, quite misunderstood—with regard to the genus *Turbinaria* (see Vol. II., 1896, p. 18, last paragraph). If this can be established generally, a great reform in the classification of corals can not be long delayed. All purely imaginary groups such as species or morphological "forms" of indefinite distribution will be abandoned as units, and the corals will have to be treated as we treat races of men—*as factors in the areas which they inhabit*, and upon the conditions of which they largely depend for their peculiarities.

Before criticizing the preceding quotation, it is desired to call attention to Bernard's geographic subdivision of the *Porites* of the western Atlantic, the Gulf of Mexico and the Caribbean Sea. They are Brazil, Curaçao, Trinidad, Barbados, Guadalupe, Antigua, Barbuda, Nevis Island, St. Christopher, St. Bartholomew, Anguilla, Santa Cruz, St. Thomas, Porto Rico, Santo Domingo, Jamaica, Belize, Vera Cruz, Florida, Bahamas, Bermuda: 21 different areas are recognized.

One would infer from the first sentence of the remarks just quoted that the free-swimming larval stage of the Madreporaria has been overlooked. Duerden's "West Indian Madreporarian Polyps" was examined to see if he gives any definite information on the duration of this stage in the corals that he studied. The data given by him are indefinite, but the larvæ of some species may be free for several days at least, and it is possible that those of *Siderastrea radians* may live in that state for several weeks. Over extensive areas where coral reefs occur, the three conditions favorable to the wide distribution of shallow-water coral species are realized; these conditions are: (1) Either shoal water or intermittent shoals; (2) oceanic currents; (3) larvæ that can live unattached for at least moderate, and possibly considerable, periods of time. There is every *à priori* reason for the relatively extensive distribution of coral species; and it will be impossible to convince many who have had wide experience with these organisms, that their species do not often have such distributions. A few instances of wide distributions are *Fungia fungites* (L.), from the East Coast of Africa to the Philippines; *Fungia paumotensis* Stutchb., the Philippines and Papeeti, Tahiti; *Fungia patella* (Ell. & Sol.), East Africa and the Hawaiian Islands; *Mœandra* (*Diploria*) *labyrinthiformis* (L.), Bermudas, Bahamas, Belize (British Honduras), Curaçao; and there are many other similar instances. As a further illustration, the results recently obtained by the reviewer from a study of *Orbicella annularis* (Ell. & Sol.) and its variations may be cited. The typical form of this species was determined by comparison with photographs of the type, kindly furnished by Professor J. Graham Kerr, of the University of Glasgow. The typical form, used in the most restricted sense possible, of this species is represented in the United States National Museum by specimens from Hog Island, Bahamas, Dry Tortugas, Florida, and Belize, British Honduras. One of the variations from the typical form comes from Dry Tortugas and Hog Island. The variation from the typical form may be of vegetative origin, *i. e.*, induced by something peculiar in the environment under which the specimens lived, or they may be due to variations in the germ cells. We do not know which of these causes is responsible for the variation; but that *Orbicella annularis* occurs throughout the coral reef areas of the coasts of the Gulf of Mexico and the Caribbean Sea, including the Antilles, Florida and the Bahamas, is undeniable. The implied postulate of Mr. Bernard that similar forms may have different phylogenies demands stronger proof than his mere suggestion that such may have happened; for there is no more reason to doubt that in corals morphologic identity means specific identity than there is to doubt its meaning for other groups of organisms.

As isolation is one of the well-recognized factors in evolution, its influence in the Madreporaria is to be expected, and this expectation is realized. For instance, as the Isthmian region of America has been closed for some time, geologically speaking, divergence between the recent Atlantic and Pacific faunas of America is to be expected, and is a fact.

Mr. Bernard is right in insisting on the need for the experimental cultivation of Madreporaria in order to understand many problems pertaining to the group; but we have obtained a number of solid facts without such experimentation, and studies of variation and general ecological investigations are fully as necessary as experiments.

Ninety-six forms of *Porites* from the Atlantic Ocean, six fossil forms from Europe, and sixteen recent forms of unknown locality are described.

From a comparison of the Atlantic and

Pacific forms the conclusion is reached "that the trabecular, horizontal, and synapticular elements which compose the skeleton are thicker and coarser in the Atlantic and West Indian forms than they are in those of the Indo-Pacific."

After the descriptions are the following analytical tables:

Table I. Contains the Locality, the Depth or Geological Horizon, when given, references to published figures, the museums in which the type is preserved, and the page in this Catalogue where the detailed description will be found, for each form. (With a supplementary Table of Porites from no recorded locality, some of which undoubtedly belong to the Indo-Pacific area; the list of known forms from that area is given in Vol. V., p. 248.)

Table II. Survey of the Geographical and Geological Distribution of the Atlantic, West Indian and European fossil representatives of the Genus, so far as at present known.

Table III. Analysis and Distribution of the Known Variations in Growth-form of the Porites of these same regions.

Table IV. Analysis and Distribution of the more easily definable Types of Calicle discoverable in the same.

In the supplement to *Goniopora* seventeen additional forms are described.

In concluding these remarks the reviewer wishes to state that he does not agree with Mr. Bernard's conclusions regarding the structure of the septa of *Porites*, and is opposed to the hypothesis of serial gemmation for each tabula in tabulate corals; he also considers that Mr. Bernard attributes too much importance to the geographic-number system for designating forms. The existence of the three factors favorable to the wide distribution of shallow water species of corals seems not to have been considered; these factors are: (1) Shoal water or intermittent shoals over extensive areas; (2) oceanic currents; (3) free-swimming larvæ. The reviewer, while recognizing the importance of isolation in causing divergence between coral faunas of separated areas, insists that some species of corals have wide geographic distribution and that there is no more reason for doubting that morphological identity in corals means specific identity than there is for similar doubt in any other group of organisms.

Mr. Bernard discovered the principles underlying the septal arrangement for *Goniopora* and *Porites* and worked out the various palar formulæ for the latter genus; he has shown students of Madreporaria the importance of studying in much greater detail the calicular structure of these corals; he has pointed out important calicular features that had previously received little or no attention; and his work on the growth forms of coralla is of importance. These are what the reviewer considers Mr. Bernard's solid contributions to the morphology of the poritid skeleton. The descriptive work of the catalogues is of value, for many forms are described in detail, excellent figures of a number of them are given, and they are referred to definite localities. No attempt was made to define species and to determine their distribution, as the data for such an undertaking were considered insufficient. However, when his contributions to the morphology of the skeleton are taken in connection with his descriptive work, Mr. Bernard deserves congratulations on having done much that will ultimately aid us in understanding the systematics of these perplexing corals.

T. Wayland Vaughan

DISCUSSION AND CORRESPONDENCE

THE FIRST SPECIES RULE: AN OBJECTION

To the Editor of Science: Pray allow me to range myself with Dr. Bather in entering a caveat against the first species rule, at any rate for paleontology. It is demonstrable that such a rule fails to interpret the views of authors. It can be tested. There are authors who have stated or obviously indicated their genotypes; there are those who have not—in fact, the same author may come in both categories. Now if the former are always found to have placed their genotypes first then is the first species rule first for the latter; but if not, then it fails.

Authors have adopted at least four methods of arranging their species: (1) the technical, as I will call it; (2) the biological; (3) the stratigraphical, as Dr. Bather points out; (4) the alphabetical.

By the technical I mean that the author describes the genotype first, and then places his other species in sequence according to their degree of difference from it. This is the only plan to which a first species rule applies justly; but this plan, though it may be common in neontology, is certainly rare in paleontology, where any of the other three methods are more usual.

The biological system consists in arranging species according to their supposed genetic sequence; but the middle or last species may be the genotype as often as the first. The biological plan may be stratigraphical in result; but not in intention. This biological method was used by Hyatt. For instance in his genus *Tropidoceras,* to name one case among many, he placed three species (*Bull. Mus. Comp. Zool.,* 5, 1867, p. 93). It can be seen from the method of his later works that he regarded these species as forming an anagenetic series, of which the first two were the immature, larval forms while the last was the mature, fully developed type of the genus; it conforms the best with his diagnosis. This, therefore, is the one to take as his genotype; a first species rule would do him injustice.

In my genera (Mon. I. O. Amm., Suppl.) the species are arranged on Hyatt's plan—in supposed genetic sequence. My genotypes are stated; but had they not been, the first species rule would fail to interpret me correctly; my genotypes come frequently in the middle of the series—preceded by species biologically less, succeeded by species biologically more, developed.

The stratigraphical method was one much favored by the older paleontologists. In such a work as d'Orbigny's "Prod. Pal." the whole arrangement is stratigraphical; that governs the first mention. Opening at random, I find *Cryptoceras* d'Orbigny first species mentioned *C. subtuberculatus* of the Devonian; but it is obvious that he regarded as the genotype *C. dorsalis* of the Carboniferous.

In other works species may be arranged by zones or beds, beginning with the earliest; the first species need not be the author's type.

Of the alphabetical method an instance may be seen in M'Coys "Carb. Foss. Ireland." His first species of *Brachythyris* is *B. duplicicosta.* Dall in his most useful work, "Index Names Brach.," records this species; and the inference is that he regards it as the type. But M'Coy had depicted without final name a form of *Brachythyrus* a few pages earlier; this is obviously his type and it is *B. oralis* which comes sixth. In *Martinia* the first species is *M. decora,* as Dall records; but M'Coy had figured an example in the same way, which is clearly a form he united under *M. glabra;* that comes third. Then M'Coy had given a further indication that he regarded *M. glaber* as his type—by using *Martinia,* for *glaber* is Martin's species.

Then there are cases in which the author indicates his type by making the generic name resemble a trivial one. Thus the obvious type of *Reticularia* M'Coy is *R. reticulata;* of *Fusella* M'Coy, *S. fusiformis;* of *Ornithella,* Deslongchamps, *T. ornithocephala.*

Since in these various cases where the genotype has been stated or obviously indicated the first species rule is demonstrably unjust, it follows that in other cases it is quite as likely to be wrong. A rule which presumes to interpret correctly in unknown cases must surely be able to show that it does justice in known cases. Tested by these the first species rule breaks down.

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Thame, England,
August 2, 1907

HOLOTHURIAN NAMES

Dr. Theo. Gill, in the August 7 issue of this journal (p. 185) rightly takes exception to the use of *Holothuria* for a genus of echinoderms. In my paper on "The Holothurians of the Hawaiian Islands" I used the name in the sense that Théel, Lampert, Ludwig and every other writer in recent years has employed the term, and I did not, as Dr. Gill surmised, take the trouble to look up the original reference (Linnæus, "Syst. Nat.," 10th ed., I., p. 657). Having *had* confidence in the above authorities I copied their blunder, with the best intentions. So much for my error.

I shall adopt (but not "with pleasure") Jäger's name *Bohadschia*. I have for some time been aware that *Microthele* probably has precedence over *Actinopyga* Bronn (for the genus erroneously called *Mülleria*), but I hesitate to accept it until the identity of Brandt's species is settled beyond peradventure.

Apropos the passing of *Holothuria*, for the old and well-known genus of sea-cucumbers, an amusing yet serious situation presents itself. Naturally, if, as Dr. Gill points out, *Holothuria* is really a Portugese man-of-war, we can no longer speak of sea-cucumbers as "holothurians," nor of the class as *Holothurioidea*. The word "holothurian" has been, in its limited field, as useful as the more familiar "mammal." And which of the several synonyms should succeed *Holothurioidea?*

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SPECIAL ARTICLES

THE OCCURRENCE OF MIDDLE TERTIARY MAMMAL-BEARING BEDS IN NORTHWESTERN NEVADA

In the summer of 1905 the writer received from Mr. Robert L. Fulton, of Alameda, California, several fragmentary bones and teeth of Miocene mammals, said to have been obtained at Virgin Valley, in northwestern Nevada. Subsequently arrangements were made to visit the locality in company with Professor John A. Reid, of the University of Nevada. Professor Reid very kindly made inquiry as to the location of the beds, but was himself unable to visit the region. In June, 1906, the writer in company with Mr. Felix T. Smith, of the University of California, visited Virgin Valley for the purpose of making a preliminary examination of the field. In reaching the valley we were kindly assisted by the employees of the Miller & Lux Company, and in locating the most fossiliferous exposures we were much indebted to Mr. T. H. McGhee, whose son, Mr. Edward McGhee, was the first person known to have discovered fossil bones in that region.

Virgin Valley is situated in northwestern Nevada, about 15 miles south of the Oregon line and 40 miles from the California line. Virgin Creek, which drains the valley, is a tributary of Thousand Creek, emptying into Thousand Lake, close to the northern border of Nevada. The region about Virgin Valley is semi-arid and is practically treeless. Though no extensive search has been made through the literature, I am not aware that this region has ever been visited by any geological party. A number of explorers have evidently passed near it to the north and to the south.

The valley of Virgin Creek is a basin with a north and south trend, the fossil beds being situated in a trough formed by an older series. The older formation consists largely of tuffs, ashes, and rhyolitic lavas. Superficially it resembles a part of the Clarno Eocene series of the John Day region to the north. On the east side of the syncline, at Thousand Creek Hill, a fine section of these beds is exposed. Some of the tuffs in the upper part of the series are exceedingly coarse, and pieces of pumice in them are in many instances several inches in diameter. The lower portion of this series was not examined, but the materials seem to be finer toward the base of the section. Beds superficially similar to those on Thousand Creek Hill cut off the southern end of Virgin Valley on the other side of the syncline, beyond the Virgin Ranch. At this point they dip back toward the Thousand Creek Hill to the northeast.

The mammal-bearing Tertiary formation, which is here tentatively designated as the Virgin Valley beds, rests in the basin formed by the older tuffs. Where the lower portion of this formation rests upon the older beds it has been somewhat disturbed, but the amount of disturbance appears, at least in some cases, to be less than that shown by the older series. The inclination of the Virgin Valley beds on the eastern side of the syncline may be largely due to the development of an extensive fault which forms Thousand Creek Hill, and presents a steep escarpment to the east.

The thickness of the Virgin Valley beds is evidently between one thousand and two thousand feet. The larger part of the formation is composed of volcanic ash or tuff showing a variable amount of induration. Characteristic bad land structure has been developed in many places. The formation may be divided somewhat arbitrarily into upper, middle and lower divisions. The lower beds are somewhat harder than the others, and where bad land structure occurs in them very steep faces are frequently produced. These beds show strong contrasts of coloration, varying from white to green or bright red. The middle beds are generally brownish or gray, and weather in gently rounded knolls. The upper beds are usually softer than the others and consist of cream-colored ash.

Mammal remains are quite common in portions of the upper beds, and at a horizon which is apparently in the lower division, though not in its lowest portion. Only a very few fragments of bones were found on the middle division, but plant remains are very abundant at this horizon. Large logs of beautifully petrified wood are present in abundance, and near the middle of this division stems and leaves have accumulated in sufficient quantity to form a thin lignitic deposit.

Judging from the character and occurrence of the fossil remains, large portions of the upper and lower divisions of the formation are of æolian origin, or have formed in shallow, shifting lakes comparable to existing lakes only a few feet in depth, such as are not uncommon in the eastern Oregon region at the present time. A part of the middle division, particularly that portion containing the lignitic deposit, has evidently formed in or about a body of water.

The mammalian remains obtained from the lower horizon include a type near *Chalicotherium* or *Moropus,* two types of horses, two or more cameloid types, a canid and a number of other forms. *Chalicotherium* is represented by a number of characteristic bones, including the peculiar phalangeal elements. Of the horses one is a form with short-crowned molar teeth resembling those of the Miocene *Hypohippus.* The other has short-hypsodont molars and is evidently in, or close to, the Miocene genus *Merychippus.* Of the camels one species is represented by limb bones indicating an animal of considerable size, and evidently of the *Procamelus* type. The canid is represented by a second lower molar apparently differing from any type thus far described from the Tertiaries of the Pacific Coast region.

The fauna of the upper beds includes a mastodon, a horse, two camels, a large cat and fragmentary remains probably representing a rhinoceros. The mastodon is a species of considerable size, and is evidently not older than the stage of the Mascall Miocene of the John Day region. One of the camels is represented by a metapodial about as large as that of *Alticamelus* of the lower Loup Fork. The cat is known only from a second phalanx indicating a large form with powerful extremities.

Such paleontological material as is present indicates that the upper division of the Virgin Valley beds is probably of Miocene age and not older than the stage of the Mascall Miocene of the John Day region. The fauna of the lower horizon, so far as known, is also evidently Miocene, though it may represent a slightly different phase.

The fauna of the Virgin Valley beds, particularly of the upper division, appears in a general way to represent the same period as the fauna of the ash and tuff formations in Nevada, which have commonly been recognized as corresponding to the Truckee Miocene. If such is actually the case, there will apparently be little reason for correlation of the Truckee with the John Day, as has commonly been done, since the Virgin Valley beds are near the age of the Mascall beds of Oregon, and the John Day is separated from the Mascall Miocene by the Columbia Lava formation, as also by a considerable unconformity below the Columbia Lava.

As far as I am aware, the beds of the Virgin Valley region offer more material for the study of extinct mammalian faunas than has yet been discovered elsewhere in Nevada. Situated as they are between the typical localities of the Tertiary formations of eastern Oregon and the areas of Truckee Miocene in Nevada, they will probably be the key to the correlation of these formations. The examination of the beds made thus far has necessarily been exceedingly superficial, but it is hoped that the continuation of this work during the next season will put us in a position to make a satisfactory determination of the relative ages of the Oregon and Nevada Tertiary formations.

John C. Merriam
University of California

PHYSIOGRAPHIC CHANGES BEARING ON THE FAUNAL RELATIONSHIPS OF THE RUSSIAN AND SACRAMENTO RIVERS, CALIFORNIA

For some time biologists in this state have noted the close relationship between the fauna of the Russian River and that of the Sacramento, in forms that do not migrate through salt water. In a recent trip through Lake County very clear evidence was found that the waters of the Scott's Creek now flowing into Clear Lake and thence into the Sacramento, formerly flowed into the Russian River. Clear Lake is a sheet of water some twenty miles in length and lying at an elevation of about thirteen hundred feet in the middle of Lake County. Scott's Creek rises in the mountains to the westward and after flowing to within two miles of Clear Lake turns to the northwest, cutting a gorge through the mountains.

On going *down* this valley one is confronted by the startling physiographic fact that it bifurcates into two valleys without change of grade. Such a division is not unusual on the flat surface of a low-grade delta, but it challenges investigation when encountered in a mountain gorge with hills rising fully a thousand feet on both sides. The valley to the left has practically a level floor and is occupied by the narrow and rather deep Blue Lakes. Three miles from where it leaves Scott's Creek, without any narrowing it terminates abruptly against a transverse ridge about one hundred and sixty feet high. Beyond this ridge the valley is occupied by Cold Creek, which empties into the Russian River.

Returning to the point of bifurcation of Scott's Creek the gorge to the right turns eastward and empties into the northern end of Clear Lake.

Climbing the hills on either side of Blue Lakes the valley in which they lie is seen to be continuous in slope and outline with that of the upper portion of Scott's Creek and of Cold Creek except for the low transverse ridge already mentioned and which evidently is the dam that made Blue Lakes.

On examination this ridge is clearly a comparatively recent landslide. It has the characteristic hummocky, uneven surface and still shows two or three ponds not yet filled nor drained. The slide came from the southwest slope of the main valley and is approximately a mile in length, starting from an elevation of fifteen hundred feet (aneroid) above the Blue Lakes. The valley is here about an eighth of a mile in width, and the momentum of the slide carried it across the valley and somewhat up the opposite slope. At this point, which is crossed by the stage road to Ukiah, the contrast in color of soil of the slide and of the eastern valley slope is very marked.

When the slide occurred the waters of Scott's Creek were evidently backed up for some ten miles, forming a lake, narrow in the gorge and widening out in the more open valley above. The waters of this new lake rose until they overflowed a low divide separating a tributary from the head of a small tributary of Clear Lake. The outlet thus determined was lowered by erosion and is now the main channel of Scott's Creek. The base level for this channel was determined by Clear Lake and the lake in Scott's Valley was soon filled by sediment making a rich alluvial plain with a maximum width of two miles. In a well sunk in the center of this plain tules were found at a depth of about seventy feet below the present surface. The portion of the old channel below the tributary through which the overflow took place did not fill with sediment as rapidly as the main valley and is now occupied by the Blue Lakes and Laurel Dell Lake—commonly termed, collectively, the Blue Lakes. The location of the low divide where the temporary lake overflowed is probably about one and a half miles from the Blue Lakes gorge. At this point the wagon road crosses a low spur that runs out to within four hundred feet of the opposite side of the valley, which is here undercut by the stream.

Remembering the recent settlement of California, it is needless to say that the time of the Blue Lakes slide is prehistoric. Indian legends tell of the sudden creation of the Blue Lakes, but they fix no date and are hardly acceptable in a physiographic court. The trees on the slide and on the adjacent slopes do not differ in apparent age, but the mountains are not heavily wooded in this vicinity. The filling in of Scott's Valley and the cutting of the divide separating the new lake from Clear Lake give some suggestion of the time. As the waters did not overflow the landslide which at its lowest point is about one hundred and sixty feet above Blue Lakes, the erosion of the new channel must have been to a less depth than the height of the slide.

Brief mention should be made of another connection between the waters of Russian River and the streams of San Francisco Bay. Copeland Creek flows down the western slope of Sonoma Mountain and debouches on a fan that spreads out over the flat divide separating the Russian River from the Bay. The southernmost of the distributaries on this fan empties into Petaluma Creek and thence to the bay. The northernmost flows into the Russian River. These distributaries meet today at the head of the fan and in flood time Copeland Creek discharges both ways. This connection seems less important than that of the Blue Lakes, for it connects the Russian River with a small stream emptying into the salt water of the bay. The Blue Lakes slide transferred bodily a portion of the fauna of Russian River directly to the Sacramento River system.

Ruliff S. Holway

FOWLER'S TOAD (BUFO FOWLERI, PUTNAM)

We are all familiar with toads—they seem common enough in our gardens and fields, yet few are aware of more than one common species in the eastern states. One toad has been strangely overlooked. Considered rare and local for many years, it is beginning to be recognized as one of the commonest forms, with a range from New England to the southern states. In fact the popular term "common toad," in much of this territory better applies to the toad (*Bufo Fowleri*), until very recently considered so rare and limited in its range, rather than to the older and better-known species (*Bufo Americanus*).

Concerning the range of Fowler's toad, Miss Dickerson in her excellent "Frog Book," reports it only from Danvers, Cutty Hunk Island, Mass., throughout Rhode Island, and New York near the coast. My own observations of this toad for a period of over ten years, lead me to believe it is a common toad that has been almost overlooked. It is heard in great numbers all along the Maanixit River, throughout the region from Oxford to Worcester, Mass., where I first became acquainted with the toad while doing some collecting in connection with nature-study work at Clark University. During the years 1900–05, I spent the greater portion of the spring and early summer at Chapel Hill, North Carolina, a small town about twenty-eight miles northwest of Raleigh. Here also I heard the unmistakable droning cries of these toads. In 1906 I took up quarters in Washington, D. C., and during the serene May nights I heard a great many of these toads in and around the Fish Ponds just west of the monument grounds. In fact these toads were hopping about throughout the vicinity—apparently the only species of toad to be met with frequently in Washington. Very recently, also, I learned from a competent observer that these toads were extremely abundant around Cumberland, Maryland. He stated that he had seen great numbers along streams in this region during the month of June, making the nights fairly hideous with their noise. In August, 1906, I met *Bufo*

Fowleri very frequently in Granby, Connecticut. In fact *Bufo Americanus* seems to be very uncommon in this region. It is at once evident that the range of Fowler's toad is rather extended, and while I am inclined to believe its southern limit is pretty nearly reached in central North Carolina, from the fact that I heard it only scatteringly there in the Chapel Hill region, I found it very abundant—segregated in numbers during the mating season, along the Maanixit River from Oxford to Worcester, Mass. There is no reason to believe it is confined to this valley alone, however, although here it is not at all uncommon.

Dr. Stejneger, of the Smithsonian Institution, recently informed me that Miss Dickerson in a recent visit to Washington identified Fowler's toad as being the common species here.

One has only to visit the Fish Ponds during the warm May nights, to hear numbers in chorus, and find them hopping about under the electric lights almost anywhere in the vicinity.

I feel that the range of this toad will be greatly extended with more careful observation. In my home region, Oxford, Mass., I think it is the commoner toad by far, and this conclusion is borne out by the relative numbers that express themselves in voice among the two species.

Bufo Americanus in this region seems to prefer the smaller pools, and is often heard in early April singing, singly or in small colonies. Its notes are among the sweetest of the springtime—mellow, musical trills, expressive of repose and serenity. On the other hand, I have heard *Bufo Fowleri* only along the Maanixit River, and along quiet-flowing streams around Worcester. In these localities in late June, the great chorus of Fowler's toads, indicates the height of their love season. Only on one or two occasions have I heard the notes of a common toad mingling with those of Fowler's toad at this season.

The congregations of the different species of frogs and toads in certain ponds and streams at the love season have always seemed rather remarkable to me. Certain ponds seem to have collected all of one species, while other near-by ponds and mud-holes never or very rarely yield a note of this same species at the song season. I can not recall having heard Fowler's toad in Grassy Pond, only a mile from Maanixit River—a pond with every condition one would judge favorable to this toad. During all the years I spent observing batrachians in this region, I found it necessary to go several miles to the river banks to hear these puzzling toads. It seems that they make rather extended journeys to certain favored streams at the egg-laying season.

I have heard nothing in nature so weird and unearthly as the almost agonized wail of this toad, repeated at short intervals. *Bufo Americanus* is heard as much during the warm spring days as at night; Fowler's toad is heard almost entirely during the earlier part of the night.

In size and coloration one can seemingly separate the two toads. *Bufo Fowleri* is a much more trim, dapper, active little fellow than its relative *Bufo Americanus.* It appears less roughened and warty, and decidedly more gray in general coloration than the latter. The latter toad is spotted beneath, while the under parts of *Bufo Fowleri* are uniform grayish, the throats of the males being dark. Whether or not these color distinctions are always thus defined in the two forms remains to be determined.

Until Miss Dickerson gave Fowler's toad specific rank, it was regarded as an extremely local race of *Bufo Americanus.* It is remarkable that the toad should have been ignored so long, and even in localities where it is the extremely common form. In the lateness of its mating season, and in its song, Fowler's toad is totally unlike the common toad (*B. Americanus*), although comparisons in the laboratory, of preserved specimens, do not at first sight show strikingly different specific characters. It would be very interesting to determine definitely the relation of this toad to *Bufo Americanus,* and the more southern form (*Bufo lentiginosus*). H. A. Allard

Bureau of Plant Industry,
Washington, D. C.,
May 24, 1907

PRELIMINARY NOTE ON A NEW DISEASE OF THE CULTIVATED VETCH

About the middle of last July the senior author discovered a fungus disease of the cultivated vetch which does not seem to have been reported before. He first observed it on the stems and pods from a small patch of the vetch on the horticultural grounds of Cornell University. It was later brought into the laboratory from two fields of the cultivated vetch on the university farm. The disease appears to be quite abundant and is often associated with an *Ascochyta*, especially on the stems. Here the two fungi are often mixed together and it is thus possible for one not familiar with the new one to confuse its spores with those of the *Ascochyta*. On the pods it often occurs quite pure, and here it is easily seen with the unaided eye to be quite distinct from the disease caused by the *Ascochyta*. It is, however, frequently mixed even on the pods with the *Ascochyta*, but the spots are here so characteristic that there is no trouble in distinguishing it.

The gross appearance of the spots and spore pits on the pods is very striking. The spots are elongated, forming either long narrow or elliptical spots, sometimes with a dull purple border. The spots on the pods are oblique, probably due to the oblique fibrous structure of the pods. The middle line of the spot is white from the numerous spores formed on the basidia and which later ooze out in masses. When in mass the spores have a pale pink or flesh color, and a hasty preparation suggests the genus *Glœosporium*. When the spores are washed by the rains they give a whitish appearance to the entire spot because of the thinness of the layer.

The fruiting part of the fungus is beneath the epidermis, the latter being ruptured in the form of a slit through which the spores escape. The mycelium becomes brown and then black, and the epidermis is also blackened by the action of the fungus. In age then the spots are black oblique lines as seen on the pods, and many of them may be sterile through failure of the fungus to fruit.

The spots caused by the *Ascochyta* are nearly or quite circular, grayish in color, with a dull purple border, and the grayish center punctate with the minute brownish pycnidia.

Besides the interesting character of the spots the structure of the fungus causing this new disease of the vetch is even more interesting. In structure it resembles that of a species of *Corticium*. The basidia form a definite hymenium which arises from the pseudoparenchymatous subhymenium of angular cells, two to three cell layers in thickness. The nourishing mycelium extends out into the surrounding tissue of the host. The basidia bear four to eight spores, which are sessile and usually produced in a whorl or crown at the end. The spores are oblong to subelliptical, straight or curved, continuous, hyaline, granular, and measure 12–20 x 3–3.5 μ. As the spores fall away from the basidia others are probably produced (in culture they are). Conidia similar to the basidiospores are produced on slender conidiophores. These are intermingled with the basidia and this character recalls that of the genus *Exobasidium*. The spores also bud in yeast-like fashion from one or both ends, rarely from the side, and the sporidia thus produced are similar to the spores. In this way a great mass of spores is produced from the spore pit. The fungus occurs on the leaves and flower bracts also. It has been obtained in pure culture by several different methods of separation. It grows slowly, but ultimately produces numerous black stromatic bodies and numerous spores, which are pink in mass.

The fungus appears to be the type of a new genus for which the name *Protocoronospora* is proposed, and a provisional diagnosis is given as follows:

Protocoronospora Atkinson and Edgerton new genus.

Stroma pseudoparenchymatous, two to three cell layers in thickness, formed by the compact branching of the mycelium, the ultimate exterior branches producing the basidia which form a hymenium. Spores sessile, hyaline, colorless, continuous, smooth, several (usually four to eight) on a basidium. Spores budding and forming sporidia similar in form. Conidia also similar in form on slender short conidiophores intermingled with the basidia.

P. nigricans Atkinson and Edgerton n. sp.

Forming narrow elongated spots on the pods, stems, leaves and bracts, spots oblique on the pods and from 2–5 mm. x 1–2 mm. Spots at first white or with a purple border, later black. Stroma of pseudoparenchymatous cells 6–9 μ in diameter, two to three cell layers in thickness. Basidia clavate to subcylindrical, 20–30 x 6–8 μ, 4–8-spored. Spores sessile, and basidia continuing to form new spores, at least in artificial culture. Spores pale pink in mass, oblong to subelliptical, hyaline, continuous, smooth, granular, straight or curved, 12–20 x 3–3.5 μ, usually becoming once septate on germination. Mycelium from the stroma penetrating the adjacent tissues. Parasitic on pods, stems, leaves and bracts of *Vicia sativa.*

Geo. F. Atkinson,
C. W. Edgerton
Botanical Department,
Cornell University

MARINE BIOLOGICAL ASSOCIATION OF SAN DIEGO[1]

General Statement.—The La Jolla park transfer matter, the sewer bond election and the building of the new boat have been the events during the past year of foremost moment to the general association. The story of these is so well known that for the purpose of this report they can be quickly despatched.

The legislation requisite in the opinion of the attorney general of the state, to enable the city to transfer its trusteeship of the park at La Jolla to the board of regents of the University of California, was secured without a lisp of opposition, so far as we know, early in the last session of the state legislature. Shortly after the enabling act became law the city council passed an ordinance providing for the transfer, under certain conditions, of the title to the park to the regents of the university, the conditions of the transfer having been first submitted to and approved by the attorney of the board of regents to insure that the trust might be accepted legally and consistently with the university's rules and policies.

[1] Extracts from the annual report, presented July 20, 1907, by Wm. E. Ritter, scientific director.

Meanwhile, by reason of enlarging ideas and plans in the minds of the station's foremost supporters, Miss Ellen B. Scripps and Mr. E. W. Scripps, the inadequacy in size of the little park for the future developments contemplated, became more and more apparent. The final step in the transaction between the city and the board of regents was consequently deferred pending another effort to secure a site of more ample size somewhere in the immediate vicinity of La Jolla, which vicinity all expert judgment appealed to unites in declaring must not be given up under any circumstances. The only piece of ground even approaching the desired size, and at the same time available, was found to be a pueblo lot of about 160 acres owned by the city. It is a great satisfaction to be able to report that the efforts to secure this land have advanced to such a point as to justify the expectation that within a month the association will be the possessor of a station site large enough to admit of the developments looked forward to.

There remains in this connection only the pleasant duty of acknowledging the association's obligations to the various agencies that have contributed to securing for the association what it has asked. It is difficult to imagine how any community could take up a purely non-commercial project like this more intelligently and heartily, and promote it more liberally, than the San Diego community has this biological one. Individual citizens, business houses and corporations, city officials, representatives of the city and county in the state legislature—everybody, in short, with whom we have come into relations has treated us even better than we expected to be treated, and that is saying a good deal.

Planning for the New Laboratory.—The plan suggested at the last annual meeting, held in September, 1906, that the first section of the new laboratory building be hurried to readiness for dedication in early September, 1907, came to the end of many another fond hope. Unquestionably real good would have resulted to the station could the scheme have been carried out. But unquestionably also the conditions that have prevented its realization, viz., the campaign for a larger and better building site necessitated by enlarged ideas and purposes for the future of the station, are a far greater good than any sort of an earlier dedication could have been.

The Work of the Summer.—The paid staff for the season consists of thirteen, five of whom are full-fledged naturalists and eight are their assistants. In addition seven "accommodated" workers are at the laboratory.

Dr. J. F. McClendon, of Randolph-Macon College, Va., has been employed as resident naturalist for the coming year.

No one beyond the Rockies was asked to come to the station this summer. The reasons were several for setting aside this once this especially stimulating and profitable feature of the policy of the directorate. When it became obvious that the little green laboratory building would have to do for the summer's work, consideration of the sardine-like condition of things that would be inevitable among the workers, strongly disfavored the alluring of strangers into the pack. Again, uncertainty as to whether the new boat would be in operation for any part of the season argued in favor of restricting operations to tasks already in hand which could be prosecuted to best advantage with the limited means for collecting that might have to be relied upon. Finally the probability that any naturalists we should care to ask would wish to attend the International Zoological Congress which met in Boston, August 19–23, did not favor an appeal to easterners.

Testing of Policy.—The policy of compensating professional naturalists for carrying on a scheme of investigation definitely undertaken by a marine biological station as a whole is an experiment until now untried, so far as I know. The plan is in its fifth year of testing here at the San Diego station. This period should be sufficient to give some intimation of its feasibility and productiveness. Fathers and mothers are not the most reliable judges of the virtues of their own children. It would be unprofitable for us of this association who have undertaken the experiment to indulge now, in the absence of anybody to criticize, in commendatory remarks on what has been accomplished. It will be enough to look for a moment at the balance sheet of outgo and results.

From 1903, our first year under the present order, up to this summer's work approximately $6,000 have been paid in salaries to naturalists and their assistants.

The product of this outlay stated numerically in terms of the printer's art is as follows: Twenty-three memoirs, aggregating 768 pages of the zoological publications of the University of California, large octavo in size, have been published. The manuscripts of two other memoirs, one of about 150 pages and the other of probably 50, are in the editor's hands awaiting their turn at the University Press. There naturally has not been time for the present summer's work to contribute anything.

No one would, of course, lay much store on this bulk method of estimating the value of the returns for the expenditure. The major part, though by no means all of what has been printed, is concerned with the description and record of organisms living in our area which before were almost wholly unknown. Some 518 kinds of organisms have been studied critically so far as the needs of identification and record are concerned. Of this number 106 have been treated by their authors as new to science, *i. e.*, have been described as new species. It is fair to assert, I believe, that as a result of these four years' work, some at least of the animal groups inhabiting our waters are better known to science than are the same groups of the Atlantic shores of the United States, where marine laboratories have existed and marine collecting has been practised for forty years at least.

It certainly would have been impossible to accomplish more than a small fraction of what has been done, but for the method that has prevailed and with the money to back it. Whether or not the knowledge gained is worth what it has cost I am willing to leave to the contributors of the funds and to the intelligent public.

Another aspect of the policy that I can not refrain from devoting a few sentences to is that of the utilization of novitiate assistance. The employment of advanced university students to assist the full-fledged investigator in the prosecution of his own researches at a compensation sufficient to cover the student's expenses, is particularly satisfactory. It yields richly in two directions: it increases by as many fold as there are assistants, almost, the productive capacity of the professional, while at the same time it ought to be, and I believe is, a benefit to the students hardly to be secured in any other way. No help is so pleasant to give or so effectual, other things equal, as mutual help; and I know few relationships anywhere in labor that comes nearer realizing the ideal of reciprocal service than this one.

The proposed enlargement of the station's scope being of the future rather than of the past, can hardly claim a place in this report. I merely call attention of the members of the association to the fact that the purposes for which the organization was formed, as indicated in its articles of incorporation, anticipate this or any other expansions that the management may at any time deem wise to undertake.

NEWSPAPER SCIENCE

FINDS A LIZARD 314 FEET LONG.

Wyoming University Expedition Unearths the World's Biggest Fossil.

Baggs, Wyo., July 24.—The most important discovery ever made in the great fossil beds of Wyoming is the skeleton of an animal of the lizard type, just found, which shows a length of 314 feet.

It is by far the largest prehistoric animal yet discovered. The skeleton, which was found by an expedition from the Wyoming State University, is in a perfect state of preservation, every bone seeming to have been in place when petrification set in.

The skeleton is in the side of a hill of shale and has not been torn entirely from the stone in which it is imbedded, but the whole length can be seen.

One vertebra, which has been removed, weighed more than 1,000 pounds. The skeleton will be placed in the Wyoming State University, which has the greatest collection of fossils in the world.—New York *Sun.*

PLEASE NAME THIS FREAK.

Skeleton Resembling Both Horse and Snake Puzzles Naturalists.

Special to the New York Times.

Seneca Falls, N. Y., July 26.—A skeleton to which local naturalists are unable to attach a name was discovered to-night in an excavation here. The frame is five feet long from nose to tail, with two legs fifteen inches long. The head is identical with that of a horse, with deeply sunken eyesockets and massive jaws. On each side of the upper and lower jaws sharp tusks protrude, with a row of fine teeth between. The neck is short, and of graceful curve.

The spine is similar to a snake's, except that it is lined with thirteen ribs on each side and has a ten-inch tail joined directly on the spine. No socket for wings is apparent. The legs have a hip, knee, and ankle joint, and the extremely long toes are said to indicate web feet.

The ground where the object was found has never before been disturbed to the knowledge of local historians.—New York *Times.*

TOMATO ON A DAHLIA BUSH.

Owner Offers $25 for an Explanation of This Freak of Nature.

Special to The New York Times.

Atlantic City, N. J., Aug. 16.—William Wilson, a farmer of Pleasantville, has a freak product in a tomato growing on a dahlia bush. The tomato weighs about a pound, and is removed from the nearest tomato vine by at least 150 feet.

Wilson offers $25 to any one who can explain the freak of nature.—New York *Times.*

Dr. Hill is often called the "American Archimides," so profound is his knowledge of mathematical astronomy. His researches in connection with the lunar theory secured him some years ago the gold medal of the Royal

Astronomical Society, London. Dr. Hill's many papers on mathematical astronomy have been purchased by the Carnegie Institute. The papers are designated as Hill's collected mathematical works.—Boston *Transcript.*

REORGANIZATION OF THE JOURNAL OF MORPHOLOGY

Plans have just been completed for the reestablishment of the *Journal of Morphology* on a secure financial basis, and the publication of the journal will be resumed immediately. This announcement, which Professor Hubrecht recently characterized as the best piece of news which he had heard since coming to America, has been made possible by the generosity of Dr. Horace Jayne, a friend and former director of the Wistar Institute of Anatomy and Biology. The journal will be published hereafter under the auspices of the institute, which assumes all financial responsibility; it will be edited by a board representing different institutions. The board of editors consists of the following:

E. G. Conklin, University of Pennsylvania.
H. H. Donaldson, Wistar Institute.
M. J. Greenman, Wistar Institute.
G. C. Huber, University of Michigan.
Horace Jayne, Wistar Institute.
F. R. Lillie, University of Chicago.
F. P. Mall, Johns Hopkins University.
C. S. Minot, Harvard Medical School.
T. H. Morgan, Columbia University.
G. H. Parker, Harvard University.
E. B. Wilson, Columbia University.
C. O. Whitman, University of Chicago.

The *Journal of Morphology* was founded in 1887 by C. O. Whitman and E. P. Allis, and it established a reputation for scientific merit and excellence of printing and illustration which was unsurpassed by any similar journal in the world. After the appearance of seventeen volumes the journal was compelled in 1902 to temporarily suspend publication, owing to insufficient financial support.

In the meantime the *American Journal of Anatomy* and the *Journal of Experimental Zoology* have been established and have taken high rank in their respective fields, but the general field of animal morphology has had no organ of publication in this country. During the past five years it has been necessary to send to European journals many contributions within this field, and it has been a source of much anxiety and humiliation to American morphologists that in this great country, where so much research work is being done and where such great sums have been given for the advancement of science, no means existed for the adequate publication of morphological contributions and monographs. This great need will be met in large part by the reorganized *Journal of Morphology,* which will be conducted on the same broad and high plane which has always distinguished it.

SCIENTIFIC NOTES AND NEWS

A. N. SKINNER, professor of mathematics, U. S. N., of the U. S. Naval Observatory, was retired according to law upon reaching the age of sixty-two years on August 12, 1907. Professor Skinner will remain upon active duty, however, until the completion of some unfinished work on the Astronomische Gesellschaft zone $-14°$ to $-18°$, which was observed under his direction from 1892 to 1894. H. L. Rice, formerly assistant astronomer at the observatory, has been appointed to the professorship vacated by this retirement, and H. R. Morgan succeeds Mr. Rice in the position of assistant astronomer. The organization of the work of the observatory has been changed in the direction of the consolidation of the work, and Professor W. S. Eichelberger, U. S. N., has been placed in charge of all the astronomical work of the observatory.

PROFESSORS J. J. STEVENSON and W. M. Davis are the official delegates of the Geological Society of America to the centenary of the Geological Society, of London, to be held this month.

PROFESSOR S. ZABROWSKI, professor of ethnology in the School of Anthropology at Paris, has been elected president of the Paris Anthropological Society.

DR. A. VERNER, professor of chemistry at Zurich, has been elected a corresponding member of the Göttingen Academy of Sciences.

Dr. Edmund Weiss, director of the Astronomical Observatory of the University of Vienna, has celebrated his seventieth birthday.

Dr. Franz von Leydig, formerly professor of anatomy and zoology at Bonn, has celebrated the sixtieth anniversary of his doctorate.

The Broca prize of the Society of Anthropology of Paris has been awarded this year to M. Lapicque for his manuscript entitled "Investigation of the Negro Races." The value of the prize is 1,500 francs. Of this amount M. Lapicque receives 1,200 francs. A Broca medal and 300 francs, with honorable mention, have been awarded to M. Chaquet for his manuscript memoir on "The Teeth According to Sex and Race," and a Broca medal, with honorable mention, to E. Fisher for a research on "The Variations of the Human Radius and Ulna."

Professor W. O. Teague has resigned his position in the experimental engineering department at Purdue University, Lafayette, Ind., to accept the management of the Brookline Motor Car Company, of Brookline, Mass. Professor Teague has been at Purdue for two and a half years in charge of the engineering laboratory, giving especial attention to the work in connection with automobile power.

Charles George Crane, B.S. (Wesleyan '07), has been appointed assistant in the Division of Zoology of the U. S. Public Health and Marine Hospital Service, in the place of Dr. David G. Willets, who has resigned.

Major James Carroll, surgeon, U. S. Army, professor of bacteriology and pathology in the George Washington University, eminent for his investigations on yellow fever, died at his home in Washington on September 16, at the age of fifty-three years.

Dr. Francis H. Markoe, professor of clinical surgery at Columbia University, and previously demonstrator of anatomy, died, on September 13, at the age of fifty-two years.

At a recent meeting of the Kentucky State Bar Association the following resolutions were adopted in regard to expert testimony:

Whereas, The abuses of expert testimony have grown to such proportions as to become a public reproach and often actually to pervert justice; and,

Whereas, The rules of the present system or lack of system regulating such testimony are deserving of the most serious consideration in all the branches thereof; and,

Whereas, The State Medical Association is qualified to give great assistance in consideration of the subject of medical expert testimony; now, therefore, be it

Resolved, That this association create a committee to be composed of three members to be appointed by the president, whose duty it shall be to consider the subject of expert testimony in all branches; that said committee be instructed to confer with a like committee from the State Medical Association on medical expert testimony, and further instructed to report back to this association at its next annual meeting.

The Rome correspondent of the London *Times* reports that the number of states which have ratified the convention for the creation of an International Institute of Agriculture in Rome now reaches 44; and they include almost every country in the world of any importance from the point of view of agricultural production. Of the English colonies and possessions, Canada, Australia and India have applied for separate representation. The palace which is being erected for the institute in the gardens of the Villa Borghese is rapidly approaching completion, and before the end of September will be roofed in. The building, designed by the architect Signor Pompeo Passeroni, promises to do credit to Italian taste. Invitations for the meeting of the permanent committee and for the inauguration of the institute will probably be issued in the course of November next, and with the first meeting of the committee in the spring of next year the institute will enter upon its career of activity. In the meantime, the Italian Royal Commission has appointed Professor Pantaleoni to superintend an inquiry for the purpose of ascertaining exactly the extent of the information which the different countries which have adhered to the convention are in a position to supply with regard to their agricultural production. This information will be catalogued and classified in a tabulated form, and a report, which will also contain comments on the various statistical methods employed, will be ready for the use of the permanent committee, whose first duty will be to discover the amount and reliable character of the statistics already available and to suggest new means of obtaining information where necessary. A great mass of material bearing on this subject has already been received by the *Consulta* from the countries interested. The Royal Commission has also entrusted Professor Bodio, of the General Bureau of Statistics, with a mission to Germany and Austria in order to study on the spot the systems pursued by those countries for the collection of agricultural reports, and has taken other steps as well in order to extend and improve the statistics furnished in Italy.

At a meeting of the Association of German Architects and Engineers at Kiel, on August 25, Herr Scholer, an official of the Imperial Canal Office, made some statements with regard to the projected extension of the Kiel Canal, which are reproduced in foreign journals. The widening of the canal has been rendered necessary by the fact that even the battleships of 13,200-ton Braunschweig class, with a beam of 22.2 meters, are nearly a quarter of a meter broader than the sill of the canal, which would thus be totally impracticable for the new 18,000-ton battleships now under construction. As already announced, the depth of the canal is to be increased from 9 meters to 11 meters and the width of the sill from 22 meters to 44 meters, which would give a sectional water area of 825 square meters, instead of the present area of about half that extent. The course of the canal will remain essentially the same, and the widening is, as far as possible, to be confined to one bank in order that traffic may not be interrupted. In view of the not altogether satisfactory channel in the neighborhood of the Upper Eider Lakes, east of Rendsburg, a new cut two kilometers in length is to be dug between Lake Audorf and Lake Schirnau. The channel between Levensau and Holtenau is also to be modified. The sill is to be horizontal, and eleven bays are to be constructed, some of which will be carried sufficiently far back to allow the largest steamers to turn in the canal. At various points, like the low-lying district near the Kuden Lake, considerable difficulties will have to be surmounted, owing to the marshy nature of the soil. No less than 500 cubic meters of material will be built into the new locks at Brunsbüttel. The foundations of the new bridges will be sunk to a considerable depth, so as to permit of their being utilized if still further extensions of the canal should be found necessary in the future. The village of Westerrönfeld, near Rendsburg, will be completely bridged over. At Brunsbüttel 42 houses, some of which are of quite recent construction, will have to be pulled down in order to make way for the canal. The total amount of earth to be excavated is estimated at 100 million cubic meters (3,531,700,000 cubic feet). The entire work will be carried out by the Imperial Canal Office with a reinforced staff.

UNIVERSITY AND EDUCATIONAL NEWS

Two important gifts, made to Yale University during the past week, are announced. Archibald Henry Blount, of Herefordshire, England, has left the university nearly his entire estate, the value of the bequest being estimated at $400,000. The reasons that led Mr. Blount to make this bequest to Yale University are not known. Mrs. James B. Oliver, of Pittsburg, Pa., has given the Sheffield Scientific School $150,000 for a new lecture hall for work in English economics and history. This hall is a memorial to her son, Daniel Leet Oliver, formerly a student in the Sheffield Scientific School, who was killed in an automobile accident last June.

By the affiliation of the Indiana University and the State College of Physicians and Surgeons, Indianapolis, the name of the medical school is dropped and that of the "Indiana University School of Medicine" substituted. It is specified that the board of trustees of the state university shall have full control of the medical college, but there will be no change in the course of instruction nor in the faculty. The first two years of work are to be given at the state university, Bloomington, and the last two at Indianapolis.

A director of physical training has been appointed for the Boston School system, and a professional nurse has been assigned to each of the twenty-two districts.

Dr. Wm. North Rice, professor of geology at Wesleyan University, has been appointed acting president during the absence of President Raymond.

Dr. Thomas T. Read, who has held during the past year the position of professor of mining and metallurgy at Colorado College, has accepted the position of professor of metallurgy at the Imperial University in Tientsin, China. The vacancy at Colorado College caused by his resignation has not yet been filled.

Dr. Gustave M. Meyer, of the department of biological chemistry of Columbia University, has been elected head of the department of physiological chemistry at Syracuse University.

E. R. Dewanup, of the University of Chicago, has been appointed professor of railway management in the University of Illinois.

Mr. T. D. Beckwith, of the Bureau of Plant Industry, Department of Agriculture, Washington, D. C., has been appointed assistant professor of botany and bacteriology at the North Dakota Agricultural College at Fargo, N. D.

New appointments at Stanford University for 1907–8 have been made as follows: *In Law:* Mr. Frederic C. Woodward, of Northwestern University, as professor of law; Mr. Joseph W. Bingham, of Cornell University, as acting assistant professor. *In Philosophy:* Mr. Henry W. Stuart, of Lake Forest University, as assistant professor; Mr. George H. Sabine, of Cornell, as instructor. *In Applied Mathematics:* Mr. Sidney D. Townley, of the International Latitude Observatory, Ukiah, California, as assistant professor; Mr. J. D. Suter, of the University of Wisconsin, and Mr. Edward Jordan, of St. Peter's College, Australia, as instructors. *As Librarian:* Mr. George T. Clark, of the San Francisco Public Library. *In Political Science:* Mr. James M. Motley, of Wells College, as assistant professor. *In Romanic Languages:* Mr. A. L. Guerard, of Williams College, as assistant professor; Mr. Ernest G. Atkin, of Cornell, as instructor. *In German:* Mr. George H. Danton, of Western Reserve, as acting assistant professor; Mr. Herman Hilmer, of Michigan University, and Mr. Bruno Boezinger, of Texas, as instructors. *In Education:* Mr. Percy E. Davidson, of New York Normal Training College, as acting assistant professor; Mr. M. E. Dailey, of San Jose Normal School, as lecturer. *In History:* Mr. A. Edward Harvey, Princeton '98, as instructor. *In Drawing:* Mr. Robert B. Harshe, of Nantucket School of Design, as instructor. *In Electrical Engineering:* Mr. W. A. Hillebrand, Cornell '00, instructor. *In Greek:* Mr. Edward W. Hope, of University of Illinois, as instructor. *In Metallurgy:* Mr. Luther W. Bahney, University of California '97, as instructor. *In Civil Engineering:* Mr. J. H. Foss, Stanford '03, and Mr. F. H. Fowler, Stanford '05, as instructors. *In Mechanical Engineering:* Mr. Everett P. Lesley, Stanford '97, and Mr. Robert Harcourt, of San Francisco, as instructors.

The following appointments have been made at New Hampshire College: William Morton Barrows, M.S. (Harvard '06), assistant in zoology; C. S. Spooner, of the Bureau of Entomology, assistant entomologist; Fred Rasmussen, of the Iowa Agricultural College, associate professor of dairying; J. F. Eastman (Massachusetts Agricultural College '07), assistant agriculturist; W. H. Pew (Iowa Agricultural College '07), assistant professor of animal husbandry; Ray Spencer (Dartmouth '07), instructor in English and modern languages; C. P. Cooper (Ohio State University '07), assistant in mechanics and electrical engineering; T. J. Laton (New Hampshire College '04), instructor in drawing; S. T. Adams (New Hampshire College '06) assistant professor of physics and electrical engineering. E. D. Sanderson, professor of zoology and entomology, has been made director of the experiment station.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, SEPTEMBER 27, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE UNIVERSITIES OF AUSTRALIA AND NEW ZEALAND[1]

AUSTRALIA

I SHOULD not for a moment venture to make suggestions to the authorities of the university of which I am the guest were it not that these authorities have made a special request that I should give them an outline of my impressions. Each institution must work out its own destiny in its own way and as directed by its own environment. While each university must profit by the experience of others, as the universities of America have profited enormously by the experience of the universities of Germany, no university can use the methods of another unless these methods spring naturally, from likeness in conditions.

My direct knowledge of the University of Sydney is, as you know, slight. I have met some of its professors at different times and from these I have justly formed a high estimate of the character of the institution and of its work. For the rest, I have only the university Calendar and the impressions formed in a week of cordial hospitality.

The most important matter in a university is the character of its faculty. Next comes the degree of completeness of its

[1] In a course of lectures before the University of Sydney, President Jordan was asked to give a summary of his impression of the needs of the University of Sydney. A similar request was made at Wellington regarding the four colleges which constitute the University of New Zealand.

library and appliances, and lastly, the nature and adjustments of its courses of study and the fitness of the university's methods to the actual needs of the actual people which it serves. In these regards, considered as a whole, the University of Sydney must take a very high rank. In America it would take its position in the first rank or group of American universities. In organization, methods and work, it would stand nearest to the University of Pennsylvania, and its problems are much the same as those of that institution. The faculty, although smaller than in American institutions of like grade, is of a quality equal to that of the best institutions in any country, and in this consists the main excellence of a university anywhere.

If the University of Sydney were in America, it would open its doors more widely for the admission of students. It would not lower its entrance standards, but it would allow larger freedom in choice of subjects for admission, laying less special stress on Latin, or even on languages, if the student were well prepared in other subjects requiring an equivalent amount of work. It would lay no official stress on any particular subject, but would let each stand on its merits as determined by the judgment of the masters of its preparatory schools. The university would aid the secondary schools and widen its usefulness if it would examine the schools rather than the students at the time of matriculation. In other words, it would find out from friendly conference and careful inspection which of the secondary schools of Australia really and thoroughly met its requirements. It would then receive the pupils of these schools without further question.

The university should make it possible for the energetic and competent student to pay his way by work in vacation or otherwise, without outside help, through his university course. This would involve a material reduction in fees, and the difference should be made good by the state, in view of the great advantage which would accrue to it by the extension of the public school system to its crowning element, the university. In a frontier country, the intelligence and power of the new generation arises from the cabins of the pioneers rather than from the homes of those already well-to-do.

It is the experience of America that free scholarship won in competition by the very poor or the very bright does not meet the need of the state. It is morally better that all, rich and poor, should be treated alike. Moreover, the element of competition for prizes and favors is opposed to sound scholarship and to the pursuit of learning for its own sake.

In the course of study, some modification toward the group system or the elective system will be found to intensify the interest of students in their work. Interested students make good teachers. The results of placing all subjects and all chairs on an academic equality, putting aside set courses, and placing each student's course under the direction of his major professor, have been found excellent in America. It has led to a new birth of educational interest wherever it has been tried. If each professor has the educational direction of his own students, there is no occasion for the discussion of the relative values of students and studies, as between science, mathematics, history and the classics. Each student can select his own master among the university professors and each professor can carry out his own ideas of education. After all, it is the man who counts and not the subject. There is no value in subjects prescribed for mental broadening if these are taken unwillingly.

Unwilling work forms bad mental habits, degrades learning and paralyzes instruction. In these matters the student can be trusted to choose. Whatever his choice, he can not go far wrong, and the greater the responsibility thrown on him, the more certain he is to rise to it.

The examination does not play such an all-compelling part in Sydney as in Oxford and Cambridge. And yet I think too great stress is laid upon it. What we want is that the student should do his work honestly, thoroughly, and when it is due. That he should pass an elaborate examination is another matter. The power to pass examinations well is often a matter of quick memory rather than of sound understanding. Examinations are passed through mastery of text-books; to comprehend the subject is quite another matter.

To have examinations set by outside persons is to degrade the teacher to a mere coach. To make examination a chief function of a university is to substitute an incidental function of questionable value for the real purpose of the university. The standards set by the University of London, which is primarily an examining board, are very high, but it is an open question whether this university, as an examining university granting degrees, does now anything worth while for English scholarship. The real university is a teaching university. All forms of knowledge which can broaden the mental horizon, add to the rational pleasures of life, better human conduct or be wrought into rational and helpful action are within its province.

To meet this demand in full, the range of studies in the University of Sydney will need to be greatly widened and intensified as time goes on. The number of professors should be doubled, the chairs should be subdivided, the work should be carried farther, and "the hunger and thirst which only the student knows" should be satisfied in every possible way. This again means larger equipment, a larger library and a vastly increased range of scientific appliances.

To this end the state must have a higher appreciation of the university. It must treat it more liberally—not to be generous, but to be just, toward its own interest. The rich men of Australia should regard the university as their natural heirs, for in no way can money do more good than in increasing the energy, the intelligence, the self-devotion, the efficiency of the generations which follow. That the state will demand a larger share in the control of the university is another reason why the university should educate the state.

Another need of the University of Sydney, one which can not be so easily met, is that of generous competition. The friendly rivalry between neighboring universities strengthens both, the more so if they differ in organization and method. It leads the youth of promise to feel that his choice lies between university and university, not to the mere choice between the local university and none at all.

Since California came to have two universities close together, the number of college students in the state has risen from 450 to over 4,500. The pressure of higher education to the square inch is said to be higher in California than anywhere else in the world.

On each recurrent day of athletic rivalry, the whole population of the state is divided between the blue and gold of California and the cardinal red of Stanford. In a recent address in San Francisco, Professor Bacon, of the University of California, said that if the whole endowment of Stanford had been given to the older institution, it would have helped it less than it has been aided by the friendly rivalry of the two.

And yet, when Stanford University opened in 1891, a prominent journal said that there was "about as much need of a new university in California as for an asylum for decayed sea captains in Switzerland." It is through variation in structure and through the natural selection of favorable variations that all progress arises, whether in the evolution of organisms or in the development of universities.

The history of every nation is first written in its universities, and in so far as the Australia of the future shall have a noble career, the elements of this career must be first recorded in Sydney, in Melbourne, in Adelaide, in the universities that are and are yet to be.

NEW ZEALAND

In answer to a request for suggestions as to means of improving the teaching effectiveness of the colleges of New Zealand, I may be allowed to say:

1. Let examination be a function of the professor, not of the university. Each professor should certify to the college the work which the student has actually accomplished in satisfactory fashion.[2] Each college to certify to the university of New Zealand, through a vote of its professorial board, those students entitled to degrees.

2. Requirements of degrees should be stated in terms of work accomplished, not in terms of examinations required. The examination of any class should be controlled by its teacher.

3. The chairman of the professorial board should have as many as possible of the functions of the American university president. Especially he should have the initiative in academic matters, the choice of professors and the adjustment of courses. In this he should appear as representative of the professorial faculty, looking after their common interests and keeping in touch with them. He should frequently visit the universities of Europe and America, and in the work of teaching, should he retain his chair, he should be aided by a competent associate.

4. So far as possible, the certificate of masters of approved secondary schools should be received in place of matriculation examinations. In receiving students, a generous range of substitution of subjects should be allowed, and book-cramming, especially in science, should be discouraged.

5. In American experience, the best method of adjusting the course of study is through that form of the group system known as the "major professor" system.

In New Zealand this could be adjusted as follows:

(*a*) Each student on matriculation shall select his major work in some one of the recognized departments of the college, as classics, modern languages, English, philosophy, education, mathematics, history, economics, zoology, botany, geology, physics, chemistry, law, civil, electrical or mechanical engineering.

(*b*) The professor in charge of the department becomes the student's adviser, and his approval is necessary in all adjustments of studies at the beginning of each college term.

(*c*) Each of these departments will carry on such courses as the staff is able to

[2] At present, all papers representing final examinations in the four colleges composing the University of New Zealand (Otago College at Dunedin, Canterbury College at Christchurch, Victoria College at Wellington and University College at Auckland) are sent to London to be graded. To those successful in the final examinations in six subjects (representing about three years' work) degrees are granted by the University of New Zealand.

carry, the higher value of advanced over elementary work being kept in mind.

(*d*) To be eligible to the bachelor's degree a student must have completed the equivalent of three (preferably four) years of instruction in collegiate work. In this must be included the major work of some one department, with such minors as may be indicated by the head of such department, and also such electives as may be approved by the "major professor" at the time of registration.

(*e*) A student may change his "major department" on petition (and with the consent of the professors concerned). In this case the work done as major becomes a minor, and the back work of the new major must be made good.

(*f*) Departments should stand on a basis of academic equality, no student being obliged by the college to take one subject rather than another. Such prescription of studies should be the work of the major professor.

The colleges in New Zealand should devote themselves primarily to the actual needs of New Zealand. The professorship should carry greater power and greater responsibility than now, and much of the work of the council should be transferred to the four professorial boards.

6. Degrees should not be granted for extra-mural study, and in general not for attendance on night lectures or extension lectures.

To do work really worthy of university recognition, the student should enter the university atmosphere. He should make all possible use of teachers, laboratories and libraries.

7. Taxation of university students is the most oppressive form of state taxation.

8. In general, the professor as teacher has far too little initiative in the colleges of New Zealand. The students with their varied interests and varied talents should be the first consideration of the university. Honors may be granted on the judgment of the professorial body. It is impossible to arrange good students in linear series, as each one should be striving for a goal of his own.

David Starr Jordan
Stanford University

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SUMMER MEETING, SECTION E—GEOLOGY AND GEOGRAPHY[1]

Section E of the American Association for the Advancement of Science held a summer field meeting at and near Plattsburg, N. Y., July 3–11, inclusive, to which all members of the Geological Society of America and the Association of American Geographers were invited. The number in attendance at the meeting was forty-four. The section was fortunate in having delightful weather for all of the excursions, there being no rain to interfere with the field trips until noon of the last day, when the party were assembled under the hospitable roof of Professor Kemp's house on Lake George.

The preliminary trip on July 3 was made to visit "The Gulf" at Covey hill. This drive of some thirty miles from Mooers, N. Y., across the Canadian boundary was exceedingly interesting to all students of glacial geography. The marine and glacial shorelines were visited on the route westward from Mooers, and the party stopped for lunch in "The Gulf," near the two lakes which show the location of the gorge that represents the ancestor of Niagara. The noon talk, given by J. B. Woodworth, who has worked out the glacial history of this region, was on

ABANDONED SHORELINES

At "The Gulf" Professor Woodworth spoke in substance as follows: "The Gulf"

[1] Plattsburg, New York, July 3–11.

and Covey hill north of it constitute a locality of critical importance in the study of water-levels in the Champlain and St. Lawrence valleys. "The Gulf" pertains to the closing stages of the great ice-dammed lakes which formed in front of the ice in its retreat from the territory of the United States. When "The Gulf" was being excavated by a powerful torrent of water, the ice-sheet still hugged the northern side of Covey hill, itself the northernmost spur of the Adirondacks.

The waters which entered "The Gulf" came from the west, the region of Lake Iroquois, whose waters would have taken this path after the ice retreat offered a lower outlet than that at Rome. The waters passed from "The Gulf" into Lake Vermont, the preglacial lake occupying the valley of the present Lake Champlain. Lake Vermont could not at this stage of its existence have risen above the surface of the water in the waterfall pools of "The Gulf." The lower lake is now 645 feet above sea-level. The sea could not at this latitude have stood higher than the bottom of "The Gulf."

With the further retreat of the ice from the northern slope of Covey hill the water, which had previously discharged through "The Gulf" on the south side of the hill, flowed around the northern slope of the hill and emptied into the sea. The salt water came in, and the history of the great glacial lake was completed.

Signs of wave action occur on the Champlain side of the Adirondacks as high as 720 feet, but these higher water levels do not continue about the northern side of Covey hill north of "The Gulf." A good beach is continuous from the Champlain valley about Covey hill into the upper St. Lawrence valley with an altitude of 450 feet at Covey hill. Higher signs of probable wave action occur up to 570 feet, merging into beaches evidently made by torrential waters confined between the hillside and the retreating ice-front.

"The Gulf" was properly understood by Ebenezer Emmons to have been made by a powerful torrent flowing where now no stream can flow. Gilbert, with the knowledge of the glacial theory, sought for a torrent spillway along the retreating ice-sheet, and considered "The Gulf" the outlet for the glacial waters. "The Gulf" therefore is an integral part of the wonderful story of the great glacial lakes, and the political chance which has drawn the boundary line between Canada and the United States across "The Gulf" serves doubly to remind us of its living type, the gorge of Niagara.

On Thursday, July 4, those who had taken the preliminary trip to Covey hill drove from Mooers southward to West Chazy along many abandoned shorelines, at elevations varying from 300 to 600 feet above the present sea-level. At West Chazy others joined the party from Plattsburg, and all met on Cobblestone hill, where a halt was made for an hour to study the remarkable beaches of cobbles showing pronounced bars, spits and hooks, at levels of 600 feet and over above sealevel.

These beaches of heavy glacial detritus were laid down in a fresh-water glacial lake, when the ice stood a short distance north of this point, by the waters discharging from the northwest over Flat Rock from the Altona spillway.

Thence the party drove across the bare Potsdam sandstone over the Altona spillway, where striking evidences were seen of the scouring action of torrential glacial waters. After lunch at a spring of water running from the Potsdam sandstone in the spillway the party listened to a talk by H. L. Fairchild on

IROQUOIS EXTINCTION

Lake Iroquois was the great glacial water held in the Ontario basin while the Laurentian ice-mass occupied the St. Lawrence valley and forced the overflow by the Rome outlet to the Mohawk and Hudson valleys. This original Iroquois outlet was effective for several thousand years, and determined the water-level for nearly the whole existence of the glacial waters.

When the ice-body weakened, and the front receded on the salient which projects northeastward from the Adirondacks into Canada, a lower escape for the ice-dammed waters was opened across the Covey hill ridge, precisely at the international boundary.

"The Gulf," as it is locally known, is a great cut in Potsdam sandstone, long since noted by Emmons and Gilbert, and recently described by Woodworth. The present altitude of the head of the Covey outlet is over 900 feet, but at the time it was opened the locality was about 460 feet lower than to-day, and the initiation of the river flow must have been inferior to the Rome level, which is now 440 feet.

After at least many centuries of flow this predecessor of the St. Lawrence river, carrying the overflow of the second stage of Iroquois waters (or Hypo-Iroquois), was extinguished by the ice recession opening a yet lower pass, on the north slope of Covey hill. This third phase of the Iroquois waters was short lived and of rapidly falling levels, the river-flow past the ice-front only terracing the sandstone slope.

When the waters were lowered about 450 feet below the Gulf channel, they became confluent with the oceanic waters, and the Ontario basin was occupied by the Gilbert gulf, a branch of the Champlain or Hochelogan sea.

On Friday the parties from Mooers and Plattsburg met at Chazy where Professor Cushing and Dr. Ruedemann showed the visiting geologists many interesting features of the Chazy limestone, the local succession of beds, the characteristic fossils, the faults, and the dissection which have produced the present topography. After supper, while waiting for the train to Plattsburg, the party sat on the hotel porch and listened to a talk by R. Ruedemann on

THE LOWER SILURIC PALEOGEOGRAPHY OF THE CHAMPLAIN BASIN

The relations of the faunas of the Beekmantown, Fort Cassin, Chazy, Black River, Trenton, and Utica beds to those of the Atlantic and Pacific basins and the Mississippian sea were discussed, and by means of these relations the probable marine connections of the Chazy basin and the Levis channel with the oceanic basins traced. It was suggested that the Beekmantown sea, while extending as far as the Newfoundland embayment, held an American epicontinental fauna; that the Fort Cassin fauna did not reach Canada, but flourished in the Appalachian trough to the south of the Chazy basin, and also spread westward into the epicontinental sea. The typical Chazy fauna is thus far recorded only for the Chazy basin and the southern Appalachian trough. It extended as far as the Mingan islands, and came probably from the Atlantic basin. There is also evidence that it had some connection with the American epicontinental sea.

The Black River and Trenton faunas, while largely American in their aspects, contain European species as the first of the Lower Siluric; and the connection of the Trenton sea with the Atlantic ocean can not be doubted. In Utica time the channel became so wide that an oceanic current could enter the epicontinental sea from the northwest, bringing with it new faunal elements, and spreading mud shales over a large area of eastern North America.

The evidence of a deeper sea in the

Levis channel, furnished by the series of Lower Siluric graptolite shales, was also presented, and the relations of the graptolite shales to the mobile parts of the earth-crust, the geosynclines, briefly mentioned.

Friday evening the party went to Cliff Haven, three miles south of Plattsburg, where the authorities of the Champlain Assembly had placed at the disposal of Section E the New York cottage, in which the party were delightfully housed for five days. Excursions were made each day to various points, and in the evening all returned to the broad piazzas of the cottage, where they sat and discussed the various trips, within a few feet of one of the striking fault-line scarps of the region, looking out over the waters of Lake Champlain.

On Saturday morning, July 6, the party gathered on the steam launch kindly furnished by the state of New York, and under the guidance of Professor Cushing, Dr. Ruedemann and Professor Hudson took a charming sail on Lake Champlain. The party visited Crab and Valcour islands and studied the paleozoic sediments which are there so beautifully exposed with their many interesting structural features.

At noon the party enjoyed the delightful hospitality of Professor and Mrs. George H. Hudson of Plattsburg at their charming camp on Valcour island. After lunch a paper was given by John M. Clarke on

LAKE CHAMPLAIN

Dr. Clarke spoke of the origin of the Lake Champlain valley as the result of a series of downthrown fault blocks having the evident aspect of a Graben. He referred to the later evidence as confirmatory of Logan's conception of the Lake Champlain fault and indicated that this origin was borne out by the present attitude of the downthrown paleozoic against the abrupt eastern scarps of the Adirondack crystalline shield.

Reference was also made by the speaker to the possibility that the geographical name Trembleau, which designates the prominent headland and mountain ridge just south of Port Kent, embodies the record of an ancient seismic disturbance, and with this as a text fuller reference was made to the Canadian earthquake of 1663 which appears from the records preserved in contemporary documents to be the severest disturbance this continent has ever suffered from terrestrial dislocations. This earthquake was evidently a movement of the paleozoics against the crystalline shield along the course of the St. Lawrence river or the St. Lawrence fault, and its destructive effects from Montreal down to Tadousac were tremendous. It seemed to the speaker quite reasonable to infer that this displacement must have been continued along the contact line of the paleozoics and the crystallines in the direction of the Champlain fault, although the historic records for this region are very meager.

After lunch the party divided, one portion spending the afternoon on the shores of Valcour island studying stratigraphy and paleontology. The others sailed southward to the delta of Ausable river, where a landing was made and photographs taken showing some of the recent shoreline changes. Thence this party sailed across the lake between Stave and Providence islands, and then northward along the Vermont shore, returning to Cliff Haven.

In the evening in the auditorium of the Catholic Summer School the one formal gathering of the Plattsburg meeting took place. The Reverend John Talbot Smith, LL.D., president of the summer school, welcomed the members of Section E to Cliff Haven, and said that anything they could do to make our stay pleasant and profitable would be a great pleasure to the authorities of Champlain Assembly. Father Smith introduced the vice-president of Section E, Dr. Alfred C. Lane, who gave his vice-presidential address on the "Early Surroundings of Life."[3]

Professor B. K. Emerson thanked the authorities of the Champlain Assembly for their hospitable reception of Section E.

On Sunday various features of the local geology were visited by members of the section. Others attended services at the Chapel on the grounds.

At noon the party were entertained most delightfully by the Honorable Smith M. Weed and his family at his summer home on the shores of Lake Champlain. In the afternoon another sail was taken in a steam launch on Lake Champlain.

In the evening Professor George H. Hudson, of the Plattsburg Normal School, showed the laboratories and some of the work of his students. The members then met in the science class-room, and listened to an informal talk by Professor Hudson on "Blastoidocrinus and its Type," illustrated by fifty lantern slides. The slides of Billings's type were from negatives possessing an amplification of ten diameters, and showed in a remarkable manner many points of structure not before noted in the specimen. The outer folds of the hydrospires were seen to extend under the interbrachials to the edges of the bibrachials. The position of the stem was shown to be not normal, as Billings supposed, but thrust up into the cœlomic cavity and separating the basals from the radials. There were no features to show a specific difference between the Canadian type and the more perfect Valcour island specimen, but the type served to corroborate in a clear manner much of the detail worked out from the latter and published in Bulletin 107 of the New York State Museum.

On Monday, July 8, the party went by train from Plattsburg to Lyon Mountain, and spent the day studying the magnetite mines under the guidance of Mr. Newland. After lunch the section listened to a paper by D. H. Newland on

THE IRON ORES OF THE ADIRONDACK REGION

Four varieties of iron ores are found within the limits of the Adirondack region, each constituting a more or less independent class of deposits as regards geological associations and mode of origin. The varieties are as follows: (1) Non-titaniferous magnetites, (2) titaniferous magnetites, (3) hematites, (4) limonites. In respect to the relative age or period of formation, it is probable that the magnetites of class 1 are the oldest, since they antedate the metamorphism and structural disturbances that affected the region during Precambric time. The titaniferous ores were formed before the oldest of the fossiliferous rocks of the region (the Potsdam sandstone) was deposited, and are generally regarded to be contemporaneous with the igneous inclusions in which they occur. The hematite ores are probably later than the Potsdam; while the limonites have the character of bog ores and are relatively recent surface concentrations.

The non-titaniferous magnetites are the most wide-spread of all the ores in their geographical distribution, and have been in the past and still are the main source of supply for the region. In a strict sense they are hardly deserving of the name that has been applied to them by geologists, since they nearly always carry titanium, though the amount is small, usually but a fraction of one per cent. These ores are found in all parts of the Adirondacks, except the central which is occupied by the great gabbro-anorthosite mass. They are associated with different members of the Precambric crystalline series, including gneisses of igneous derivation with the

[3] Published in Science for August 2, pp. 129–143.

mineralogy of granites and syenites, with gneisses of doubtful relationships, and with the schists and limestones of the sedimentary (Grenville) type. Their origin is obscure, a problem that has been fruitful in discussion and theorizing among geologists. It is doubtful if any one of the explanations that have been advanced is satisfactory as a general basis for the whole group; rather it would seem that the varying conditions surrounding the character and associations of the deposits indicate that they have been formed by a complexity of processes which may have differed materially in individual cases.

The titaniferous magnetites are distinguished from those of the preceding group by their higher percentage of titanium, which ranges from about 3 or 4 per cent. as a minimum up to a maximum of 10 or 15 per cent., and by the fact that they are always enclosed by basic igneous rocks of the gabbro family. They have been described by Professor J. F. Kemp as basic segregations formed during the cooling and consolidation of the wall rocks, an explanation that is generally regarded as correct. Some of the largest deposits of iron ores in the region belong to this class, those of Lake Sanford being specially extensive. After a long period of inactivity, due to the difficulties encountered in smelting the ores in the blast furnaces, attention is now being directed to the deposits with a view to their utilization. It has been found that the ores in some cases at least are not simply magnetite carrying titanium uniformly through its mass, but that they consist of a mixture of magnetite and ilmenite, the former having almost no titanium, a condition that is favorable to their commercial treatment.

The hematite ores are practically limited to the western Adirondack region of St. Lawrence and Jefferson counties. In this area the Grenville schists and limestones attain wide development, forming an interbedded series which has been upturned and sharply folded. Granite intrusions are numerous, but there is a noticeable lack of the basic igneous rocks that occur abundantly in the central and eastern Adirondacks. The ore bodies consist of lenticular, tabular, or irregular masses enclosed within belts of the schist and limestone, or lying along the contact of these rocks as at the Caledonia mine. Stringers and larger bands of ore often extend out from the main bodies for considerable distances into the foot and hanging walls. The deposits have originated, without much doubt, by a process of replacement. They grade at the borders into the wall rock and frequently inclusions may be found that show complete transition from the rock to the ore. Where the walls are schist, the ore often preserves the appearance of banding and cleavage, and not uncommonly carries a small percentage of graphite, the only mineral that seems to have successfully resisted the solvent action of the iron-bearing solutions.

As to the source from which the iron has come, the explanation advanced by C. H. Smyth, Jr., merits full acceptance since it meets the conditions surrounding the geology of the deposits. His theory is that the iron has been derived from pyrite and magnetite, which occur abundantly in the schist in the immediate vicinity of the ore bodies. By oxidation the pyrite would yield ferrous and ferric sulphates, which would be readily taken up by the underground circulations. Free sulphuric acid would also result and react upon the veins and disseminations of magnetite. By reaction with the limestone and the minerals of the schist, the solutions would decompose and the iron precipitate as carbonate and limonite. By subsequent alteration these minerals have been changed to hematite. Residual masses of carbonate are occasionally found in the deposits. Whenever the Potsdam sandstone is found in contact with the ore, the lower layers show a deep iron stain, evidently the effect of impregnation by the iron-bearing solutions.

The fourth class of iron ores, the limonites, are not of much importance in the Adirondack region. The deposits are, as already stated, superficial accumulations due to the washing and leaching of the neighboring rocks and soils. They seldom, if ever, exist of sufficient size and richness to repay working, at least under present conditions.

On Tuesday an excursion to Keesville and the Ausable chasm was made by train and tally-ho. Professors Woodworth and Cushing showed the party the marine delta of the Ausable river, the former lake shorelines, the post-Hochelogan gorge of the Ausable river cut in Potsdam sandstone, the Potsdam conglomerate, the northern slope of Trembleau mountain, and the anorthosite.

In the evening at the Champlain Club Professor H. P. Cushing discussed the evidences of physical oscillations during the Cambro-silurian in northeastern New York as brought out by a general study of the stratigraphy of the region. There was a great Potsdam subsidence on the northeast, diminishing to zero westward. The succeeding Beekmantown depression encroached further on the land than did the Potsdam on the southern margin of the region, but like that was greatest on the northeast. During the Beekmantown occurred an uplift which caused cessation of deposition in all the region except the eastern border, confining the later Beekmantown and the Chazy deposits to that district. Oscillation then occurred between the Beekmantown and the Chazy, pinching out the Chazy to the south. Depression then ensued on the south and west, and the Lowville beds were deposited. The Black River limestone followed, this being the first formation found on all three sides of the region, which indicates connecting waters and similar conditions on these sides.

In the following Trenton time it seems likely that the waters nearly overspread the entire present Adirondack region, though shoreline conditions and small subsidence are characteristic of the Mohawk valley region.

Utica shale conditions came in from the east, and gradually encroached westward on the Trenton, so that the one thickens as the other thins, the Trenton thickest on the west, the Utica on the east. Following the Utica came the uplift which brought most of the region above sea-level.

On Wednesday, July 10, the party regretfully bade good-bye to the hospitable authorities of the Catholic Summer School, and took the delightful sail down Lake Champlain.

At Baldwins, the steamboat terminal at the northern end of Lake George, the party were met by Professor J. F. Kemp, by whom they were guided in the Lake George valley. The first stop was Hague, where the graphite bed at the Lakeside mine was studied. The bed is ten feet thick, and consists of a graphitic schist in which graphite supplies the micaceous mineral. Feldspar, quartz and a little pyrite constitute the associated minerals. In physical aspect the beds appear but slightly changed from a shaly sandstone. The floor and roof rocks are a garnet-feldspar gneiss with much sillimanite. The pegmatitic phases are frequent. The several methods of origin, organic; hydrocarbons akin to petroleum; the influence of eruptive rocks, etc., were passed in review. The forms of occurrence of graphite in the Adirondacks, in crystalline limestones, pegmatite veins, and schists or quartzites were set forth. The invariable association even of the graphite-bearing pegmatites with Grenville sediments was emphasized, and the schists seemed most probably a metamorphosed carbonaceous sediment, or one which had been impregnated with a heavy oil.

The party next visited the potholes on Indian Kettles point, two miles north of Hague. These interesting relics of the glacial epoch are on a rocky point, and fifteen feet or more above the present lake.

In the evening a brief exposition of the local geology and physiography was given by J. F. Kemp, and illustrated by manuscript maps. The sediments of the Grenville series are the oldest rocks, now greatly metamorphosed. A syenitic series of eruptives, the most extensive of the local formations, succeeded the Grenville, and these are also greatly metamorphosed. There are also rocks intermediate between syenite and gabbro; true gabbros and granites. Lastly came a few basaltic dikes. There are no late Paleozoics in the reigon, but the Potsdam and Beekmantown are near or in the Lake George basin. The physiography was believed by the speaker to be chiefly due to block faulting, which was freshened up by the ice-sculpturing of the glacial epoch.

The next morning the party proceeded to Huletts, and visited an igneous contact on Tafts point. At Huletts dock interesting pegmatites and the effects of shearing and faulting were seen. Three sets of displacement could be detected. The party were kindly taken about the lake by Dr. Smith Ely Jelliffe in his launch, adding greatly to their pleasure and profit. After lunch in the charming summer home of Professor and Mrs. Kemp the members continued south through the lake and dispersed.

The following resolutions were passed by Section E:

Section E of the American Association for the Advancement of Science in summer session assembled desires to express its high appreciation and gratitude

To Dr. John M. Clarke and the members of the New York Survey for valued advice in the preparations for this meeting, and for guidance during its progress;

To Professor and Mrs. George H. Hudson, to the Honorable Smith M. Weed, and to Professor and Mrs. J. F. Kemp for most gracious hospitality; and

To the governing board of the Champlain Assembly for giving us an attractive and convenient home during our session, and the opportunity to become acquainted with a valuable and interesting educational institution.

The following members were chosen to represent the geologists and geographers of the American Association at the centenary celebration of the Geological Society of London, to be held in September, viz:

Professor J. P. Iddings, University of Chicago, Chicago, Ill. Vice-President Section E, Geology and Geography.

Dr. John M. Clarke, State Hill, Albany, N. Y. Director Science Division, N. Y. State Education Department.

Professor R. S. Tarr, Cornell University, Ithaca, N. Y. Acting President Association of American Geographers.

F. P. Gulliver
Secretary

SCIENTIFIC BOOKS

The Birds of North and Middle America: A descriptive catalogue of the higher groups, genera, species and subspecies of birds known to occur in North America, from the Arctic lands to the Isthmus of Panama, the West Indies and other islands of the Caribbean Sea, and the Galapagos Archipelago. By Robert Ridgway, Curator, Division of Birds. Part IV., Family Turdidæ—Thrushes. Family Zeledoniidæ—Wren-Thrushes. Family Mimidæ—Mockingbirds. Family Sturnidæ — Starlings.

Family Ploceidæ—Weaver Birds. Family Alaudidæ—Larks. Family Oxyruncidæ—Sharp-bills. Family Tyrannidæ—Tyrant Flycatchers. Family Pipridæ—Manakins. Family Cotingidæ—Chatterers. Washington: Government Printing Office. 1907. Bulletin of the United States National Museum. No. 50—8vo, pp. xxii + 973, pl. i.–xxxiv.

As shown by the above transcript of the title-page, Part IV. of this monumental work includes the last six families of the Oscines and the first four families of the Mesomyodi. Two of these, the Sturnidæ and the Ploceidæ, are represented in America only by introduced species—the first by the common starling of Europe, of casual occurrence in Greenland, and introduced and apparently thoroughly naturalized over a considerable area about New York City; and the second by two weaver-finches, introduced long since from western Africa to Porto Rico, where they have become naturalized. The Alaudidæ, also almost exclusively an Old World family, is represented by only two genera, each with a single species in America, namely, *Alauda*, represented by the skylark (*Alauda arvensis*), of accidental occurrence in Greenland and the Bermudas, and also as an introduced species at various points in the United States; and *Otocoris*, comprising the horned larks, of which a single species is widely distributed in North America, reappearing in the highlands of Colombia. Other species of this genus occur in Europe and Asia, extending southward to northern Africa. The horned larks have evidently been long residents of North America, as shown by their wide distribution and multiplicity of forms, no less than twenty-five subspecies being currently recognized in America alone, and several others in northern Eurasia. This species shows great adaptability to diverse conditions of environment, it ranging from the Arctic barren-grounds to tropical northern South America, and from the most arid semi-desert areas of the southwestern United States and tableland of Mexico to the humid coast belt of Oregon, Washington, and western British Columbia. While the extreme forms are very diverse in point of size and coloration, and occupy in the breeding season remote and widely different physical areas, they are all connected by intermediate forms, occupying intermediate areas. They are all more or less migratory, and during winter several forms are often found together, but in the breeding season they occupy distinct ranges, and admirably illustrate the law that, among vertebrates at least, two closely related forms do not occupy the same area.

Of the remaining seven families treated in the present volume, one, the Turdidæ or Thrushes, is nearly cosmopolitan, while the other six are exclusively New World and mainly tropical. Two—Zeledoniidæ and Oxyruncidæ—are monotypic, the first being for the first time given family rank in the addenda (p. 885), on the basis of structural characters made known by Pycraft during the printing of the present volume. The family Zeledoniidæ is allied to the mockingbirds (Mimidæ), and Oxyruncidæ to the tyrant flycatchers. The three remaining families—Tyrannidæ, Pipridæ, Cotingidæ—are tropical American, the last two exclusively so, the first with a few genera ranging widely in temperate latitudes. The Tyrannidæ constitute one of the largest, and is the most perplexing, of the families of American birds. It contains upward of 80 genera, and more than 550 species and subspecies, which have recently been arranged by Berlepsch[1] in seven subfamilies. They present great diversity of form and habits, developing types that strongly suggest birds of widely different families, inhabiting in some cases distant parts of the globe; some resemble titmice, others kinglets, others are thrushlike, and others strongly recall pipits, wagtails and stonechats. As only thrushes, of these several diverse types, share with them the same geographic area, these resemblances can not be ascribed to protective mimicry, but must be regarded as adaptive parallelisms. Indeed, adaptive parallelism in the develop-

[1] Studien über Tyranniden, von Hans Graf Berlepsch, Proc. Fourth Internat. Orn. Congress, 1905 (1907), pp. 463–493.

ment of color patterns, relative length of wing, tail and feet, the form of the bill, etc. (the latter features often combined with conspicuous resemblances in color markings), are common, not only in birds which inhabit different continental areas, but in other classes of animals, indicating that the range of differentiation is limited, and that repetition is necessary; such repetitions have no necessary genetic relationship, being for the most part adaptive.

In the three families Tyrannidæ, Pipridæ and Cotingidæ, there are several transpositions of genera from one to the other, on the basis of newly acquired evidence respecting their affinities. There are also several important changes in nomenclature, as where *Procnias* takes the place of *Casmarinchos*, etc., and current purisms are abandoned for the original forms of names.

As in the previous volumes of this series, the treatment is strictly systematic and technical, and shows the author to be the master of his subject, while his methods are eminently worthy of emulation. With this volume his great task is half completed, and it is the wish of all systematic ornithologists that he may have the health and strength to finish in due time this vast undertaking, which easily takes rank as the most important contribution to American systematic ornithology yet undertaken.

J. A. A.

Annals of the Lowell Observatory. Volume III.: Observations of the Planet Mars during the Oppositions of 1894, 1896, 1898, 1901 and 1903 made at Flagstaff, Arizona. Percival Lowell, Director of the observatory. 1905. Pp. xiv + 293 + 60. 4to.

In the body of this book are 293 pages, with all the details of observations during the oppositions of 1894, 1896, 1900–1 and 1903 treated separately, and subdivided into eleven chapters. The first chapter under each opposition deals with general matters pertaining to methods and dates of observation. Each of the other ten chapters gives the details of the observed surface features in order of longitude from Syrtis Major back to the two Syrtes.

Nearly all the observations were made by the director himself, and are described individually and relatively in such manner as shows a symmetry of method and similarity of purpose running through work on all the four oppositions. The observations made by Mr. Douglass and Mr. Drew, while being narrated in the same methodical sequence, have been published as the supplement of sixty pages. These embody the entire report on the opposition of 1898–9, and an auxiliary report on the opposition of 1900–1.

While there are many illustrations scattered through the volume, yet the major portion is given in the appendix of twelve plates inserted between pages 266 and 267, under the title: "1903 Drawings of Mars, being selected reproductions direct from the record-book Views from the Globe made from Observations of the Opposition"—whatever that may mean. Following these plates, pages 267–281, is a complete "Index of Names on Maps and Globes of Mars" inclusive of an index to volumes one and two of the *Annals*.

"Of the making of books, there is no end" is a dictum of about twenty centuries ago, and a thousandfold more true since the advent of printing than then. That this book is a handsome example of the "art preservative" no one can deny: large type, leaded; extra wide margins, with marginal headings; typography for the most part even, and press-work superb: the paper, heavy plate. It is a pleasure to read such books, whatever be their contents. It is all the greater pleasure when one finds such a piquancy of style, and such a wealth of detail of observation coupled with such explicitness of statement through so many pages, concerning objects which so many other able astronomers claim are either nearly invisible or totally non-existent. The writer of this review is as ignorant as any astronomer can well be of the objectivity of all these claimed observances on the face of our neighboring planet. During seventeen years' experience as an observational astronomer he has never had an opportunity of seeing Mars through a larger aperture than 4″.5. That he was requested to write this review for Science was, therefore, probably due to this qualification as most likely to produce an unbiased summary of the book.

With this explanation, he will proceed to point out what seem to be the strongest points and best features of this Volume III. of the *Annals of the Lowell Observatory,* besides those already mentioned above.

Results secured at the opposition of 1894: At Flagstaff 116 new canals were discovered, 44 in the dark regions and 72 in the light: reobservation was made of 67 out of 79 of Schiaparelli's earlier discoveries, which verified the fixity both of existence and of position (though not the continuous visibility) of the canals: seasonal changes were disclosed by observed changes in the markings: new knots at intersections of canals were discovered, in the dark regions as well as in the light, thus incidentally exploding the supposition that they are seas, but giving them rather the character of oases: discovery of the so-called carets, where the canals debouched.

Ever bearing in his mind the degree of incredibility attached to these announcements by most astronomers, the author points out that the times of nearest approach of Mars through the epoch most usual for observing may not be always the most propitious season for multiplicity of detail. He also expresses the opinion that the failure of others to see the canals may be due to their looking at a "featureless face" (page 7). On page 4, he also points out a wide distinction between "sensitive eyes" and "acute eyes" and shows that a high ability to detect faint stars or satellites may be the very criterion which would presumptively preclude its possessor from the securing of a retinal impression of such surface features as Martian canals, etc. This opposition was observed with an eighteen-inch Brashear objective, usually with a power of 320.

At the opposition of 1896, a Clark objective of twenty-four inches was used. At first, for about three months at Flagstaff, and afterwards at Tacubaya, Mexico, the powers used ranged from 163 to 528. Three hundred and forty-one drawings of the complete disk were made at this opposition. As results, the enumeration includes many double canals—some being always double, others only at certain seasons of the Martian year. Evidence of the canals in the dark regions as well as in the light; and the subjective discovery that the detail of canals and oases came out finer and more minute as experience grew; and that many apparent changes in appearances arose "not because of change in them, but because of growing aptitude in the observer."

At the opposition of 1900, some canals were seen still always double: and that, too, independently of the apertures of the telescope objective or of the optical interference bands. Discovery was also made of bright spots in various parts of the planet, and at times difficult to explain. Though seemingly fixed in location, they were subsequently regarded as Martian clouds.

The opposition of 1903 was observed continuously for seven months while the tilt of the planet's north pole towards us was nearly at its greatest possible angle. The main results were noting the connection between the oases and the double canals, the oases being exactly embraced by the two arms of the double, and the oases were round and the canals tangent at the extremities of a diameter. Also the observer noted an apparent contradiction of Schiaparelli's announcement in 1888 of a change of longitude of Lucus Ismenius. Changes of color were noted, and a semi-annual flux in the development of canals, together with a complete confirmation of the objectivity of the canal gemination, and much additional information was gained as to the nature of that gemination.

In the Supplement, page 53, the author calls particular attention to Mr. Douglass's remarkable set of observations on the "projection" of December 7–8, 1900, and affirms that his observations and drawings showed conclusively that the successive appearances could be explained only by *clouds,* and were perfectly satisfied by that explanation.

Herman S. Davis
Dover, Delaware

SOCIETIES AND ACADEMIES

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE. TWENTY-THIRD MEETING

New York University and Bellevue Hospital Medical College, May 22, 1907. President Flexner in the chair. Members present—Atkinson, Beebe, Brooks, Calkins, Carrel, Emerson, Ewing, Field, Flexner, Gibson, Gies, Lillie, Lusk, Meyer, Murlin, Salant, Shaffer, Teague, Wadsworth, Weil, Wolf, Yatsu.

Abstracts of the Communications[1]

The Osmotic Pressure of Colloidal Solutions and the Influence of Electrolytes and Non-electrolytes on such Pressure: Ralph S. Lillie.

Determinations were made of the osmotic pressure of gelatin and egg albumin. The colloids were used (1) in approximately pure solution, and (2) after the addition of various electrolytes and non-electrolytes to the colloidal solution; in this case the employed substance was added in the same concentration to the outer fluid of the osmometer so as to pervade the entire system on both sides of the membrane in uniform concentration. The osmotic effects observed under these conditions can be due only to the colloid and not to the added substance. The colloidal solution was found, however, after the addition of an acid, alkali or neutral salt, to exhibit an altered osmotic pressure, the degree of alteration varying with the nature and concentration of the added electrolyte. Non-electrolytes were found to have no appreciable influence on the osmotic pressure of these colloids.

Hemolysis in Eclampsia: James Ewing.

The author's observations indicate that the eclamptic toxin is not a hemolytic agent derived from the placenta, and that hemolysis is not necessarily associated with the lesions of the viscera. Semb's experiments in which he demonstrates visceral lesions strongly resembling those of a hemolytic serum, can not be accepted as furnishing evidence of a specific eclamptic toxin. Histological study of the liver in eclampsia indicates that the characteristic lesions consist of fibrin thrombi and not in agglutination and hemolysis of red cells, and that when hemolysis occurs it results from the products of degeneration and necrosis of endothelial and hepatic cells. It is therefore probably an entirely secondary factor in the disease.

Glycocoll Nitrogen in the Metabolism of the Dog: John R. Murlin.

While attempting to explain the behavior of gelatin in metabolism it occurred to the author that much significance might be attributed to its high content of glycocoll. It is well known that the nitrogen of gelatin is not ordinarily retained in the body, but appears quantitatively in the urine, chiefly as urea. But when fed with meat and an abundance of carbohydrate, it is possible to establish nitrogen equilibrium near the fasting level, if two thirds of the total quantity of nitrogen fed is given in the form of gelatin and only one third is present in the meat. Would glycocoll, if given in the same way, behave as does gelatin? The author's experiments answered this question in the affirmative.

An Hydrodynamic Explanation of Mitotic Figures: Arthur B. Lamb.

The distinctly polar arrangement of the chromatin substance about the astral centers in dividing cells, combined with the pronounced curvature of the astral rays and of the spindle fibers, has demanded the assumption of some polar force as universally operative. On such an assumption it is of course necessary to assume further that astral centers represent either opposite or like poles. On the alternative of opposite poles, we should expect, with any force so far proposed, a configuration of astral rays simulating that of iron filings between *opposite* magnetic poles, coupled with a mutual *attraction* of the astral centers. On the other alternative, we should similarly expect a configuration of astral rays and spindle fibers simulating that of iron filings between *like* magnetic poles, coupled with a mutual

[1] The abstracts presented in this account of the proceedings have been greatly condensed from abstracts prepared by the authors themselves. The latter abstracts of the communications appear in Number 6 of Volume IV. of the Society's proceedings, which may be obtained from the Secretary.

repulsion of the astral centers. Actually, we have neither of these conditions, but instead, a configuration like that of iron filings between *opposite* magnetic poles *and at the same time an apparent repulsion between the astral centers or the centrosomes.*

This is not the case with the forces of attraction or repulsion existing between bodies oscillating or pulsating in a fluid medium. More specifically, if two spheres are pulsating synchronously, and in opposite phase, or oscillating synchronously and in the same phase, they will repel one another, *but at the same time the field between them will simulate the configuration of iron filings between opposite magnetic poles.*[2]

If then we assume that the centrosomes are pulsating in opposite phase, or better, oscillating in the same phase, we shall obtain the desired repulsion and at the same time have a configuration like that actually observed.

The configuration taken by the chromosomes is explicable on the same grounds. Indeed, it is not necessary to assume any independent motion on their part, but simply to consider it an induction phenomenon. The tri- and multi-polar spindles are also better explained on these hydrodynamic grounds than on previous assumptions.

The foregoing explanation is, of course, pure hypothesis, with no support other than the facts it seeks to explain. There is, however, nothing inherently impossible in it, and it may provoke fresh observation and new ideas.

Transfusion Experiments on Dogs, showing Artificially Implanted Tumors: George W. Crile and S. P. Beebe.

Direct transfusion of the whole blood from immune dogs to dogs with actively growing, artificially implanted tumors has been conducted in six animals. In the first set of three, sufficient time has elapsed to determine the outcome, which was as follows:

I. Dog 116. Planted January 7, 1907. Tumors were first seen on February 20; continued to grow slowly. March 20, transfusion experiment: dog was bled 400 c.c. and immediately transfused with 550 c.c. of blood from dog 244, in which implantation had occurred on January 18; tumors were first noticed on February 6, and had continued to grow until February 20, when they began to regress. Regression complete March 7. Three days after transfusion, dog 244 was again planted with tumor. Four plants were made with positive results in three and tumors are growing at the present time. The immunity which dog 244 possessed as a result of the previous growth and regression of the tumors could not have been very marked. The effect of this transfusion upon tumors of dog 116 was negative, since they continued to grow until the death of the animal in a cachetic condition four weeks later.

II. Dog 125. Weight 13 kilos. Tumors were planted December 6. All plants grew and continued to increase in size until the day of transfusion, March 20. On this day the dog was bled 500 c.c. and immediately transfused with the same quantity of blood from dog 163. Following the bleeding and transfusion the tumors of dog 125 became softer and began to regress. One tumor has entirely disappeared and the others are subsiding.

III. Dog 133. Weight 17 kilos. Tumors planted January 31; first growth noticed February 13, and continued active until day of transfusion. March 20, bled 600 c.c. and transfused 1,500 c.c. from dog 289. The latter animal was 19½ kilos in weight, in very good physical condition and naturally immune to the tumor. Following this transfusion, which was the largest and of the best quality that any animal in this series received, the tumors of dog 133 began to regress immediately, and at the present time the regression is complete.

The authors postponed discussion of these results.

Transplantation of the Thigh from One Dog to Another: Alexis Carrel.

On April 23, 1907, at 9:50 A.M., a medium-sized dog was killed with chloroform. At 10:20 A.M. the left thigh of the cadaver was amputated just below its middle part, perfused with Locke solution and placed on a

[2] See Bjerknes's text-book, "Hydrodynamische Fernkräfte," J. A. Barth, Leipzig, 1902.

table of the laboratory, the temperature being 88–90° F.

At 11 A.M. a medium-sized bitch was etherized; her left thigh was amputated and immediately replaced by the thigh of the dead dog. The reconstruction of the thigh began by the suture of the bone, the adductors and quadriceps. Then the femoral vessels were united and the circulation reestablished at 1 P.M. The operation was completed by the suture of the nerves, muscles, aponeuroses and skin, and the limb placed in a plaster of Paris apparatus.

On April 23, 24 and 25 the animal remained in good condition and walked on her three normal feet. The transplanted limb was warmer than the normal one and its circulation very active. On April 26 she appeared to be sick. There was a phlegmon of the thigh. Incisions were made in Scarpa's triangle and on the transplanted limb, which was warm. Hemorrhage of red blood occurred from the incisions in the transplanted limb.

During the succeeding days, the circulation of the limb remained active, the foot became swollen and the general condition of the animal declined. On May 1 a large abscess was detected near the pelvis and opened. A small incision having been made on the foot of the transplanted limb, hemorrhage of red blood occurred. The general condition of the animal was very low. On May 2 the animal died of septicemia.

Then it was found that the lumen of the femoral vessels was free from thrombus, and the intima smooth and glistening. There was no deposit of fibrin on the lines of suture. In spite of the infection, the union of the vessels was excellent. The skin and the muscles were cicatrized and the ends of the femur firmly united by the ligature.

The Bacteriotherapy of Leprosy: Paul G. Woolley (by invitation).

It seemed to the author that, lacking pure cultures for the purpose, he might make the leprosy patient serve as his own culture medium. It is well known how abundant are the bacilli in the lepra nodule. The author excised a nodule from the arm of an advanced and wretched case of the tubercular form of leprosy. The nodule was very rich in bacilli. It was ground with sand and salt solution; centrifugalized; heated to 65–70° C. for fifteen minutes, and treated with enough 5-per-cent. carbolic acid to make a suspension containing 0.5 per cent. of the acid. This suspension was rich in bacilli. Of it subcutaneous inoculations of 0.01 c.c. were made at intervals, the intervals depending on the general condition of the patient. Experience with the more exact methods possible with the analogous disease, tuberculosis, indicates that minimal inoculations of the dead bacilli must be continued over a long period before a genuine arrest is attained; even, therefore, with the most favorable outcome, the author does not expect to report the results of this treatment for months to come. The author communicated the method in order that others with fuller opportunities may test it.

Direct Silver Staining of Spirochetes and Flagellated Bacteria: Simon Flexner.

The discussion of the nature of the structure now called *Spirocheta* (*Treponema*) *pallida*—whether a microorganism or some histological elements—led Flexner to try to effect the silver staining directly upon smear preparations prepared from serum exudates obtained from syphilitic lesions. While engaged unsuccessfully in this endeavor, Stern,[3] of Prag, published a simple method for staining the spirochetes directly with silver nitrate. When the deposit of silver presents a metallic sheen the impregnation is regarded as sufficient. Flexner has found the method very simple and sufficient; but he has obtained better results from long (3–4 days) than from short (1–2 days) exposures. The length of exposure required will depend somewhat upon the weather (strength of light) and the thickness of the spread. Moderately heavy spreads have given him better results than thinner ones, and impression preparations better than smear preparations.

Other spirochetal organisms, from the buccal cavity, etc., may be silvered by this method, and bacteria may also be silvered. In a

[3] Stern, *Berl. klin. Woch.*, 1907, XLIV., 400.

few comparative tests which were made, the degree of impregnation was greatest with the pallida. Whether this is to be accounted for by elective affinity or difference of medium in which the organisms were embedded can not be said. In the course of these examinations the author came across examples of flagellated bacteria from the buccal cavity in which the flagella were distinctly silvered. He attempted to stain the flagella of certain bacteria—*B. typhosus, paratyphosus, pyocyaneus, hog cholera*—from pure cultures, but unsuccessfully. The terminal cilia of the pallida appeared not to be stained by the silver.

Flexner observed instances in which the silvered films showed many more *spirochetæ pallida* than the corresponding preparations stained by Giemsa's or Proca's methods.

On the Bacterial Production of Skatol and its Occurrence in the Human Intestinal Tract: C. A. HERTER.

A large number of facultative and strict anerobic organisms have been studied with respect to their ability to form skatol. The anerobes *B. putrificus* (strain isolated by Bienstock) and one strain of the bacillus of malignant edema (obtained from Professor Theobald Smith) were found to produce skatol in peptone bouillon, although it was not possible to determine the conditions under which skatol could be regularly obtained through the action of these bacteria. It was found that skatol is rarely present in the intestinal tract except in conditions of disease associated with intestinal putrefaction. Usually skatol is associated with indol in such conditions, although there are instances in which the intestinal contents exhibit little or no indol but, relatively speaking, considerable skatol. This has been observed heretofore only in putrefactive processes associated with pronounced clinical manifestations.

A Spirochete found in the Blood of a Wild Rat: W. J. MACNEAL.

Of thirty-nine wild rats (*Mus decumanus*) caught at Morgantown, W. Va., by MacNeal, one has shown a minute, actively motile, spiral organism in the blood. It is present in very small numbers and careful search with high magnification is necessary to detect its presence.

The parasite stains readily by the various modifications of the Romanowsky stain, and very intensely by the rapid method recommended for clinical staining of *Spirocheta pallida*.[4] It takes a uniform, deep, violet-red color. The measurement of a number of individuals shows a marked variation in length, the shortest forms, consisting of one and three quarters turns or nodes, having a length of 1.75 μ; the longest, consisting of three and one half turns, being 3.55 μ long.

The infection is readily transferred to other wild rats by intraperitoneal injection of a very small drop of infected blood in normal salt solution. In many cases, not more than ten or twenty parasites could have been present in the injection, yet, so far, the wild rats have always developed the infection. The parasites never become very numerous and disappear in from one to nine days. This apparent recovery is then followed by repeated relapses. The parasite may become more numerous in the blood during the relapse than in the primary invasion. Neither a certain recovery nor a fatal result has, as yet, been observed.

White rats are susceptible, with an incubation period of four to eight days according to the dose employed. The house mouse (*Mus musculus*) is apparently more resistant.

Similar spirochetes have been described by Carter (in the rat), by Lingard (in the bandicoot, *Mus giganteus*), by Nicolle and Comte (in the bat), by Wenyon and by Breinl and Kinghorn (in the house mouse); all these in the circulating blood. Borrel and Gaylord have described spiral organisms in mouse carcinomata, and one of the forms found by Borrel has been shown by Wenyon to be identical with his *Spirocheta muris*, found in the blood of mice. Morphologically the parasite found here in the rat is apparently identical with this one of Borrel and Wenyon. Its behavior in animals is somewhat different. MacNeal tentatively proposes for it the name *Spiro-*

[4] MacNeal, *Journal Amer. Med. Assn.*, February 16, 1907.

cheta muris, var. *Virginiana*, following the principle suggested by Calkins.[5] Its specific relation to that organism must be left for further work to determine.

Experimental Ligation of Splenic and Portal Veins, with the Aim of Producing a Form of Splenic Anemia: ALDRED S. WARTHIN.

The author's results indicate that obstruction of the splenic veins of dogs by ligation is not followed by a fibroid hyperplasia of the spleen but by a partial atrophy. A more or less complete venous collateral circulation is always produced. The picture of splenic anemia as seen in man can not, therefore, be reproduced in the dog, by an obstruction to the venous outflow from the spleen.

An Experimental Control of Fischer's Attraxin Theory: C. SNOW. (Communicated by Aldred S. Warthin.)

Fischer recently reported from Ribbert's laboratory[6] that by injecting a solution of Scharlach R, Sudan III. or Indo-phenol in olive-oil under the skin of the ears of rabbits he was able to get an epithelial proliferation which was not to be distinguished histologically from a squamous-celled carcinoma in man. He was not able to get this result with other substances acting as irritants, and therefore assumed the existence of specific bodies—attraxins—in the injected solution, which exerted a chemotactic influence on the epithelial cells.

His work has been repeated by Snow as nearly as was possible from the meager description given of his technic. Three old and three young rabbits received, under the skin of the ear, injections of the Scharlach R-olive-oil solution, and the injected tissue was excised and examined at times varying from 7 to 61 days. The results show that the solution has absolutely no influence on the epithelial elements, but acts as a mild irritant, inducing a chronic inflammation with slight reaction on the part of the connective tissue in the case of the old rabbits, and a greater reaction, with the formation of foreign-body giant cells, in the case of the young rabbits, the conclusion being that the atfraxin theory is without sound foundation, so far as "Scarlet-oil" is concerned.

The Effects of Struggle on the Content of White Cells in the Lymph: F. PEYTON ROUS. (Communicated by Aldred S. Warthin.)

Preliminary determinations, with the animal (dog) quiet, showed that for any one individual the number of leukocytes per cubic millimeter of lymph, from the thoracic duct, was practically constant during the 1 to 4 hours during which observations were made. With struggle, as others have shown, the lymph flow increases sharply in amount for a few minutes. With this the author found a corresponding increase in cell content, an increase marked in "cell concentration" per cubic millimeter of lymph and in the total number of elements passed.

An additional conclusion was that, for a given individual, the lymph glands seem "set" to produce cells at definite rates. These rates have a wide range for reasons unknown. The cell increase with struggle comes from the peripheral lymph system rather than from sedimented cells in the receptaculum chyli, and is probably dependent on another factor besides increased lymph flow (a supposition upheld by later experiments with lymphagogues).

The facts elicited have a bearing on the "physiological mononucleosis" of the blood observed in man following active exercise, on the disappearance of this after prolonged exertion (25-mile run), and the absolute decrease in mononuclears sometimes seen.

A Lipolytic Form of Hemolysis: HIDEYO NOGUCHI.

Lipase is, under some conditions, an efficient hemolytic agent which acts, however, not directly upon the red corpuscles, but indirectly through the liberation from available fats of the active fatty acids. Neutral fats are not hemolytic, but they become so under the influence of lipase.

[5] Calkins, *Journal of Infectious Diseases*, April 10, 1907.

[6] Fischer, *Münch. med. Wochenschrift*, October 16, 1906.

Potassium cyanide and sodium fluoride in 1:10,000 solution inhibit the action of lipase on the fats, and calcium chloride removes the lytic agent from an active mixture. Since the bile salts are known to increase lipolysis, the effects of the sodium salts of cholic, glycocholic and taurocholic acids in $n/500$ solutions were tested on lipolytic hemolysis. The rate of hemolysis was accelerated.

On the Mechanism by which Water is eliminated from the Blood Capillaries in the Active Salivary Glands: A. J. Carlson, J. R. Greer and F. C. Becht.

There is a spontaneous flow of lymph from the quiescent parotid gland of the horse. It is probable that part of the lymph that flows from the neck lymphatics in an anesthetized dog with all the salivary glands at rest comes from the salivary glands. When the parotid of the horse is thrown into activity by stimulation of the cranial secretory nerves, or by injection of pilocarpin into the blood, there is no appreciable increase in the output of lymph from the gland as compared with that from the gland at rest. This is true both of the spontaneous flow and of the flow aided by direct massage of the gland. The activity of the submaxillary does not appreciably influence the flow of lymph from the neck lymphatic in the dog. This conclusion is based on experiments on thirteen dogs. If the activity of the submaxillary gland increases the output of lymph from the neck ducts, the increase is too slight to be detected by present methods, and is not one tenth of the saliva eliminated by the gland, as Barcroft's observations would seem to demand.

In dogs under *light* ether anesthesia, perfectly quiescent and with all the salivary glands at rest, there is always a spontaneous flow of lymph from the neck lymphatics.

The osmotic pressure of the lymph from the active parotid of the horse is not the same in all animals. The lymph obtained from the active gland had in three cases considerably lower osmotic pressures than the serum, a fact which apparently eliminates osmosis as the factor effecting the transfer of water from the blood capillaries in the active gland. The osmotic pressure of the lymph from the neck lymphatics of the horse, collected with the animal under chloroform anesthesia, may be of slightly higher, of the same or of considerably lower osmotic pressure than the serum. The osmotic pressure of the lymph from the neck lymphatics of the dog is usually lower than that of the serum. It is rarely greater. The thoracic lymph was in one case of the same, in the other case, of a higher, osmotic pressure than the serum. It is therefore probable that the osmotic pressure of the thoracic lymph is usually greater than that of the neck lymph.

Under the conditions of the experiments—ether or chloroform anesthesia for from two to four hours—the osmotic pressure of the serum at the end of the experiments was in many cases greater than at the beginning. The same difference is sometimes exhibited by the lymph collected from the same lymphatic, but at different periods of the experiment.

On the Dissociation in Solutions of the Neutral Caseinates of Sodium and Ammonium: T. Brailsford Robertson.

In the case of the neutral caseinate of *sodium* the sum of the ionic velocities was found to be slightly greater than the velocity of the Na ion, indicating a specific velocity of 2.6×10^{-5} cm. per second for the casein anion at 25° C. In the case of *ammonium* caseinate, however, the sum of the ionic velocities was found to be considerably *less* than the specific velocity of the ammonium ion. This was interpreted as indicating the presence in this solution of complex cations containing ammonium. Other considerations show that the effect is not due to viscosity. If casein be regarded as an ampholyte of the type HXOH, the sodium salt would be of the type $Na^+ + XOH^-$; it is possible that the ammonium salt in solution forms ions of the type $NH_4X^+ + OH^-$ or $NH_4X^+ + XOH^-$.

The Altmann Granules in Kidney and Liver and their Relation to Granular and Fatty Degenerations: William Ophüls.

In the kidneys of dogs, rabbits and guinea-pigs the author found the following arrangement of the Altmann granules: In the connecting and convoluted tubules, and in the descending parts of the loops of Henle, the granules are rather coarse, very definitely rod-shaped and arranged in radial rows in the basilar two thirds of the cells, often so closely set end to end that it is difficult to make out the dividing lines between them. In the part of the cells directly adjoining the lumen there are few scattered short rod-shaped granules and none in the "Bürstenbesatz." These details are naturally more plainly shown in the large cells of the convoluted tubules, but in a general way the smaller cells in the connecting tubules and in the descending loops of Henle resemble them very closely. Some groups of convoluted tubules have much coarser granules than others. Ophüls has not been able to make out whether this is a constant anatomic difference or due to different functional stages. If the granules have any relation to the function of the cells, which seems probable, one would surmise that the connecting tubules can not purely serve the function of conducting urine from one place to another, all the more so since in the large ducts of the pyramids which serve this purpose alone, the granules are very scanty and irregularly arranged. In the large light cells of the ascending parts of the Henle loops, the granules are exceedingly small, also slightly rod-shaped, extremely numerous and scattered all through the cells in an irregular fashion. This condition might be used as an argument in favor of a difference in function of this portion of the tubules. In the cells of the liver of these animals the granules vary greatly in size from just visible to quite coarse granules. All of them are rods, some short, others quite long and more or less wavy. The granules are scattered irregularly all over the cells.

In granular degeneration, the characteristic macroscopic and microscopic pictures of which can be best produced by intravenous injection of potassium bichromate, the granules enlarge in size, become more or less spherical, lose their normal arrangement and stain very deeply with the Altmann stain, contrary to what has been generally assumed after the work of Schilling,[7] who seems to be the only investigator of this question. In the liver the change is similar, all cells being equally involved. The albuminous granules in granular degeneration, then, are not newly formed granules, but to a great degree the enlarged and disarranged normal Altmann granules. The author's observations on the kidneys and liver confirm the view that in fatty degeneration, fat in all cases appears first in and around the Altmann granules. It seemed more as if the granules were changed to fat *in toto*.

These observations indicate why granular degeneration and fatty degeneration so frequently occur simultaneously, for both appear to be the result of abnormal conditions in the Altmann granules.

The Relation of Anatomic Structure to Function: William Ophüls.

The kidney appeared to be the organ best suited for the study of this problem, for by collection of the urine directly after its discharge from the ureters, the exact moment of the occurrence of the disturbance could be ascertained. It is possible to produce albuminuria in dogs within a few hours by intravenous injection of potassium bichromate (about 2–3 c.c. of a 2-per-cent. solution). If Altmann specimens are made from the kidneys at this time no lesions are found. That the poison, nevertheless, acts upon the epithelial cells and the granules in them is shown by the subsequent development of severe lesions.

In phlorhizin glycosuria, likewise, no lesions are demonstrable by this method, although we are fairly certain that the excretion of sugar in this case is due to a lesion in the kidney.

The author believes that quite a number of the anatomic changes which we now look upon as primary, are the result rather than the cause of the functional disturbances, although the disarrangement brought about by them naturally often aggravates the original condition. It is questionable whether the real primary lesion in these cases is of such character as ever to be demonstrable by physical methods.

[7] Schilling, *Virch. Arch.*, 1897, CXXV., 410.

Protein Poisons: Victor C. Vaughan.

The author has been able by diverse methods to split proteins—bacterial, vegetable and animal—into poisonous and non-poisonous products.

The poisons obtained from the different proteins are similar, but are not identical. All are soluble in both water and absolute alcohol, more freely in the latter than in the former. The aqueous solutions are acid and slowly decompose sodium bicarbonate, forming salts, apparently, and these are less poisonous than the free acids. The aqueous solutions give the general color reactions for proteins with the exception of that of Molisch, and some of them give this reaction. However, most of the protein poisons obtained by cleavage of the protein molecule contain no carbohydrate and are free from phosphorus.

These poisons when injected into animals intra-abdominally, subcutaneously or intravenously induce characteristic symptoms and when administered in sufficient quantity kill promptly.

Death is due to failure of respiration and the heart often continues to beat for some minutes after respiration has ceased. It seems most probable that death is due to the direct action of the poisons on the respiratory center. It is inferred from the readiness with which recovery may follow non-fatal doses that the poison cripples, but does not destroy, the cells of the respiratory center.

All attempts to produce antitoxins with these protein poisons have, so far, failed. It is true that repeated treatments of animals with non-fatal doses of the poisons from the colon and typhoid bacilli enable animals to bear from two to four times the ordinarily fatal doses of living cultures of these bacteria, but this seems to be due to an increased resistance rather than to a true immunity. This condition is not specific and may be induced by the poisons obtained from peptone or egg white, as well as with that obtained by cleavage of the homologous bacterium.

Attempts have been made to ascertain the chemical constitution of the protein poisons by splitting them up with mineral acids, but at present these experiments have not yielded satisfactory knowledge, and work along this line is being continued. The physiologic action of the protein poisons leads to the suspicion that they contain a neurin group, but so far the author has not been able to demonstrate the presence of such a radical.

Observations on the Living, Developing Nerve Fiber: Ross G. Harrison.

The immediate object of the author's experiments was to devise a method by which the end of a growing nerve could be brought under direct observation while alive, in order that a correct conception might be had regarding what takes place as the fiber extends during embryonic development from the nerve center to the periphery.

The method employed was to locate pieces of embryonic tissue known to give rise to nerve fibers, as, for example, the whole or fragments of the medullary tube, or ectoderm from the branchial region, and to observe their further development. The pieces were taken from frog embryos about 3 mm. long, at which stage, *i. e.*, shortly after the closure of the medullary folds, there is no visible differentiation of the nerve elements. After carefully dissecting it out, the piece of tissue is removed by a fine pipette to a cover slip, upon which is a drop of lymph freshly drawn from one of the lymph sacs of an adult frog. The lymph clots very quickly, holding the tissue in a fixed position. The cover slip is then inverted over a hollow slide and the rim sealed with paraffin. When reasonable aseptic precautions are taken, tissues will live under these conditions for a week and in some cases specimens have been kept alive for nearly four weeks. Such specimens may be readily observed from day to day uuder highly magnifying powers.

While the cell aggregates, which make up the different organs and organ-complexes of the embryo, do not undergo normal transformation in form, owing no doubt in part to the abnormal conditions of mechanical tension to which they are subjected, nevertheless, the individual tissue elements do differentiate characteristically. Groups of epidermal cells round themselves off into little spheres or stretch out into long bands, their cilia remain active for a week or more and a typical cuticular border develops. Masses of cells taken from the myotomes differentiate into muscle fibers showing fibrillæ with typical striations. When portions of myotomes are left attached to a piece of the medullary cord, the muscle fibers which develop will, after two or three days, exhibit frequent contractions. In pieces of nervous tissue numerous fibers are formed, though owing to the fact that they are developed largely within the mass of transplanted tissue itself, their mode of development can not always be followed. However, in a large number of cases fibers were observed which left the mass of nerve tissue and extended out into the surrounding lymph clot.

It has not yet been found possible to make permanent specimens which show the isolated nerve fibers completely intact. The structures are so delicate that mere immersion in the preserving fluid is sufficient to cause violent tearing and this very frequently results in the tearing away of the tissue in its entirety from the clot. Nevertheless, sections have been cut of some of the specimens and nerves have been traced from the walls of the medullary tube, but they were in all cases broken off short.

In view of this difficulty an effort, which resulted successfully, was made to obtain permanent specimens in a somewhat different way. A piece of medullary cord about four or five segments long was excised from an embryo and this was replaced by a cylindrical clot of proper length and caliber, which was obtained by allowing blood or lymph of an adult frog to clot in a capillary tube. No difficulty was experienced in healing the clot into the embryo in proper position. After two, three or four days the specimens were preserved and examined in serial sections. It was found that the funicular fibers from the brain and anterior part of the cord, consisting of naked axones without sheath cells, had grown for a considerable distance into the clot.

These and many other interesting observations described by the author show beyond question that the nerve fiber develops by the outflowing of protoplasm from the central cells. This protoplasm retains its amœboid activity at its distal end, the result being that it is drawn out into a long thread which becomes the axis cylinder. No other cells or living structures take part in this process. The development of the nerve fiber is thus brought about by means of one of the very primitive properties of living protoplasm, amœboid movement, which, though probably common to some extent to all the cells of the embryo, is especially accentuated in the nerve cells at this period of development.

The Presence of Allantoin in the Urine of the Dog During Starvation: Frank P. Underhill.

During the progress of an investigation upon intermediary metabolism, it became necessary to subject the experimental animals to periods of starvation lasting from ten days to two weeks. From the urine of these dogs allantoin separated spontaneously in pure white crystals and the presence of this substance in the urine was constant. The presence of allantoin in the urine during starvation has not been recorded hitherto. This observation makes it probable that allantoin is a constant constituent of the urine of the dog.

Alkaloidal Compounds of Mucoids, Nucleoproteins, and other Proteins: Walter H. Eddy and William J. Gies.

In continuation of their studies of protein compounds the authors have observed that nucleoprotein, mucoid, caseinogen and alkali albuminate form water-soluble products with alkaloids. By intimately mixing samples of the purified moist protein and the pure alkaloid, especially with the latter in considerable excess, soluble products are formed, which may be precipitated by alcohol or alcohol-ether, and which, after purification and drying, readily dissolve in water. Such aqueous solutions are neutral to litmus, and the proteins may be readily precipitated from the solutions by slightly acidifying them.

The purification of such products as well as their chemical and pharmacological study, is under way.

William J. Gies,
Secretary

DISCUSSION AND CORRESPONDENCE

ORIGIN OF SINK-HOLES

THE writer has read with much interest Professor A. H. Purdue's paper in the issue of SCIENCE of July 26, 1907, on "Origin of Limestone Sink-holes." In this connection it may be of further interest to call attention to a type of sink-hole very frequently met with in Florida formed under conditions apparently not included in Professor Purdue's discussion.

The surface deposits throughout much of the interior of Florida consist of sands and clays with occasional limestone layers. These deposits are variable, being in some places almost entirely absent, while in others they are of considerable thickness. Beneath these surface accumulations occurs a limestone of undetermined thickness. This foundation limestone, which is for the most part porous, holds inexhaustible supplies of water, and is traversed by solution cavities.

When first formed, the typical sink throughout this area is an opening leading from the surface through the superficial deposits to or into the limestone below. Many of these sinks are perfectly cylindrical, not funnel-shaped. This is especially true of the smaller sinks. As a result of subsequent caving of the banks, the bottom usually becomes clogged and the sides sloping. The formation of these sinks is practically instantaneous and results from a sudden caving of the earth. In size they vary from a few feet to many rods in diameter. So frequent is their formation in certain sections, notably the phosphate mining area of Alachua and Columbia counties, that one must be on the lookout in driving through the country for newly formed sinks. Indurated layers exposed along the sides of the sink are rough-edged and bear evidence of fracture due to the sudden giving away and breaking under the weight of the load above. The depth of the sinks is probably quite variable. As a rule, they reach through and connect with the permanent underground water horizon. Some reach much below the water line.

The type here described is not merely a modification of the type described by Professor Purdue. This is evident from the fact that the static head of the water in many, though not all, of these sinks is such as to bring it above the top surface of the limestone. There is abundant evidence of solution in the limestone at all depths, both above and below the static head of the underground water. It is apparent, however, that the conditions existing in the limestone below the water level are not such as to bring about a funnel-shaped cavity. This point would scarcely seem to call for emphasis were it not that Professor Purdue considers the cave-in sink the rare exception.

A sink of this type was examined by the writer within a few hours after its formation about one mile south of Juliette in Marion County in 1905. This was a small sink, not more than eight feet in diameter, and of the usual cylindrical form. The sides down to the water level were, so far as could be determined, entirely of clay. The sink which had formed directly under the railroad track was caused possibly by the jar of a passing train, the engine of which had passed safely over. The water rose immediately in the sink to the static head of the water of that locality.

The writer recalls having often seen similar tubular openings reaching from the surface to the runway of abandoned coal mines, the "cave-in" occurring in these cases through a thickness of forty or fifty feet of clays and shales. From analogy it seems probable that the formation of the sinks in question results from a gradual caving of the clay from the bottom, assisted, perhaps, by the removal mechanically of a part of the material by underground water. Finally a point is reached at which the entire remaining mass suddenly gives way. While some of these sinks are in clay formations entirely, others break through considerable thicknesses of limestone.

E. H. SELLARDS

SPECIAL ARTICLES

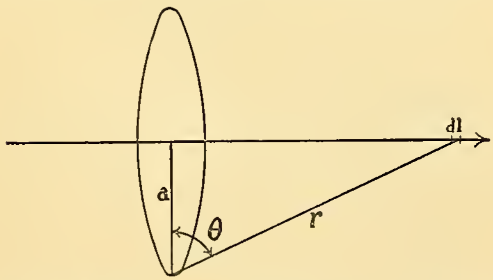
NOTE ON THE MAGNETIC FIELD DUE TO AN ELECTRIC CURRENT IN A STRAIGHT WIRE

The force in dynes on a unit magnetic pole at any point outside an infinitely long straight wire carrying a current is, as we know, tangent to a circle through whose center the wire passes at right angles, and is numerically equal to $2C/a$, where C is the current in absolute units, and a the distance in centimeters of the point from the axis of the wire.

While the approximate direction of the force is easily found experimentally, its numerical value is determined only by integrating the effects of all parts of the current. And since the force is in a plane at right angles to the wire, it is not an easy matter to make clear to students beginning the subject why it is necessary to consider parts of the wire off this plane.

This is one of the many places where the electron theory can be used to marked advantage, and besides, if, as many believe, it is the correct theory—or embraces a larger number of facts than any other—then it should be used both in this case and in all others.

Let electrons, all moving in the same direction with the constant velocity V centimeters per second, be uniformly distributed along a straight wire, and let E be the total amount of electricity per centimeter length of the wire. Then, assuming the field of force from each electron to be the same in all directions, that is, moving slowly and undisturbed by other electrons, the rate of change of induction, due



to the electricity at all parts of the wire, through a circle at right angles to it of radius a; or in other words, the work required to carry a unit magnetic pole once around this circle (see the figure) is given by the equation

$$\frac{dF}{dt}=2\int_0^\infty \frac{Edl}{r^2}\,2\pi a V\cos\theta.$$

But $\cos\theta dl = rd\theta$, $1/r=\cos\theta/a$, and $EV=C$, the current.

Hence

$$\frac{dF}{dt}=4\pi C\int_0^{\pi/2}\cos\theta d\theta=4\pi C,$$

and therefore the force on a unit pole at any point on the circumference of a circle of radius a is

$$\frac{4\pi C}{2\pi a}=\frac{2C}{a}.$$

However, presumably the field due to each electron is influenced by all others, and so influenced that it is confined to a plane at right angles to the wire, but equal in every direction from it. From this it follows at once that

$$\frac{dF}{dt}=4\pi EV=4\pi C,$$

and

$$f=\frac{4\pi C}{2\pi a}=\frac{2C}{a}.$$

According to this conception, which I believe to be the correct one, the magnetic force at any point is due entirely to that part of the current nearest to this point; the more distant parts having no direct effect whatever. But, of course, as just explained, all electrons produce their full effects indirectly by compressing each other's fields into planes at right angles to the wire.

While the above contains nothing new in physics, it is given because it, or some modification of it, may be of use in the class-room.

W. J. Humphreys

Mount Weather Observatory,
Bluemont, Va.,
June, 1907

REFLEX PROTECTIVE BEHAVIOR IN BUFO VARIABILIS

During the past year, while studying the *Opalinae* parasitic in the recta of different species of frogs and toads, I have had to kill many of these batrachians. In each case the backbone and spinal cord were cut behind the head and the brain destroyed by "pithing" with a needle. In this way *Rana fusca, Rana esculenta, Rana agilis, Bufo variabilis, Bombinator igneus, Bombinator pachypus* and *Hyla arborea* have been killed. In all but one of these species I find that, on cutting the ventral skin to open the abdomen, the hind legs kick vigorously. The exceptional species is *Bufo variabilis,* about a dozen of which I killed in Naples.

The living *Bufo variabilis* is very sluggish. When handled, especially if roughly handled, it remains perfectly quiet, only distending the body to a great size by inflating its lungs. One can prick or cut the animal and produce no effect except a further distention, till the skin is stretched taut as a drum-head. Even cutting the spinal cord never produces much action and often produces none.

The interesting thing is that after one has cut the spinal cord and has destroyed the brain, the animal refuses to react by observable movements to any sort of abuse or injury, remaining as quiet as would an animal upon which no operation had been performed.

Bufo variabilis, like most toads, has very perfect protective coloration. It is further protected by the poisonous secretions from its skin glands. (I have had *Rana esculenta* die from being left twelve hours in a small aquarium, in a little water, with this toad.) The toad's habit of remaining quiet, even under abuse, is probably connected with its protective coloration and poisonous skin secretions, and is doubtless a recent acquisition. This reaction, or rather lack of reaction, in the normal animals may be either "conscious," or reflex, or both. In the animal whose brain has been destroyed it must be purely reflex.

Maynard M. Metcalf

Würzburg, Bavaria,
July 3, 1907

BOTANICAL NOTES

THE ORIGIN OF ANGIOSPERMS

Within the past few months two important papers have appeared upon the origin of the higher seed plants (angiosperms). The first is by E. A. Newell Arber and John Parkin, of Cambridge University, and appeared in the *Journal of the Linnean Society, Botany* (vol. 38, pp. 29–80, July 11, 1907). In it the authors first refer to the recent progress in our ideas as regards the phylogeny of the gymnosperms, which are evidently closely related to the *Pteridophyta,* and to the increasing isolation of angiosperms. Just as we find closer affinities between gymnosperms and *Pteridophyta,* we find the gap between *Pteridophyta* and angiosperms increased, until "it may be said that no definite theory as regards the origin of angiosperms has up to the present been elaborated." While "the gap that originally existed between the phanerogams and vascular cryptogams was now bridged, in its place there appeared a wide gulf between the gymnosperms as a whole and the angiosperms."

After a summary reference to certain principles of evolution (the law of corresponding stages, homoplasy and mutation) the authors discuss "primitive features among living angiosperms," basing their discussion upon the theory that the typical angiospermous flower is essentially a strobilus. They regard "the simpler, unisexual flowers, including apetalous forms, as derived from an amphisporangiate strobilus by reduction." They restrict the term "flower" to the angiosperms alone, and regard it as typical "when it possesses both micro- and megasporangia, as well as a perianth which in many cases has an attractive function."

In their critical examination of Engler's theory they hold that *Piperales, Amentiferae,* and *Pandanales* are not primitive in type, but that they are reductions from hermaphrodite types with well developed perianths. They regard *Apetalae* as forms "reduced from amphisporangiate strobili, in each case possessing a perianth," and not as primitive plants from which the petalous forms have evolved. In further criticism of Engler's theory, while admitting its merit of simplicity, they affirm that "its application as a working hypothesis does not assist us in our search for a clue to the phylogeny of the angiosperms as a whole: nor does it help to bring this group into line with any of those now known to us in the fossil state."

For the theory which they adopt, namely, "that the monosporangiate apetalae were derived by reduction from an amphisporangiate strobilus possessing a distinct perianth" they affirm that it "leads us back naturally to a great group of Mesozoic plants, the *Bennettiteae,* which afford the key to the ancestry of the race in question." They then construct a mental picture of a primitive strobilus (flower) consisting of a large, elongated, conical axis, bearing megasporophylls above, and microsporophylls below, and still below these a perianth of usually more than one whorl. Such a primitive flower is conceived to have been polypetalous, hypogynous, and apocarpous. Structures similar to this imaginary primitive flower occur in *Magnoliaceae, Ranunculaceae, Nymphaeaceae* and *Calycanthaceae* among dicotyledons, and in *Alismaceae, Butomaceae* and *Palmaceae* among monocotyledons.

The authors then take up an examination of the *Bennettiteae,* which "appear to afford the long sought for clue to the phylogeny of the angiosperms." They show that in these plants the anthostrobilus is sufficiently like that of the simple angiosperms to warrant the suggestion that the latter are derived from structures much like the former. They are able to reconstruct the anthostrobilus of *Bennettites,* and a comparison of this with the pro-anthostrobilus of the hypothetical *Hemiangiospermae,* and the primitive flower referred to above shows that the steps from the *Bennettiteae* to the angiosperms are easy and quite probable. In their discussion they make one remark which will surprise many a botanist who has not kept in touch with the recent advances in paleobotany, namely: "the seed itself is an exceedingly ancient organ, dating far beyond the period at which we first became acquainted with fossil plants; in other words, it was a highly evolved structure at a very remote period in geological time." Yet while all these early seed plants were gymnospermous, it does not follow that they gave rise to the sub-class *Gymnospermae,* as now understood. On the contrary, it is shown to be probable that the gymnospermous *Bennettiteae* gave rise rather directly to the *Angiospermae.*

The authors show how entomophily helped shape the developing primitive flower, and regard it as an important factor in the evolution of the angiospermous flower. They close their paper with a couple of pages of general conclusions and summary, including a helpful geological table of angiospermous relationships, and finally a bibliography of seventy-one titles.

The second paper, by O. F. Cook, "Origin and Evolution of Angiosperms through Apospory," was published in the *Proceedings of the Washington Academy of Sciences* (vol. 9, pp. 159–178, July 31, 1907). In it the author first refers approvingly to the now widely accepted hypothesis as to the origin of gymnosperms through the ferns and the *Cycadofilices,* and then remarks that while evidence of such origin of the gymnosperms has increased rapidly in recent years, it "has not been accompanied by any equally convincing indications that the angiosperms shared the same pteridophytic ancestry." He, therefore, suggests that "morphologists may be willing to consider an alternative possibility, that the origin of the angiosperms should be sought more directly in some such primitive condition as the thallose liverworts, without the need of following back through the stages of development represented by the ferns and other vascular cryptogams." In brief, his suggestion is that "the female reproductive apparatus of the angiosperms is analogous to the fern-prothallia which are sometimes produced directly from the parent plant without the intervention of spores, that is, by aposporous growth from cells of the parent fronds."

The author then develops the theory that angiosperms have descended from an *Anthoceros*-like type. He holds that *Anthoceros* is not representative of ancestral pteridophytes, a contention which appears to us to be quite unnecessary, even from his own standpoint, since it is evident that pteridophytes and angiosperms have much in common. He suggests that were the capsule of *Anthoceros* to become perennial, and "produce prothallia instead of spores" the transition to the higher plants would be accomplished.

The paper is quite markedly philosophical, and while one may not be able to accept its conclusions, every botanist will find it profitable reading.

THE STUDY OF DIATOMS

The "Report on the Diatoms of the Albatross Voyages in the Pacific Ocean, 1888–1904," by Albert Mann, published as one of the Contributions from the United States National Herbarium (vol. 10, part 5) is a notable addition to our knowledge of this group of plants. In the introductory pages the author describes the methods of work, and points out the importance of a fuller study of these plants than has yet been given them by our government officials. The generic and specific names accord with "the rules now generally prevailing in botanical nomenclature," necessitating in some instances "the substitution of obscure and inappropriate names for those universally known and recorded among living diatomists," which the author "feels to be a grave misfortune." The "Annotated Catalogue" which occupies 160 pages, includes three hundred species, of which forty-three are here described for the first time. The author has not found it necessary to establish any new genera, and this fact taken with the very moderate number of new species, shows him to be conservative in his treatment of the group. It is interesting to note that of the species, 169 belong to the subfamily *Centricae,* while 131 belong to the *Pennatae.* The large genera are *Coscinodiscus,* with 34 species; *Tripodiscus,* 13; *Biddulphia,* 30; and *Navicula,* 54. A most useful bibliography (the work of P. L. Ricker) including about four hundred titles, and eleven full-page plates, including 56 figures (mostly of new species) complete this very interesting and valuable paper.

Charles E. Bessey
The University of Nebraska

MEDALS FOR RESEARCH IN TROPICAL MEDICINE

The Mary Kingsley medal, instituted by the Liverpool School of Tropical Medicine to commemorate Miss Mary Kingsley, the African traveler, who died in 1900, has been presented to the following for distinction in work of special research into tropical medicine:

1. Colonel David Bruce, F.R.S., C.B., Royal Army Medical Corps, who in 1887 discovered the cause of Malta fever, and proved that that malady was produced by the milk of infected goats.

2. Professor Dr. Robert Koch, Nobel Laureate, who ascertained the cause of cholera, and who has contributed much to the knowledge of tropical diseases, especially the discovery of the frequency of malarial infection in children.

3. Dr. A. Laveran, Pasteur Institute, Paris, and D.Sc., University of Liverpool, who in 1880 made the great discovery that malarial fever is caused by parasites in blood.

4. Sir Patrick Manson, F.R.S., K.C.M.G., London School of Tropical Medicine, who in 1878 discovered that one of the parasites of man belonging to the group of *Filaria* is carried by a kind of mosquito.

5. Dr. Basile Danilswsky, professor of physiology, University of Kharkoff, who discovered numerous parasites of blood in a large number of animals shortly after Laveran's discovery was made.

6. Dr. Charles Finlay, chief sanitary officer of Cuba, who in 1880 originated the theory that yellow fever is carried by mosquitoes.

7. Dr. Camirlo Golgi, professor of pathology, University of Pavia, who in 1887 made a complete study of the life cycle of parasites of malaria.

8. Colonel W. C. Gorgas, United States Army, who as chief sanitary officer of Havana gave practical effect in 1902 to the discoveries of Finlay and of the American commission in connection with yellow fever, and succeeded in banishing the disease from the city.

9. Waldemar Mordecai W. Haffkine, C.I.E., who in 1893 discovered a method of inoculation beneficially used in India.

10. Dr. Arthur Loos, professor of parasitology, School of Medicine, Cairo, for work in connection with parasitology.

11. Dr. Theobald Smith, professor of comparative pathology, Harvard University, who in 1893 discovered a new kind of blood parasite in the so-called Texas cattle fever.

SCIENTIFIC NOTES AND NEWS

Dr. Elwood Mead, chief of irrigation investigation of the U. S. Department of Agriculture and professor of institutions and practise of irrigation in the University of California, has accepted the office of chief of irrigation investigations for Australia. The salary of this position as reported is $15,000.

The Belgian Academy of Sciences has elected as foreign members Professor Svante Arrhenius, director of the division of physical chemistry of the Nobel Institute of the Swedish Academy of Sciences at Stockholm; M. E. J. A. Gautier, professor of organic chemistry and mineralogy in the faculty of medicine of the University of Paris, and Dr. Otto Wallach, professor of chemistry at Göttingen.

Dr. Albert Shaw, editor of the *Review of Reviews,* is president, and Mr. Ambrose Swasey, of the optical firm of Warner and Swasey, vice-president, of the jury of awards, now in session at the Jamestown exposition.

Professor J. Arthur Thomson, regius professor of natural history in the University of Aberdeen, will give seven lectures at Lake Forest College from September 24 to October 3. The Bross lectures are as follows: "The Wonder of the World," "The Order and Progress of Nature," "The Method of Animate Evolution," "Man's Place in Nature," and "The Spirit of Nature." There are two popular lectures, one on "The Biology of the Seasons," and one on "Some Wonders of Bird Life in Great Britain." The Bross fund was given to the trustees of Lake Forest University in 1879 by the late William Bross, of Chicago. According to the agreement, the sum of forty thousand dollars, the income of which was to accumulate in perpetuity for successive periods of ten years, the accumulations of one decade to be spent in the following decade, for the purpose of stimulating the best books or treatises "on the connection, relation and mutual bearing of any practical science, the history of our race, or the facts in any department of knowledge, with and upon the Christian Religion."

The president of the British local government board has authorized the following researches under the grant voted by parliament in aid of scientific investigation concerning the causes and processes of disease: (1) Further study of Dr. Sidney Martin, F.R.S., of the chemical products of pathogenic bacteria. (2) Bacteriological investigation by Dr. F. W. Andrewes of the air of sewers and drains. (3) Observation by Dr. W. G. Savage of the bacteriology of "garget" and maladies of the udder or teats of milch cows, and of possible relation of sore throat in the human subject to pathological conditions of the udder and teats of these animals. Also investigation by him of paratyhoid fever and its microbic cause. (4) Joint investigation by Drs. M. H. Gordon and T. J. Horder of the life processes of the meningococcus, with a view to means of combating cerebro-spinal fever.

Mr. H. G. Ferguson (Harvard '04) has been appointed assistant geologist in the Bureau of Science, Manila.

Mr. Sapir, recently appointed research assistant in the department of anthropology at the University of California, has this week returned from a two-months' trip to Shasta County for study of the Yana Indians and investigation of their language. He has brought back valuable information as to the structure of their language, which he is now about to prepare with a view to publishing.

Captain Isachen, commander of the Norwegian Arctic expedition, who returned to Christiania, on September 19, from Spitzbergen, says that on September 3 he found a letter, dated August 2, from William Bruce, the arctic explorer, for whose safety fear has been entertained, declaring that Mr. Bruce intended to journey northward instead of returning to his headquarters the next day, as he had planned.

Mr. William Wright, of Dayton, O., and his associate in negotiating the sale of the Wright Brothers' aeroplane to Germany, arrived at Berlin on September 16 and has been sympathetically received by the chiefs of the military balloon division of the army.

Professor Wilbur Olin Atwater, since 1873 professor of chemistry at Wesleyan University, died, on September 22, aged fifty-three years.

Dr. George Washington Plympton, professor of physics and engineering in the Brooklyn Polytechnic Institute since 1863, died, on September 11, at the age of eighty years.

Dr. Elmer R. Reynolds, examiner of pensions under the government, known as an author and for writings on archeology, died in Washington, on September 18, at the age of sixty-one years.

Mr. Timothy Holmes, an eminent British surgeon and anatomist, has died at an advanced age. He graduated from Cambridge University in 1847.

Dr. Freidrich Vogel, docent in applied mathematics and electrical engineering at the Technical Institute at Berlin, died on August 28.

At the recent Los Angeles meeting of the National Educational Association three new departments were added, increasing the number to twenty-one, viz., department of technical education (authorized at the Asbury Park meeting); department of rural school and industrial education; department of educational committees of women's clubs. The board of directors authorized the appointment of seven committees of investigation, and made an appropriation of $500 for the expenses of each committee, viz., on the Culture Element in Education; on a System of Teaching Morals in Public Schools; on Industrial Education in Rural Schools; on Shortage of Teachers; on Provisions in Public Schools for Exceptional Children; on a National University; on Courses in Manual Training for Elementary Schools.

At the recent meeting of the Anti-alcoholic Congress at Stockholm the physicians present formed an international society, the next meeting of which will be held in London in 1908. The subject of alcoholism also received much attention at the tenth Congress of Polish Naturalists and Physicians, recently held in Lvov, Galicia.

According to Mr. A. T. Coons in a chapter in "The Mineral Resources of the United States," about to be issued by the U. S. Geological Survey, more salt was produced in the United States in 1906 than in any previous year, and the value of the product was greater than in any year since 1890. The quantity was 3,944,133 short tons, or 28,172,380 barrels, valued at $6,658,350, a gain of 308,876 tons, or 2,206,588 barrels, over the production in 1905. This increase in production was accompanied by a slight increase in price, from $1.68 to $1.69 per ton—not sufficient, according to some producers, to offset the increased cost of labor and supplies. In 1906, as in 1905, a large part of the output of salt was used in chemical works, as brine, without concentration into salt. The quantity of dry salt reported in 1906 was 2,603,818 short tons, or 18,598,700 barrels, valued at $6,179,666, an average value of $2.37 per ton or 33.226 cents per barrel. The corresponding figures for 1905 were 2,533,467 short tons, or 18,096,191 barrels, valued at $5,702,425, an average value of $2.25 per ton, or 31.512 cents per barrel. These figures show an increase for 1906 in the reported production of dry salt of 502,509 barrels, or 70,351 short tons in quantity; of $477,241 in value; and 1.714 cents per barrel, or 12 cents per short ton, in average price. New York leads in value of output, closely followed by Michigan. The output of Michigan, however, is considerably greater than that of New York. The average net price per barrel in New York in 1906 was 23.4 cents; in Michigan, 20.3 cents. Ohio ranks next, followed by Kansas. In 1905 Kansas exceeded Ohio in value of output; each shows an increase for 1906. California, Texas and Utah show an increase, and Louisiana and West Virginia a decrease, in value of output. Michigan and New York combined contributed more than two thirds (67.14 per cent.) of the total production of the United States. Of the five leading salt-producing states during 1906, Michigan produced 9,936,802 barrels (35.27 per cent.), New York 8,978,630 barrels (31.87 per cent.), Ohio, 3,236,758 barrels (11.49 per cent.), Kansas 2,198,837 barrels (7.8 per cent.), and Louisiana 1,179,528 barrels (4.19 per cent.). These five states contributed 90.62 per cent. of the total quantity of salt produced in the country during the year.

UNIVERSITY AND EDUCATIONAL NEWS

It is announced that the Morley Chemical Laboratory of Western Reserve University, named in honor of Dr. Edward W. Morley, emeritus professor of chemistry, will be built during the present year.

The College of the City of New York begins its fifty-first year in its magnificent new buildings on St. Nicholas Heights.

Work on the new medical and science buildings of McGill University, to replace those destroyed by fire, is progressing rapidly. The new medical building will cost at least $500,000.

It is proposed to erect a new building for the medical department of Tulane University, New Orleans. The building will be on the university campus, at a cost of $150,000.

Dr. Joseph Marshall, of the University of California, succeeds Dr. William H. Carmalt, as professor of surgery in Yale University.

Dr. A. M. Reese, of Syracuse University, has been appointed professor of zoology at the University of West Virginia, Morgantown, W. Va.

Julian C. Smallwood, M.E. (Columbia University '03), has been appointed professor in charge of the department of mechanical engineering at George Washington University.

Mr. Murray Arnold Hines, Ph.D. (Harvard), of the Mallinckrodt Chemical Works of St. Louis, has been appointed assistant professor of chemistry in Northwestern University.

Professor J. C. Shedd, for the past seven years professor of physics at Colorado College, Colorado Springs, has been elected dean of the College of Letters and Science of Westminster University, Denver, Colorado. Dr. Shedd will also hold the chair of physics. Dr. John Inglis, of Pueblo, Colo., has been elected to the chair of physiological psychology and physiology and hygiene. Dr. Inglis was for three years director of the Presbyterian Hospital at Pekin, China, and has studied abroad in the Hospitals of London and Berlin.

The following additional appointments have been made in the department of chemistry, College of the City of New York: *Tutors*—Robert W. Curtis, Ph.D., Yale, 1904; L. J. Cohen, Ph.D., Columbia, 1907; H. B. Griffin, A.B., Bowdoin, 1904. *Assistant Tutor*—B. F. Feinberg, B. S., College of the City of New York, 1907. Tutor Prager has been granted a year's leave of absence to complete his work for the degree of doctor of philosophy at the Clark University.

The following promotions and appointments, some of which have already been announced, have been made at Lehigh University for the coming year: Professor J. F. Klein, dean of the faculty and superintendent of heat and light; P. B. deSchweinitz, professor of machine design in the department of mechanical engineering; Robert C. H. Heck, professor of experimental engineering in the department of mechanical engineering; Frank P. McKibben, professor of civil engineering, in charge of the department; Winter L. Wilson, professor of railroad engineering in the department of civil engineering; W. B. Schober, professor of chemistry; Dr. Myron J. Luch, assistant professor of English; Dr. Benjamin L. Miller, professor of geology; Walter S. Landis, assistant professor of mineralogy and metallurgy; Dr. Walter W. Davis, professor of physical education; Dr. Percy L. Hughes, assistant professor of philosophy and psychology; N. M. Emery, assistant to the president; Joseph B. Reynolds, instructor in mathematics; Dr. George E. Stebbins, J. A. Veasey and Rollin L. Charles, instructors in physics; Edward S. Foster, instructor in electrical engineering; Dr. Wm. L. Berkeley, instructor in industrial chemistry and qualitative analysis; Dunlap J. McAdam, Jr., assistant in chemistry; T. A. W. Mawhinney, assistant in German; R. J. Gilmore, assistant in German.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, OCTOBER 4, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ON THE CHEMICAL CHARACTER OF THE PROCESS OF FERTILIZATION AND ITS BEARING UPON THE THEORY OF LIFE PHENOMENA[1]

I

THERE may be a difference of opinion as to whether or not it will ever be possible to produce living matter from inanimate; but I think we all agree that we can not well hope to succeed in making living matter artificially unless we have a clear conception of what living matter is. Living organisms have the peculiarity of developing and reproducing themselves automatically, and it is this automatic character of reproduction and development which differentiates them, for the time being, from machines made of inanimate matter. Hence the answer to the question of what living matter is will have to be an answer to the question what determines the phenomena of automatic development and reproduction. Since all life phenomena are ultimately purely chemical, the answer must consist in pointing out one or more series of definite chemical reactions, for which it can be proved that they are identical with the phenomena of development and self-perpetuation. It always seemed to me that the natural starting point for a search after this definite chemical reaction or series of reactions was the analysis of that process which causes the resting egg to develop into an embryo, namely, the process of fertilization.

[1] Address delivered at the International Zoological Congress at Boston, August 22, 1907.

II

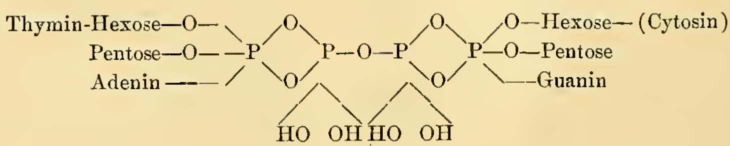
The spermatozoon produces two kinds of effects upon the egg. It causes the egg to develop and it transmits the paternal qualities to the offspring. We are here concerned only with the developmental effects of the spermatozoon. If the question be raised as to what is the most obvious chemical reaction which the spermatozoon causes in the egg, the answer must be, an enormous synthesis of chromatin or nuclear material from constituents of the cytoplasm. After the entrance of the spermatozoon the egg has one nucleus which during segmentation is successively divided into two, four, eight, sixteen, etc., nuclei. Boveri has shown that each new nucleus has the same size as the first nucleus after fertilization. It is therefore obvious that one, and, to all appearances, the foremost chemical effect of the spermatozoon upon the egg is an enormous synthesis of nuclear matter, and to this we must give our attention.

The main mass of the nucleus consists of a salt, the acid of which is nucleic acid, the base a protein substance of the type of protamins, the synthesis of which has been accomplished by A. E. Taylor, or histones. The skeleton of the nucleic acid molecule seems to be phosphoric acid, to which are coupled at least two chemical groups, namely, purin bases (adenin, guanin and possibly other representatives of the same group) and carbohydrates—a pentose and a hexose. The constitution of the nucleic acid may be represented by the following diagram by Burian, of which he states, however, that it can not be entirely correct since it has forty-one instead of forty atoms of carbon in the molecule.

From where does the material for this synthesis of nucleic acid after fertilization come? Our attention is first called to the phosphoric acid. In the case of eggs developing in sea-water, one might think of the possibility that these phosphates are taken from the sea-water. I have made experiments with artificial sea-water from chemically pure salts which contained no phosphates. Eggs of the sea-urchin accomplish their nuclein synthesis just as fast in solutions free from phosphates as in sea-water. Since the same is true for eggs caused to develop by chemical methods, it is obvious that the phosphates for the synthesis of nucleins are derived from the egg itself. The same is true for the other constitutents of the nucleus, since the segmentation of the egg of the sea-urchin can proceed to the blastula and gastrula stage in a solution containing only the chlorides of sodium, potassium, calcium and magnesium.

Miescher found that the amount of lecithin in the blood of the salmon is increased during the period of the formation of sex cells, and he concluded that lecithin is one of the substances from which nucleic acid is formed. The egg itself does not seem to contain any preformed nucleic acid, according to the investigation of Kossel, in the hen's egg, and of Tichomiroff in the eggs of insects. All eggs and possibly all embryonic cells possess comparatively large quantities of lecithin, a fact to which Hoppe Seyler has already called attention.

The lecithin consists of two different groups of bodies, one being distearyl (or oleyl), glycero-phosphoric acid, the other being cholin.



$$C_3H_5\begin{cases}(C_nH_{2n-1}O_2)_2 \\ O.PO \quad OH.O\end{cases}C_2H_4N(CH_3)_3OH.$$

The cholin can apparently not be utilized for the synthesis of nucleins, but the other constituent is able not only to furnish the phosphoric acid skeleton of the nucleic acid molecule, but also the carbohydrates. The fatty acid could be rendered available for this purpose by oxidation, and we shall see indeed that phenomena of oxidation are the prerequisite of the synthesis of nucleins. If the lecithin of the egg is utilized for this synthesis it is obvious that the lecithin molecule must first undergo a cleavage, whereby it is freed from the cholin group. The question as to whether or not lecithin is the source of the phosphates and possibly some other constituents of the nucleic acid group can not be decided until the synthesis of the nucleic acid has been accomplished.

Some further data concerning the synthesis of nucleic acid in the egg can be obtained. The fertilized egg can not develop or increase the number of its nuclei unless an ample supply of free oxygen is present. Twelve years ago I showed that if all the oxygen is withdrawn from the egg, no nuclear, and no cell division is possible, and no increase in its mass of nuclein occurs. The same effect is accomplished if we inhibit the oxidations in the egg through the addition of KCN. The latter, or possibly the HCN formed by hydrolytic dissociation, inhibit the oxidations in the egg. The addition of $\frac{1}{2}$ c.c. of a 1/20 per cent. solution of KCN to 50 c.c. of sea-water is sufficient to bring to a complete standstill the effect of the fertilization in the egg of the sea-urchin, without otherwise injuring the egg, provided the latter does not remain too long in the absence of oxygen or the presence of KCN. As soon as oxygen is again admitted to the egg which has been deprived of it, the synthesis of nuclein and the segmentation begin again; the same occurs when the eggs are brought back from the cyanide sea-water to normal sea-water, provided they are sufficiently aired. It is therefore obvious that the nuclein synthesis depends absolutely upon a process of oxidation.

By way of digression I may mention that this rôle of oxidation in cell division should induce teachers of physiology to discontinue the antiquated statement that the sole object of oxidation in living cells is the production of heat. Oxidations occur in plants and animals which do not need to keep up a constant temperature. But in all these animals a synthesis of nuclein and cell divisions occurs.

We can further show that aside from the process of oxidation, still other processes are originated or accelerated through the entrance of the spermatozoon into the egg and that these processes occur even in the absence of oxygen. This follows from the difference in the resistance of the fertilized and the unfertilized eggs towards lack of oxygen. Fertilized eggs suffer much more quickly from lack of oxygen or from KCN than unfertilized eggs. Eggs were fertilized and a few minutes later put into sea-water free from oxygen, in which they remained twenty-four hours at a temperature of about 15° C. No segmentation or increase in nuclei occurred in the eggs while they were without oxygen. At the end of the twenty-four hours, air was admitted and segmentation began; many eggs, however, segmented abnormally and none developed beyond the blastula stage. Simultaneously the same experiment was made with the unfertilized eggs of the same female. When after twenty-four hours air was admitted and sperm added, all the eggs developed into normal plutei. The same experiment can be made more easily and strikingly by adding KCN to the sea-water. These facts show that lack of oxygen or the suppression of oxidations in the egg injures the fertilized egg much more quickly than the unfertilized egg. This becomes easily intelligible under the assumption that the spermatozoon causes or accelerates still other processes in the egg than oxidations, *e. g.*, hydrolyses, and that the products of these hydrolyses are utilized in the processes of oxidation. If the oxidations do not occur the products of the hydrolyses accumulate in the egg or give rise to further reactions not compatible with the life of the egg. It thus becomes comprehensible why the fertilized egg suffers much more readily than the unfertilized egg, which seems to be able to stand the influence of lack of oxygen for several days, and possibly a longer period of time. It is of course possible that among the hydrolyses occurring in the fertilized egg might be those of lecithin.

III

Our present knowledge of the chemical structure of the spermatozoon does not enable us to state why the entrance of the spermatozoon into the egg should cause its development. That part of the spermatozoon which prevails by its mass is its head, which seems to have essentially the same chemical composition as the egg nucleus or any other cell nucleus. The tail of the spermatozoon is cytoplasm which is at present not characterized by anything special except a relatively large amount of lecithin and fat. If we wish to gain any further insight into the nature of the process of fertilization we must turn to those experiments in which the action of the spermatozoon on the egg can be imitated more or less completely by well-known chemical agencies. The data on heterogeneous hybridization seem to indicate that the substances which cause the egg to develop must be identical or closely related in widely different forms, otherwise we could not understand why the sperm of various starfish, of the brittle star, the crinoids, and, according to Kupelwieser, even of mollusks, should be able to fertilize the egg of the sea-urchin. It almost looks as if the only limitation to heterogeneous hybridization were the fact that for some reason the spermatozoon is not able to enter into the egg of a widely different family. This may explain why it is often necessary to change the constitution of the sea-water, for example, to raise its alkalinity, in order to enable the spermatozoon to enter the foreign egg. It follows from this fact that we can draw conclusions upon the nature of the process of fertilization only from such methods of artificial parthenogenesis as are of a more general application.

We shall begin our discussion with a consideration of the methods of artificial parthenogenesis in the sea-urchin, since they have been most thoroughly investigated in this form. The first method by which larvæ were produced from the unfertilized egg of the sea-urchin consisted in treating the eggs with sea-water whose osmotic pressure had been raised about 50 per cent. The method consisted simply in putting the unfertilized eggs for about two hours at a temperature of about 20° C. into a mixture of 50 c.c. sea-water plus $7\frac{1}{2}$ c.c. $2\frac{1}{2}N$ NaCl and then transferring them to normal sea-water. This method, which gave comparatively constant and good results on *Arbacia* at Woods Hole, gave unreliable results in a form of sea-urchin common at Pacific Grove, *Strongylocentrotus purpuratus*. Neither were the results obtained with this method, on the shore of France and at Naples, very satisfactory, according to reports by Giard, Herbst and others; while E. B. Wilson obtained good results with this method on *Toxopneustes* at Beaufort, North Carolina.

Whenever we notice such an inconstancy of results by a definite method it is probable that some essential variable of the experiment has been overlooked. It seemed difficult to suggest what this variable might be. But there was another chance of overcoming this block. I had noticed in my first experiments that the unfertilized eggs which had been caused to develop by the treatment with hypertonic sea-water differed typically in the form of their development from the eggs fertilized by sperm. This fact was at first welcome since it disposed of the general objection that my results were due to an infection by sperm. The main differences were the following: the egg fertilized by sperm forms immediately after the entrance of the spermatozoon a fertilization membrane, while in the egg caused to develop by the osmotic treatment no membrane was formed. It was also found that a segmentation and development of the egg occurred more rapidly and more regularly in the fertilized egg than in the egg treated osmotically. These and other differences led to the idea that the treatment of the egg with hypertonic sea-water initiated only certain, but not all of the developmental effects of the spermatozoon. It therefore seemed to be necessary to find a second agency which in combination with the osmotic treatment would allow a more complete imitation of the effects of the spermatozoon. In the pursuit of this idea it was found that if the unfertilized eggs of the Californian sea-urchin, *Strongylocentrotus purpuratus,* are treated for some minutes with sea-water to which a small but definite amount of a monobasic fatty acid (or any acid with only one carboxyl group) was added, they will form a typical membrane of fertilization after being transferred to normal sea-water. If these eggs are subsequently treated for from 30 to 50 minutes with hypertonic sea-water (50 c.c. sea-water plus 8 c.c. $2\frac{1}{2}N$ NaCl) at a temperature of 15° C., practically all the eggs will develop into larvæ, provided the time of exposure to the hypertonic sea-water is correctly chosen. In a part of these eggs the segmentation occurred in a perfectly normal way and these eggs developed into normal plutei. If the eggs are treated with only one of the two agencies, the fatty acid or the hypertonic sea-water (for from 30 to 50 minutes) no egg develops. The calling forth of the membrane formation alone leads, at room temperature, to the formation of the first nuclear spindle and division, and then soon to a rapid disintegration of the egg. The experiment can also be made in the reverse order, namely, the eggs can first be treated with the hypertonic sea-water and then be submitted to the treatment with fatty acid. If this order is adopted the eggs must be exposed to the hypertonic solution much longer than in the other case, namely, for from 1½ to 2 hours. This difference in the duration of exposure is due to the fact that the process of membrane formation leads to an acceleration of certain chemical reactions in the egg, whereby the hypertonic sea-water can accomplish its effects more quickly than if it is applied to an intact egg. The superiority of this new method of artificial parthenogenesis over the old one is very striking in the eggs of *Strongylocentrotus.* It happened often enough that the old, purely osmotic method of artificial parthenogenesis led to the formation of none or a small percentage of larvæ, while the new method of combining the fatty acid treatment with the osmotic treatment led to the development of the majority or practically all the eggs of the same female.

It could be shown that in this method we are not dealing with the direct effect of the fatty acid upon the egg, but with the effect of the membrane formation caused by the fatty acid. To cause the membrane formation it was necessary to put the unfertilized eggs at 15° C. for from 1½ to 2½ minutes into a mixture of 50 c.c. sea-water plus 2.8 c.c. $N/10$ butyric acid (or any other monobasic fatty acid). If the eggs were taken a little too early from the solution, after about eighty seconds, only part of the eggs formed membranes after being transferred to normal sea-water. If these eggs were afterwards treated for from 30 to 50 minutes with hypertonic sea-water, only those eggs developed into larvæ which had formed the membrane. A further proof lies in the following data. In 1887 O. and R. Hertwig published the fact that if chloroform is dissolved in sea-water the sea-urchin eggs may form membranes in such sea-water, and Herbst showed in 1893 that benzol, toluol, xylol, act in the same way. I suspected that all fat solvents have the same effect, and an experiment with amylen confirmed this expectation. If the membrane formation is called forth in the egg of *Strongylocentrotus purpuratus* with any of these fat solvents and the eggs are afterwards treated for from 30 to 50 minutes with hypertonic sea-water they will develop into larvæ. It is, however, important to realize that these fat solvents cause cytolysis of the eggs, unless the latter are transferred very rapidly to normal sea-water. On account of this cytolytic effect it is preferable for practical purposes to cause the membrane formation by a fatty acid.

It is therefore obvious that we are now in possession of a method which allows us to imitate more completely the effects of the spermatozoon than the previous purely osmotic method. My attention was again directed towards the fact that the purely osmotic method gave unreliable results with the eggs of the Californian *Strongylocentrotus*, while it gave better results with the eggs of the eastern *Arbacia*. Experiments on the effect of the alkalinity of the sea-water upon segmentation indicated that the sea-water in the laboratory at Woods Hole is considerably more alkaline than that used by me in Pacific Grove. It occurred to me whether this difference might have something to do with the difference in the result of the osmotic method in both places. This suggestion proved correct. It was found that a neutral hypertonic solution with a concentration of hydroxyl ions of 10^{-7} or 10^{-6} normal, as a rule does not cause the development of the unfertilized egg of *Strongylocentrotus*, no matter how high the osmotic pressure is; but that with a sufficiently high concentration of hydroxyl ions a comparatively small increase in the osmotic pressure of the sea-water is sufficient to cause the unfertilized eggs of *Strongylocentrotus* to develop into larvæ. It was, moreover, found that the minimal concentration of hydroxyl ions in the hypertonic solution necessary to call forth the development of unfertilized eggs differs considerably for the eggs of different females. For the eggs of some females this minimal concentration was as low as that found in the sea-water at Pacific Grove, namely, between 10^{-6} and 10^{-5} normal, but as a rule a higher concentration of hydroxyl ions was required. It is possible to obtain good and constant results with the purely osmotic method in *Strongylocentrotus* if only the concentration of the hydroxyl ions in the hypertonic solution is sufficiently raised through the addition of NaHO. In cases in which the eggs of *Strongylocentrotus* will not develop into larvæ when put for about two hours at 15° C. into a mixture of 50 c.c. sea-water plus 8 c.c. $2\frac{1}{2}N$ NaCl they will develop when about 1.5 c.c. $N/10$ NaHO is added to this solution.

The apparently purely osmotic method, therefore, turns out to be composed of two agencies, one being the increased osmotic pressure of the solution, and the other the concentration of the hydroxyl ions. It could be shown that these two agencies can with good results be applied separately, and that therefore there exists a far-reaching analogy between the effects of the alkali in these experiments and the fatty acid in the experiments previously mentioned. If the unfertilized eggs of *Strongylocentrotus* are first put for two hours into a mixture of 50 c.c. of a neutral van't Hoff solution isotonic with sea-water plus ½ or 1 c.c. $N/10$ NaHO and then for from 30 to 50 minutes into hypertonic sea-water (50 c.c. sea-water plus 8 c.c. $2\frac{1}{2}N$ NaCl) many eggs or the majority will develop into larvæ. If the eggs are treated with the alkaline solution alone, without being subsequently treated with hypertonic sea-water, they will not develop. The treatment of the eggs for from two to three hours with NaOH acts, therefore, in a way similar to the treatment of the same eggs for about two minutes with a solution of the fatty acid of the same concentration. The analogy shows itself also in that with this method of combining the effects of alkali and hypertonic sea-water those eggs which develop into larvæ form often, if not always, a membrane. This membrane is not quite as distinct as the fatty-acid membrane for the reason that it surrounds the cytoplasm more closely. This membrane formation does not occur or does as a rule not become manifest until the eggs are returned from the hypertonic to the normal sea-water. If the order of events is reversed and the eggs are first put into the hypertonic sea-water and afterwards into the hyperalkaline solution, they must remain longer in the hypertonic sea-water, namely, for from 1½ to 2 hours; this also corresponds to the experience with the fatty-acid treatment.

We therefore possess two parallel methods by which we can imitate the fertilizing effects of the spermatozoon upon the egg of *Strongylocentrotus*, namely, we treat the unfertilized egg for from 1 to 2 minutes with a solution of fatty acid (50 c.c. $M/2$ van't Hoff solution plus 0.7 c.c. $N/10$ butyric acid) or for from 2 to 3 hours with an equivalent alkaline solution (50 c.c. $M/2$ van't Hoff solution plus 0.7 c.c. $N/10$ NaHO) and afterwards for from 30 to 50 minutes with hypertonic sea-water (temperature $= 15°$ C.). The treatment of the eggs with fatty acid or alkali can be replaced by a treatment with a fat solvent. Fatty acids, alkalis and fat solvents all act in the same way, namely, by causing those changes in the egg which result in the process of a membrane formation.

IV

I have not yet had time to apply these results to the eggs of many other forms, but I believe from what I have seen that we are now in possession of at least some of the general methods and principles of artificial parthenogenesis. It seems that in general the treatment of the eggs with alkalis and acids, sometimes with, sometimes without subsequent treatment with hypertonic sea water, causes the development of unfertilized eggs.

The unfertilized eggs of *Polynoë*, a marine annelid, can develop into larvæ if they are permanently put into hyperalkaline sea-water, *e. g.*, 50 c.c. sea-water plus 1.5 c.c. $n/10$ NaHO. It is well to keep the eggs for this experiment in shallow watch-glasses which are loosely covered with glass plates; in this case the oxygen of the air diffuses more readily to the eggs, than if they are kept in dishes with a deep layer of liquid above them. These eggs of *Polynoë* are immature when taken from the ovary and do not become mature in ordinary sea-water unless they are fertilized by a spermatozoon. They become, however, mature without the aid of sperm, when kept for some hours in hyperalkaline sea-water. They form a membrane and throw out the polar bodies. If we wait until this occurs and then transfer the eggs for from 2 to 3 hours at 15° C. into hypertonic sea-water (50 c.c. sea-water plus 8 c.c. $2\frac{1}{2}n$ NaCl) and after this time bring the eggs back into normal sea-water they develop more quickly and more eggs segment than if they remain permanently in the hyperalkaline sea-water without any treatment with hypertonic sea-water.

Three years ago I had found that a small number of the eggs of mollusks, *Lottia gigantea*, and various forms of *Acmæa*, can be caused to develop if put for 2 hours into hypertonic sea-water. I have convinced myself this year that no development occurs if they are treated with a neutral hypertonic solution; that, however, if the alkalinity of the hypertonic solution is raised sufficiently high by the addition of NaHO many, if not practically all, the eggs of *Lottia* can be caused to develop into larvæ. In these experiments it was also noticed that the concentration of the HO ions in the hypertonic solution necessary for the production of larvæ from the unfertilized eggs differed considerably for the eggs of different females.

I have convinced myself also that the unfertilized eggs of *Sipunculus* can be caused to develop into larvæ by putting them permanently into a solution with a comparatively high concentration of HO ions.

As far as the production of larvæ from unfertilized eggs with the aid of acids is concerned, we may mention the eggs of starfish, which can be caused to develop with the aid not only of the acids containing one carboxyl group, but apparently with the aid of all acids. They differ in this respect from the eggs of the sea-urchin. It is possible that the acids with one carboxyl group act also better in the case of the starfish egg than the other acids; and this might explain why Delage obtained better results with CO_2 than with other acids, although according to my own experience the results with the other acids are much more satisfactory than those of Delage.

For the eggs of the starfish the acid treatment suffices, and no further treatment with hypertonic sea-water is required. In the egg of one form of starfish, namely, *Asterina*, the spermatozoon causes a membrane formation which is just as distinct as in the sea-urchin egg. The membrane formation can be induced in *Asterina* by exactly the same methods as in the sea-urchin egg, namely, a treatment with a fat solvent (benzol, or amylen) or a fatty acid. In these eggs the production of the membrane is sufficient to cause the development into normal larvæ at least of a number of eggs and an after-treatment with hypertonic sea-water is not required. The starfish eggs differ also from the sea-urchin eggs in the former having a tendency to develop spontaneously if left in sea-water, although the number of eggs developing in this way is, as a rule, very small. This development may be due to the action of the HO ions in the sea-water, or the action of an acid, *e. g.*, CO_2, formed in the egg itself. In *Asterina* it can also be noticed that if eggs remain in sea-water occasionally some of them form a membrane spontaneously, possibly also through the influence of the HO ions of the sea-water or an acid formed in the egg.

In the eggs of *Thalassema mellita*, a marine worm, Lefevre has produced membrane formation and normal segmentation by treating them with acid. The eggs of this form are immature when removed from the ovary, and the entrance of the spermatozoon causes them to form a membrane, to throw out their polar bodies, and to segment and develop. Lefevre found that by treating the unfertilized eggs with any acid, HCl, NHO_3, oxalic, acetic acid, CO_2, he could cause the membrane formation, maturation, normal segmentation, and the formation of normal larvæ in a large percentage of the eggs. In order to produce these results he put the eggs for about five minutes into a mixture of 85 c.c. sea-water plus 15 c.c. $N/10$ acetic acid.

V

These and similar facts may serve us as a basis for the further analysis of the nature of the process of fertilization.

If we call forth the membrane formation in the unfertilized egg of *Strongylocentrotus purpuratus,* either by treating it with benzol or with a fatty acid or with alkali, the same processes take place at first, as in the case of the entrance of a spermatozoon; after some hours a normal nuclear spindle is formed and the nucleus divides regularly into two nuclei. This shows that the synthesis of nuclein salts is started by the membrane formation. If the temperature is very low (from 2° to 5° C.) the segmentation continues slowly but regularly and a few normal blastulæ may be obtained. At a temperature of 15° or more the development does not go beyond the formation of the first nuclear spindle or nuclear division; soon after this the egg begins to disintegrate in a characteristic way. If, however, the egg is put after the membrane formation for from 30 to 50 minutes (at 15° C.) into hypertonic sea-water, all the eggs remain alive and develop, provided the time of exposure is chosen correctly; and in a number of these eggs segmentation and development occur in a normal way. *It is therefore obvious that the calling forth of the membrane formation in the egg starts the nuclein synthesis and the other processes of development, but that the chemical processes do not occur properly.* Through the subsequent treatment of such eggs with hypertonic sea-water these processes are carried back into the proper channels. In some forms, *e. g., Thalassema* and *Asterina,* the calling forth of the process of membrane formation obviously suffices to start the chemical processes in the egg in the right channels and no after-treatment with hypertonic sea-water is required. Our understanding of the developmental effects of the spermatozoon therefore depends upon the answer to the three following questions: (1) What is the physico-chemical character of the process of membrane formation whereby this process is able to start the development of the egg? (2) Why does it start this development in some forms, *e. g., Strongylocentrotus purpuratus,* in the wrong channels? (3) In which way does the treatment of such eggs with hypertonic solution carry the development back into the proper channels? We shall try to answer these three questions in turn.

As far as the physico-chemical character of the process of membrane formation in *Strongylocentrotus* is concerned, we have seen that it can be produced by very different means in the sea-urchin; first, by fat solvents, *e. g.,* benzol, toluol, amylen, etc. Since I had formerly expressed the suggestion that the process of membrane formation might be due to a coagulation and since it might be argued that the above-mentioned agencies might also have a slight coagulating effect, it was of importance to make certain whether they really act only through their fat-dissolving power. Benzol has a high fat-dissolving power and an extremely slight coagulating effect on proteins. Phenol, on the contrary, has a much smaller fat-dissolving power but a very great coagulating effect. If the process of membrane formation were due to a coagulating effect of these agencies, phenol should act much more powerfully in the membrane production than benzol;

if, however, these media act through their fat dissolving power, the reverse should hold. Benzol is practically insoluble in sea-water. For the purpose of the membrane formation about 2 drops of benzol were put into 50 c.c. of sea-water and the mixture shaken. In order to increase the solubility of the benzol in the sea-water the latter was heated slightly. The shaking caused an emulsion, but only a trace of the few drops of benzol went into solution; yet this caused the membrane formation instantly in the eggs of the sea-urchin. On the other hand, phenol is very soluble in sea-water. It was necessary to add 6 c.c. $m/2$ phenol (Kahlbaum) to 50 c.c. sea-water to produce the membrane formation. Moreover, although toluol has been used extensively in experiments on protein solutions, no author has ever noticed a coagulating effect. Yet it is just as effective as benzol for the production of the fertilization membrane. I think there can be no doubt that we are dealing with an action of benzol, amylen, toluol, on the solution of fatty compounds and not on coagulation.

The second agency for the membrane formation is a treatment of the eggs with alkali. The saponifying action of alkalis upon fat is too well known to require any further discussion.

The action of acids, however, is very peculiar and interesting. As already stated, only such acids as contain one (but not more) carboxyl group produce the membrane formation in *Strongylocentrotus purpuratus*. HCl, HNO_3, H_2SO_4, NaH_2PO_4, and dibasic or tribasic organic acids, *e. g.*, oxalic, succinic, citric acids, etc., were practically ineffective. This shows that the effect of the fatty acids can not be due to the hydrogen ion; the hydrogen ion inhibits the process of membrane formation, as can be shown by the fact that the membrane can not be formed as long as the egg is in the acidulated sea-water, but only after it has been transferred back to normal sea-water. Moreover, it can be shown that the ineffectiveness of such acids as HCl, HNO_3, etc., is not due to a secondary injurious effect upon the eggs, for an effective solution of butyric acid remains just as effective if we add to it the equivalent amount of hydrochloric acid. *We are obviously dealing here with a specific action of one group of acids, namely, of those which contain one carboxyl group.* Some of these acids, *e. g.*, acetic, are well-known fat solvents. Pflueger pointed out long ago the fat-dissolving action of oleic acid. All of these monobasic fatty acids are more soluble in fat than the other acids. It is therefore possible that these acids act as fat solvents and that it is due to this action that they cause the membrane formation.

But why should the membrane formation in the egg be connected with the process of fat solution? Several years ago I showed that the process of membrane formation in the egg is a transition stage in such cases of cytolysis of the egg, whereby the latter is transformed into a shadow. If we treat eggs with benzol or amylen they form a membrane and are a few seconds later transformed into shadows. The treatment of the unfertilized eggs with alkali also transforms them rapidly into shadows if the solution is free from Ca or Mg. In this process also a membrane is formed. The treatment of the eggs with a fatty acid does not cause cytolysis, but this is due to the inhibiting action of the H ions. Through the addition of acid to sea-water the cytolytic action of fat solvents like benzol is also inhibited. We can also produce cytolysis by treating the eggs with hypertonic sea-water of a very high osmotic pressure, *e. g.*, $1\frac{1}{2}$ to 2 m., or with very dilute sea-water; in both cases the process of membrane formation is a transitional stage in the cytolysis.

Experiments on cytolysis in red blood corpuscles seem to show that the mechanism of this process is the destruction of the membrane of the red corpuscles chiefly by lipolysis. Koeppe assumes (as is generally agreed) that the surface of the red blood corpuscle consists of a lipoid film which is liquefied, saponified, or otherwise destroyed, in cytolysis. I believe that the same is true for the cytolysis of the egg, with this difference only, that in the egg it is not the most superficial film which is liquefied, but the layer underneath it. The surface film is preserved in this process; it is at first quite thin and invisible, but very soon becomes visible, possibly through an imbibition with water which causes it to swell.

The process of membrane formation, according to these facts, seems to be due to a solution of the fatty layer underneath the surface film of the egg. This fatty layer forms together with the surface film a solid shell around the unfertilized egg. As soon as the fatty layer under the surface film is liquefied, water is squeezed out from the cytoplasm and forms a layer between this and the outside film which in the meanwhile has become toughened. But how could this process of fat solution and possibly lipolysis be connected with the synthesis of nucleins? We can not answer this question except by mentioning the possibility, that the lecithins may be involved in the liquefaction and hydrolysis of the surface layer of the egg.

The second question raised by us was: Why does the process of nuclein synthesis come to a standstill so soon after the membrane formation (unless the egg is treated with hypertonic sea-water) and why does the egg disintegrate so rapidly in this case? To this question we are able to give a pretty definite answer. We stated in the beginning of this paper that processes of oxidation are the *conditio sine qua non* of nuclein synthesis and development in the fertilized egg. The nuclein synthesis and the segmentation of the nucleus and the cytoplasm after the artificial membrane formation also depend upon oxidations and do not occur in the absence of O or the presence of KCN. It can be shown that the disintegration of the eggs does not occur if the eggs are put after the membrane formation into an atmosphere of pure hydrogen, or if the oxidations are suppressed in the egg by the addition of a trace of KCN. Eggs which after the membrane formation are thus treated remain intact and can be caused to develop if after a number of hours they are treated with hypertonic sea-water, while at this time the eggs of the same experiment which had remained in normal sea-water are already disintegrating. We must therefore conclude that the artificial membrane formation causes or allows the oxidations underlying the synthesis of the nucleins, but that these oxidations do not occur in the right direction; and that these faulty oxidations are the cause of the rapid disintegrations of such eggs. This disintegration occurs the sooner the higher the temperature.

This conception receives support through the experiments intended to give an answer to the third question, namely, how it happens that eggs which after the artificial membrane formation are treated for from 30 to 50 minutes with hypertonic sea-water develop normally. It was found in all experiments that a hypertonic solution acts in this way only if it contains free oxygen. If we substitute for the air pure hydrogen or if we add to the hypertonic solution a small amount of KCN this effect is not produced. If the eggs possessing membranes are brought back from the hypertonic solution free from oxygen or containing KCN into normal sea-water, they disintegrate in the same way as if they had not been treated with the hypertonic solution; if the same eggs are put after the treatment with hypertonic sea-water free from oxygen for from 30 to 50 minutes into hypertonic sea-water containing oxygen they will develop normally when put back into normal sea-water. The dominant rôle of the oxygen in the action of hypertonic sea-water upon the unfertilized egg is still more manifest in experiments on eggs which possess no membranes. If we put the unfertilized eggs of *Strongylocentrotus* directly into hypertonic and hyperalkaline sea-water, *e. g.*, 50 c.c. sea-water plus 10 c.c. $2\frac{1}{2}$NaCl plus 1 c.c. $N/10$ NaHO and leave them in such a solution at 15° C. for about two hours, many eggs will develop after they are transferred back to normal sea-water, while others will be injured and perish in a short time. Both effects, however, are only produced if the hypertonic solution contains oxygen. If it is carefully freed from oxygen or if the oxidations are inhibited by KCN the eggs are intact when taken out of the solution. They will neither develop nor disintegrate when put back into normal sea-water. If after a few hours sperm is added to such eggs they will develop. However one may vary the experiment, the result is always the same, namely that a hypertonic solution stimulates or modifies the development of the egg only in the presence of free oxygen. This seems to indicate that the effect of the hypertonic solution in artificial parthenogenesis consists in a modification of the phenomena of oxidation in the egg; the latter are led back into the right channel. This is the reason why the eggs do not disintegrate but develop if they are treated with hypertonic sea-water after the artificial membrane formation.

VI

If we summarize all the experiments on artificial parthenogenesis it seems that the essential feature of the process of fertilization consists first in a liquefaction or hydrolysis or both, of fatty compounds, and second, in the starting of processes of oxidation in the right direction. In some forms, *e. g.*, *Asterina*, the latter will take place naturally if only the former process is started. In the eggs of many forms the process of liquefaction or saponification of lipoids occurs under the phenomenon of membrane formation. These processes of the liquefaction of fats and hydrolysis and oxidation form apparently the basis of the synthesis of nucleins. It is possible, but far from proved, that among the fatty compounds involved in the process of hydrolysis are the lecithins.

These results are in harmony with the facts observed in the germination of oily seeds. The process of germination is an analogue to the starting of the development in the animal egg, inasmuch as resting cells are thrown into the process of cell division and this process is based upon the synthesis of nucleins. Experiments on the germination of the castor bean have shown, according to Hoyer, that as soon as the seeds are put into water a hydrolytic process is started which results in the formation of acid, chiefly carbonic, lactic, and to a smaller degree, acetic acid. Through these acids a lipolytic enzyme is activated by which the oil of the seed is rapidly hydrolyzed. The rest of the process of germination is primarily a nuclein synthesis. This synthesis depends, as in the case of the egg, upon the presence of free oxygen, since Moritz Traube has shown that seeds can not germinate except in the presence of free oxygen. I think the chemistry of the germination of seeds is essentially the chemistry of nuclein synthesis, and I believe the method of starting this synthesis is essentially the same as in the fertilization of the egg.

We can also understand why certain eggs can develop without fertilization or show natural parthenogenesis, while others require fertilization. The naturally parthenogenetic eggs are those in which the nuclein synthesis can be started without the addition of an outside agency. In analogy with the experience on seeds, we may assume that the acid formed in them after they have left the ovary is sufficient to bring about the necessary hydrolytic process or processes; either directly or through the activation of enzyme. Such eggs must also contain the necessary prerequisite for the normal occurrence of the process of oxidation. In the eggs which require fertilization we must probably discriminate between two groups, one for which the hydrolysis is sufficient to start the nuclein synthesis, *e. g.*, starfish, *Thalassema, Polynoë;* the second group for which in addition provisions are to be made for the processes of oxidation, by treating these eggs with hypertonic sea-water containing oxygen, *e. g.*, sea-urchin, and *Lottia.*

I am of the opinion that this mechanism of nuclein synthesis is the thread by which we can find a rational way through the maze of the otherwise bewildering mechanisms, characteristic of living matter; on one hand, the phenomena of growth, on the other, those of self-preservation.

I will illustrate this by one example. It can be proved that the nucleus itself or one of its constituents acts as a catalyzer in the synthesis of nuclein in the unfertilized egg. This follows from the fact that the velocity of the nuclein synthesis in the fertilized egg increases in proportion with the number of nuclei already present in the egg. If the mass of the original fertilization nucleus is m, the mass of nucleins increases during the first segmentation period to $2m$, during the next to $4m$, and so on, increasing with the exponent of 2; while the duration of the various periods of segmentation differs little and these differences have no relation to the mass of the nuclear material formed during the period. This behavior of a chemical reaction is characteristic for such catalytic processes in which one of the products of the reaction is itself a catalyzer for the reaction. We must therefore conclude that the nuclei themselves or one of their constituents are the catalyzer for the nuclein synthesis or one phase of it. It is possible that the nucleus catalyzes only the phenomena of oxidation, and in as much as oxidations are the conditio sine qua non of nuclein synthesis, this would explain the autocatalytic effect of the nuclei upon this reaction. A number of years ago I pointed out that the nucleus seems to act as the main (though possibly not the only) oxidizing agency of the cell. This influence of the nucleus upon the nuclein synthesis, and the rôle of this synthesis upon the preservation and continuation of living matter, explains one of the most mystifying characteristics of the latter, namely, the phenomenon of automatic reproduction of cells.

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Advanced Algebra. By Arthur Schultze, Ph.D. New York, The Macmillan Company. 1906. Pp. xiv + 562.

College Algebra. By Charles H. Ashton and Walter R. Marsh. New York, Charles Scribner's Sons. 1907. Pp. ix + 279.

For more than a century after the inventions of analytical geometry and the calculus, mathematicians and physicists may be said to have fairly rioted in applications of these instruments to geometric, mechanical and physical problems without concerning themselves about the nicer questions of fundamental principles, cogency and precision. The efforts of Euler, Lacroix and others to systematize results served to reveal in a surprising way the need of improving foundations. Constructive work was not arrested by that disclosure. On the contrary, new doctrines continued to spring up and old ones to expand and flourish. But a new spirit began to manifest itself. Mathematics became increasingly critical as its towering edifices more and more challenged attention to their foundations. Already manifest in the work of Gauss and Lagrange, the new tendency, under the powerful impulse and leadership of Cauchy, rapidly developed into a powerful movement. It was the foundations of the calculus that were first overhauled, and, while its instrumental efficacy was greatly improved, the calculus was advanced from the level of a tool to the rank and dignity of a science. Accordingly every genuine university to-day offers two courses in the calculus: an elementary course designed to equip the student with the calculus viewed as an instrument for making rough investigations, and an advanced course designed to acquaint him with the intimate structure of the subtlest of the sciences and to qualify him to use the calculus in the finest and exactest thinking. The work of Messrs. Veblen and Lennes deals with the calculus in the latter conception of it. Their work has but a single English rival, viz., "The Theory of Functions of Real Variables," by Professor James Pierpont, which appeared in 1906. Prior to the appearance of the latter work, an American or English student of the modern critical calculus had to depend upon such foreign works as Jordan's "Cours d'Analyse" and Stolz's "Allgemeine Arithmetik." The aim of such critical work being precision and logical perfection, it tends at first to be prolix and only at last succeeds in becoming concise. The most conspicuous among the merits of the work by Messrs. Veblen and Lennes is the union of conciseness with rigor. This union was effected by means of two principles of economy. One of these is the happy definition of the all-important notion of the limit of a function in terms of the notion of "value approached." The other consists in the systematic employment throughout of a recently established theorem in the modern doctrine of assemblages (ensembles, manifolds, sets), namely, the Borel theorem, so called after its discoverer. The value of the book might be improved by the introduction of more numerous illustrative examples.

The books by Professor Chandler and Professor Osborne, as designed for the beginner, have numerous English rivals. Professor Chandler in this third edition of his book has made some changes to bring the treatment and content into fuller accord with modern demands both of rigor and of utility. The basis is laid in the doctrine of limits. The differential notation is introduced at an early stage, and, everywhere throughout, the reader finds the abstract notions and processes illuminated by simple applications to concrete problems, chiefly of geometry. The closing chapters afford an excellent introduction to differential equations and mechanical integration. Taken all in all, it is one of the more substantial books for the student of engineering, for whom it is primarily designed. It is not one of those emasculated, merely "practician," works that some teachers and students of engineering seem to crave.

By introducing a chapter on series, by rearranging the order of topics, by the earlier geometric illustration of the notion of derivative, and by the incorporation of physical and mechanical applications, Professor Osborne has amply justified the revision of his well-known book, though his decision to give several (not obviously equivalent) definitions of the differential instead of one can hardly fail to annoy the instructor and confuse the pupil.

The book contains too little theory and about three times too many examples. The work demands too much finger work and too little thought.

The algebras by Professor Schultze and by Messrs. Ashton and Marsh cover the material usually presented to high school pupils and college freshmen. Both works are well suited to prepare the student for the examinations held by the College Entrance Examination Board. Messrs. Ashton and Marsh's book begins with the theory of radicals, the preceding matter being presented for review by numerous well-chosen examples. Both works deal admirably with graphs, determinants and the theory of equations. Neither one aspires to the rigor of the superb work of Professor Fine, but both of them are likely to be regarded, whether correctly or not, as more teachable.

C. J. Keyser

Columbia University

Metabolism and Practical Medicine. By Carl von Noorden; Anglo-American issue under the editorship of Walker Hall. Vols. I. and II. Chicago, W. T. Keener & Company.

This work is a translation of the first volume of v. Noorden's "Handbuch der Pathologie des Staffwechsels," the most exhaustive treatise that has yet appeared on the subject of metabolism. The German original (two volumes) is the joint product of the following contributors: v. Noorden, A. Czerny, C. Dapper, Fr. Kraus, O. Loewi, Magnus-Levy, M. Mathes, L. Mohr, C. Neuberg, H. Solomon, Ad. Schmidt, Fr. Steinitz, H. Strauss, and W. Weintraud.

The original of the first volume of the translation comprises 479 pages written by Magnus-Levy. It treats of normal metabolism in all its different phases, and is a very readable piece of metabolism literature. In addition it is a veritable mine of numberless detailed facts and corresponding references to the original literature. It should prove exceedingly valuable to the investigator who wishes to look up definite facts with the minimum waste of time. In some important particulars, as, for example, with regard to the factors which determine the percentage composition of human urine the volume is already more or less obsolete. This is, however, not the fault of the author. His manuscript must have been finished in 1904, and as he says in another connection: "Die Fragen, deren Lösung wir dank der eifrigen Arbeit der verschiedenen Schulen in wohl nicht zu ferner zeit erhoffen dürfen, sind eigentlich zahlreicher, wie die bereits gewonnenen Aufschlüsse und Ergebnisse."

The second volume (of the translation) deals with metabolism in starvation, in overfeeding, in fevers, and in diseases of the digestive tract, respiration, the liver, the blood and the kidneys.

Three of these chapters, namely the first two and the last one, are v. Noorden's, and are written in his usual clear, critical, yet somewhat dogmatic style. These chapters constitute excellent résumés of what is yet known concerning the subjects treated. They abound in concrete instances drawn from the author's experience as a clinician—instances which show how a mastery of even the present limited knowledge of the laws of metabolism is indispensable for the correct diagnosis and the dietetic treatment of many cases coming under the care of every physician.

Of the other chapters in this volume those on fevers (Kraus) and on diseases of the liver (Weintraud) are the most interesting. A part of the matter here introduced, as, for example, Ehrlich's "parallelism" between the process of assimilation and the action of toxins, is perhaps of too hypothetical a nature to merit the extensive discussion it has received. Some of the data presented, notably with regard to the urinary constituents, are of very doubtful value. But taken as a whole these chapters are instructive and suggestive alike to physiologists and to pathologists who are interested in the problems of metabolism.

It is to be regretted that the scholarly character of this valuable work should have suffered at the hands of the translators. They have evidently done their part in great haste, with little regard for English style, and sometimes without even bringing out the correct sense of the original. A few illustrations of errors which mar the two English volumes may be cited: (Vol. I., p. 3) "the fats and proteins are partly vegetable, partly mineral"; (p. 5) "the questions, the solution of which follow the energetic work of numerous laboratory workers, are really at present more numerous than the discoveries and results obtained";[1] (p. 126) "im Stoffwechsel fast unangreifbar" is rendered as "almost beyond assimilation"; (p. 178) for "genau" we find "minutely"; (p. 403) for "reichlich Getrank zuzuführen" we get "water should be exhibited freely"; (p. 408) for "Kot" we get "motion"; (Vol. II., p. 1) "die Fragen des Chlorumsatzes und der Acetonuria" is transformed into "the problem of the Chlorine changes in acetonuria"; (p. 62) in overfeeding "it is a matter of indifference whether the excess takes the form of albumen or of some oxidizable substance free from nitrogen"; (p. 105) "the nitrogen output during starvation usually exceeds the intake by a small amount.

The German edition was quite up to date when it went through the press (1904–5). A cursory glance at the Anglo-American edition gives the impression that it has carried the review of the literature up to the date of issue. To be sure, some additional data have been incorporated, but much recent literature, especially in the field of normal metabolism, has been omitted.

The translators have cut out a considerable number of references to original literature given in the German edition.

Otto Folin

Plant Physiology and Ecology. By Frederic Edward Clements, Ph.D., Professor of Botany in the University of Minnesota. With 125 illustrations. Pp. xvi + 315. 8vo. New York, Henry Holt and Company. 1907.

This book, the result of more than fifteen years of ecological work on the part of its author, constitutes a notable addition to the literature of botany in America. In 1897 the first edition of Pound and Clements's "Phytogeography of Nebraska" was published, and in it we find the germs of the book now before us. Three years later the second edition appeared with considerable emendations and corrections, and this was followed by various papers published in magazines, transactions of societies and university "studies," culminating in Clements's "Research Methods in Ecology" in 1905, a technical handbook for the advanced student and investigator of ecology. The book in hand is based upon that work, and is, in fact, a less technical presentation of the same matter, adapted to the needs and preparation of college and university students.

The author considers physiology and ecology as essentially the same, hence the treatment is in accord with this view. The author does not in any place give the plant an ecological consideration as distinct from one which is physiological. It makes no difference whether the plant is studied in the laboratory, or in its field or forest habitat, in any case the investigation is essentially the same, and we are no longer to call the first physiology and the second ecology.

The book is broken up into fifteen chapters, of which the first is a somewhat philosophical discussion of stimulus and response. And here we get the author's definition of plant physiology in this paragraph (page 1): "Physiology was originally understood to be an inquiry into the origin and nature of plants. This is the view that pervades the following pages, and in accordance with this the subject-matter of ecology is merged with that of physiology." The nature of stimuli and the nature of response are discussed—concisely and precisely—and adjustment and adaptation are defined and delimited. Then follow chapters on the water of the habitat, adjustment to water (including absorption, transport and transpiration), adjustment to light, adjustment to temperature, adjustment to gravity, contact and shock, adaptation to water, and adaptation to light. In these chapters, along with much discussion of the problems involved, the au-

[1] This sentence purports to be a translation of the German sentence of Magnus-Levy's quoted above.

thor introduces fifty-seven practical tests for their experimental demonstration. Some of these experiments are familiar to every student of plant physiology, while others are new, and in many cases quite novel. Some of them are to be performed in the laboratory, while others take the student out into the fields and forests.

The ninth chapter, on the origin of new forms, is again a philosophical presentation, including a summary discussion of the law of evolution, stability and plasticity, constant and inconstant forms, origin by adaptation, origin by variation, origin by mutation, natural selection, isolation, polygenesis, etc. Several instructive pages are given to Darwin and his predecessors and followers.

The remaining chapters include methods of studying vegetation, the plant formation, aggregation and migration, competition and ecesis, invasion and succession, alternation and succession. Even in these chapters some experimental work is suggested, so that the student will not depend wholly upon observation and camera-pictures for his conclusions! It is safe to say that the student who learns his ecology in the way it is presented in this book will not do as much guessing at his facts, and drawing of inferences from landscape photographs, as has been the habit of some of the "ecologists" of the immediate past.

Charles E. Bessey
The University of Nebraska

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Comparative Neurology and Psychology for September contains two articles on animal behavior. Dr. C. H. Turner writes on "The Homing of Ants: An Experimental Study of Ant Behavior," concluding from an extensive series of field and laboratory experiments that ants find their way to and from the nest neither by tropisms nor by a homing instinct, but that they learn their way by experience. The elements which enter into this experience were subjected to experimental analysis. The second paper is by Dr. E. H. Harper, on "The Behavior of the Phantom Larvæ of *Corethra plumicornis* Fabricius." These larvæ have a very characteristic mode of locomotion in the water. They conform neither to the conventional mode of orientation laid down in the tropism scheme nor to the trial and error type of reaction, but rather to a unique type of reaction system of the larva.

The last number of *Symons's Meteorological Magazine* contains the following note: "The five hundredth number of *Symons's Meteorological Magazine* is now before our readers, a fact of no little interest when the smallness of the public to which such a journal appeals is taken into account. When Mr. Symons produced No. 1 in February, 1866, he had already issued a "monthly rain circular," as a supplement to "British Rainfall" for several years, so that a greater antiquity might plausibly be claimed for the magazine than the numeral implies. The magazine, though small, has grown, and is not, we trust, incapable of further growth without departing from the original lines on which it was planned. As an independent organ of opinion in meteorological matters, it has, we believe, been of use in the past, and we hope that this usefulness will continue. We heartily thank the many friends who have helped us hitherto, and we look forward with confidence to a wider circle of readers.

DISCUSSION AND CORRESPONDENCE

THE PARASITISM OF NEOCOSMOSPORA

In Science for September 13, 1907, Dr. Erwin F. Smith, of the Bureau of Plant Industry, U. S. Department of Agriculture, makes certain criticisms on work which the writer published some time ago in a bulletin of the Missouri Agricultural Experiment Station and in a note in Science.

My purpose in writing the papers mentioned was to record in permanent form observations which I had made in course of a study of the ginseng fungus. I submitted some conclusions which it seemed proper to draw, because there has been more or less disagreement on the parasitism of these fungi among mycologists.

Dr. Smith seems to think that the ginseng fungus is not identical with the watermelon fungus, although he himself does not appear to have done any work upon it. I am perfectly willing to admit that the two fungi may not prove to be identical, and will bear no personal ill will to any one who may establish the facts. There are, however, certain points in the communication mentioned on which a few words may be said at this time.

He doubts my identification of the ginseng fungus and criticizes me for not making "any comparative study of the two fungi, although it would have been easy" to obtain the melon fungus. I think that the following letter gives *one* very good reason why I was unable to compare the ginseng fungus with the wilt fungus he studied.

U. S DEPARTMENT OF AGRICULTURE,
Bureau of Plant Industry
Vegetable Pathological and Physiological Investigations
Laboratory of Plant Pathology.

WASHINGTON, D. C., Jan. 31, 1905

MR. HOWARD S. REED,
University of Missouri,
Columbia, Missouri

Dear Sir: In looking over my snowed-under desk yesterday I found your letter of October 27, and am very much afraid it was unanswered. I regret to say that I have no cultures of the fungus which you wish, to wit, *Neocosmospora*, described in Bulletin 17 of the Div. of Veg. Phys. and Path. I have not worked at all on the disease now for a long time and allowed all the cultures to die. It would really take all of one person's time, and perhaps rather more, to keep going in good condition cultures of all the things that we work with, and it occasionally happens that one or another dies, or is lost for the time. If I come across it again, I will try to keep in mind that you wish a culture.

Yours very truly,
(Sig.) ERWIN F. SMITH,
In Charge of Laboratory of Plant Pathology

The fact that I did not find perithecia seems to impel a particularly sharp shaft of criticism at me. In this connection the reader will permit me to refer to the bulletin written by Dr. Smith, mentioned in the foregoing letter (p. 10).

. . . the conidial stage of the watermelon fungus (spore taken in July from the interior of a vessel) has been cultivated for five years on a great variety of media, including potato, without showing a trace of perithecia, although from time to time special efforts were made to find a substratum which would lead to the production of perithecia. This is the strain of fungus which has proved so actively parasitic in the hands of the writer.

He states again (p. 11):

No perithecia ever developed in any of the cultures made from internal or external conidia taken from the cotton or watermelon.

Having only the conidial stages to start with, it is not surprising that I did not obtain the perithecial stages.

In his haste to criticize my work he appears to have fallen into the same grievous heresy of which he accuses me. From what I said concerning the parasitism of *one* species of the form-genus *Fusarium,* he recklessly gained the impression that I had made sweeping statements concerning the parasitism of that entire genus. If he will take the trouble of again reading my note in SCIENCE[1] he will find that the closing sentence *especially restricts* my statements concerning weak parasitism to the form I isolated from the ginseng plant. After carefully reexamining the text of the bulletin and also the note, I find nothing which conveys the impressions which he has apparently gained. This seems to be an "unwarranted inference" in his "course in logic."

It is a matter of no little satisfaction that in this last communication he has reported the outcome of inoculation experiments by a colleague in which sterile soil was used. In his earlier work he used "good earth" but does not appear to have taken the very important precaution of excluding all other organisms from the soil. Considering the prevalence of other soil fungi, it is surprising that he should have neglected to insure

[1] Vol. XXIII., p. 751.

sterile conditions in his own work, and this was the point on which I based certain criticisms in the publication cited. It seems to me that this is the kind of work Dr. Smith "should have done and not left for some one else to do." Howard S. Reed

September 20, 1907

AN OFFICIAL LETTER ON "TEMPERANCE PHYSIOLOGIES"

The circular letter below was recently received by certain publishing firms in New York City. While it was intended for the *guidance* of publishers, it will certainly be suggestive to educators who are interested in freedom in science teaching. Some comment follows the letter.

Dear Sirs:

It is probably well known to you that the National Woman's Christian Temperance Union, through the department of Scientific Temperance Instruction, Mrs. Mary H. Hunt, former superintendent, has been active in securing the publication of good school physiologies and their introduction into the schools, and that heretofore satisfactory books have borne the printed announcement that they had been endorsed, such endorsement being signed by Mrs. Mary H. Hunt, or by some member of the Advisory Board as appointee of the National W. C. T. U.

You are also probably aware of the fact that Mrs. Hunt and the W. C. T. U. have been repeatedly accused of receiving royalties on "endorsed" physiologies. Having been assured by Mrs. Hunt that no such royalties were received by her, we have for years unhesitatingly and unreservedly denied that any royalties were received by the W. C. T. U. or by any representative of the organization. If any one has received any royalties on endorsed physiologies, such receipt of monies was wholly unauthorized by the W. C. T. U., was positively against its policy, and was never reported to the W. C. T. U.

Since the death of Mrs. Hunt our organization has considered very carefully the present situation and has decided upon the following policy:

1. The National W. C. T. U. will continue to encourage the publication of new series of physiologies to replace weak or old series now in use, and urgently requests that all good series be revised frequently, that they may be kept up to date in all scientific and pedagogical points.

2. We shall encourage the direct relation of authors and publishers, exerting our influence to help publishers to find thoroughly competent authors and to help such authors to find good publishers.

3. We shall request publishers of school physiologies to publish a note in the preface of each book giving the name of some well-known specialist in physiology who has approved the book as to its scientific accuracy, especially concerning the latest deductions of science on the alcohol question, and that of some well-known educator who has approved the book as to its pedagogy.

Our world's and national superintendent of the Department of Scientific Temperance Instruction in Schools and Colleges and director of the Bureau of Scientific Temperance Investigation is Mrs. Edith Smith Davis, 2913 Brown St., Milwaukee, Wisconsin, a woman admirably fitted to lead this great department of our work. Mrs. Davis will have associated with her a number of well-known men in the scientific and educational world as counsellors of the department. Any scientists or educators acceptable to Mrs. Davis and her counsellors whose endorsement you may secure for your books will ensure the hearty cooperation of the National W. C. T. U. in the circulation of said books. Any physiology which fails to meet a high and satisfactory standard on the question of the effect of alcohol and narcotics on the human system will be publicly disapproved by the National W. C. T. U. and our local unions over the entire country will work against the introduction of such books into the schools.

We shall show no partiality between publishers of satisfactory text-books and will continue to do all we can to secure the teaching of physiology and hygiene in the schools, and to secure the introduction of good books.

Yours for the presentation of unbiased truth, on behalf of the General Officers of the National W. C. T. U.

This letter was signed by the president and secretary of the National W. C. T. U.

The letter has the following interesting points:

1. The question of royalties said to have been received is one of minor importance to scientific educators. Certainly no one ever believed that the W. C. T. U. as an organization could ever have descended to vote approval for accepting "royalties."

2. Scientific teachers are glad to know that publishers will be "encouraged to replace weak

or old books"; but they must wonder what society is charged with the duty of "encouraging" publishers to keep other books up to date. Should we not have a society expressly devoted to the stimulation of lazy authors and especially publishers? Any readers of the weekly lists of new books and new editions will readily see that the easy-going New York publishers need to be reminded that they must keep their books "up to date in all scientific and pedagogical points." Those of us who are interested in physiology and hygiene for schools are so altruistic that we want somebody to "encourage" the authors and publishers to keep other kinds of books up to date.

3. The note of approval by "some well-known specialist in physiology and some well-known educator" is a vast improvement over the former "endorsement" by a committee among whose members there were no well-known specialists in physiology or education. At first the change looks hopeful, for many books published with the old endorsement would never be approved by any well-known specialist in physiology who was also an expert in public school education. But any hopes of a new order of things which may be raised by paragraph 3 in the letter above are dissipated by the next paragraph, in which publishers are definitely informed that "any scientists or educators acceptable to Mrs. Davis and her counsellors" may be considered "well-known specialists in physiology" competent to write an approving preface for new text-books. This *may* work satisfactorily in practise; but before becoming too optimistic we want to see the list of specialists who might be "acceptable" to Mrs. Davis. How many members of the American Society of Physiologists, the American Society of Zoologists, and the American Society of Naturalists will be on the "acceptable" list, unless they first pledge themselves to views also "acceptable"? Will members of these societies be able without special instructions to judge concerning the "high and satisfactory standard" so that publishers may be sure of avoiding the financial loss and prestige which will follow "public disapproval"? It seems clear that publishers must make some careful diplomatic moves before they venture to print a manuscript under the advice of "well-known specialists in physiology." They may save themselves a lot of trouble by first getting a list of the "acceptable" men of science of the first rank. It can not be long enough to be cumbersome for office use.

The letter above is worth reading carefully. It indicates that the old order of things in "temperance physiology" still attempts to continue. Probably most readers of this journal believe in "presentation of the unbiased truth" concerning alcohol and narcotics and as teachers would insist upon having books which tell the essential truth so far as it has been demonstrated; but few indeed must be the readers who do not recognize the brazen effrontery of the letter above. Between the lines it reads that our well-known specialists in physiology and our educators are such incompetents that their books and even their written approval of books by others must not be published before they have been adjudged sane, satisfactory and acceptable. Truly this is an interesting footnote to the most astounding chapter in the history of American education.

M. A. Bigelow

Teachers College,
Columbia University

THE TYPES OF THE NORTH AMERICAN GENERA OF BIRDS[1]

Much of the chaos in generic nomenclature which has become intolerable to the systematist of to-day has been brought about by the failure of many writers to explain by what process they have determined the types of old polytypic genera. Had they been more explicit upon this subject we should have been able long ago to see the weaknesses in our codes and should have abandoned methods which were neither definite nor final in their operations.

The recent paper by Dr. J. A. Allen on the "Types of the North American Genera of

[1] *Bulletin American Museum Natural History*, Vol. XXIII., Article XVI., pp. 279–384, April, 1907.

Birds" is therefore especially welcome, as it throws a flood of light upon a hitherto obscure subject and shows us the possibilities of the various methods of determining genotypes. The presentation in concise form of the original basis upon which each genus was erected will be exceedingly useful to the systematic ornithologist, but Dr. Allen's conclusions with regard to the types of many of the older polytypic genera will hardly be accepted since he has not followed any one method consistently in his determinations; and consistency is absolutely essential in work of this sort. He tells us that "from the standpoint of elimination" his results agree with those given in the A. O. U. check list in all but four instances.

A careful study of his text, however, shows that he uses "elimination" in a surprisingly broad sense and that his types are really variously determined by "elimination"; "subsequent designation"; "general consent," and "restriction." Any one of which used throughout would have materially increased the number of changes necessary in the check list. Frequently two methods are applied to the same case with different results and Dr. Allen accepts one method in one instance and another in the next.

For example,

Pelecanus, p. 301.

Type designated by Gray, 1840—*onocrotalus*.

Type by elimination—*aquila*.

Conurus, p. 335.

Type designated by Gray, 1841—*leucophthalmus*.

Type by elimination—*carolinensis*.

Gray's designation is accepted by Dr. Allen in the first instance and elimination in the second, and, in both, his types agree with the check list. Obviously such choice is unwarranted; one method or the other must be used throughout.

In other cases only one method is mentioned while another method would give a different result, viz.:

Passerina, p. 357.

Type by elimination—*nivalis*.

Alca, p. 293.

Type by elimination—*torda*.

In both these cases Gray designated other species as type in 1840, but his designations so frequently accepted by Dr. Allen in preference to elimination are here completely ignored.

Many of Dr. Allen's eliminations, moreover, would yield entirely different results, were all the involved genera considered. For example:

glacialis, given as the type of *Fulmarus* by elimination, was removed from that genus as the type of *Rhantistes*, 1829, and

garrulus, given as type of *Ampelis* by elimination, was removed as the type of *Bombycivora*, 1815.

And so in many other cases critical genera are omitted from consideration.

The recent action of the American Ornithologists' Union and the Nomenclature Commission of the International Zoological Congress in repudiating the elimination method has probably forever removed this "bone of contention" from consideration.

There are left, as stated recently by President Jordan, two methods of type fixing, either of which will yield definite and final results—the first species rule and type by subsequent designation. By either method some fourteen changes will have to be made in the genera and subgenera of the A. O. U. check list, and in determining just what they are Dr. Allen's paper will be a valuable aid.

In this connection and with the idea of increasing its usefulness it seems desirable to call attention to some errors in quotation, etc.—inevitable in a work of this scope. The type of *Daption* will be found to be designated in the original publication, while that of *Thalassens* designated by Gray in 1840 was *cantiaca*, not *caspia*. Gray, moreover, did not designate a type for *Herodias* in 1840, and in 1841 selected *garzetta*, not *egretta*. The type of *Anous* which he selected in 1840 was not *Sterna niger* Stephens (= *S. stolida* L.) but *S. nigra* Linn. (= *Hydrochelidon nigra*). The genera *Dendragapus*, *Hydranassa* and *Cistothorus* are polytypic, not monotypic, as indicated.

Dr. Allen gives 415 instead of 435 as the number of genera and subgenera in the check list, but this is evidently a pure *lapsus,* as only eleven are omitted in his paper, viz., *Endomychura, Cymochorea, Phœbastria, Palassicarbo, Rhyacophilus, Uranomitra, Burrica, Chelidonaria, Pachysylvia, Myiobius* and *Neocorys.*

Witmer Stone

SPECIAL ARTICLES

SOME OLD-WORLD TYPES OF INSECTS IN THE MIOCENE OF COLORADO

The work of the past summer at Florissant has yielded us a large collection of fossils from the Miocene shales. Most of the material awaits examination; but a few things of unusual interest have been examined, and these have been found to include some forms allied rather to those of the Old World than to those now inhabiting this continent. A brief notice of these is now given. The specimens themselves were exhibited at the recent Zoological Congress in Boston.

DIPTERA

Glossina oligocena (Scudder)

A very good specimen, found at Station 14 by Mr. Geo. N. Rohwer. The mouth-parts are preserved, as also the body, wings and legs, all agreeing so well with the modern tsetse flies that generic separation is impracticable. The genus *Glossina* is to-day confined to Africa, and although placed by Austen in the Muscidæ, is a very peculiar type, better regarded as belonging to a distinct family Glossinidæ. The fossil species is not new, but was described by Scudder as *Palæstrus oligocenus* in 1892,—a supposed new genus of Œstridæ. Scudder's type, which has been compared with the new specimen, lacked the head and other important parts, otherwise its true position would certainly have been recognized.

The former existence of a tsetse fly in America is of particular interest as having a possible connection with the disappearance of some of the Tertiary Mammalia, as Professor Osborn had suggested.

HYMENOPTERA

Perga coloradensis sp. nov.

A good specimen from Station 14 (W. P. Cockerell). A large sawfly, about 27 mm. long and very robust; referable to the Australian genus *Perga,* and similar to *P. schiodtii* Westwood, from New South Wales, but larger, the antennæ longer and with a larger club (length of club, 3 mm.), stigma much more slender, virtually rudimentary, an interval of more than 1 mm. between the basal and cubital nervures at their place of approximation, and the scutellum and prothorax dark like the rest of the thorax. The anterior wing is 20 mm. long, and the basal nervure meets the transverso-medial. Konow makes the tribe Syzygoniides to include two Australian genera (with thirty-seven species between them) and two Brazilian genera (with three species between them). The fossil is clearly of the Australian, not the Brazilian, type, suggesting that the route of migration was a northern one, *via* Asia.

NEUROPTERA

Halter americana sp. nov.

A wonderfully preserved example with the wings spread, from Station 13 B (S. A. Rohwer). The anterior wings are clear hyaline, 31 mm. long, with the venation as usual in the genus; hind wings (as in all the Nemopteridæ, to which family it belongs) very long and narrow, length 46 mm., with an apical fiddle-shaped expansion, which is dark colored. The Nemopteridæ are to-day confined to the Old World, except a single species of *Stenorrhachus* found in Chile. The Florissant insect is not of the Chilian genus, but belongs to that section of *Halter* which includes the Persian *H. extensa* (Oliv.). In *H. extensa* the black area of the hind wings is broken into two, whereas in the fossil it is solid and continuous. The persistence of such an extremely peculiar type through such a long time and such migrations indicates a remarkable degree of stability.

Panorpa arctiiformis sp. nov.

Station 14 (W. P. Cockerell). A spotted species, looking like an Arctiid moth; wings about 13 mm. long. Close to *P. rigida* Scudder, already described from Florissant, but larger, with the third band (the last before the dark apex) much broader. Among the living species, it resembles *P. nuptialis,* Gerst., from Texas, and *P. picta,* Hagen, from Smyrna; but it is closer to the latter. In *nuptialis* the inner edge of the apical black area is straight, but in *picta* it is zigzag; in the fossil *arctiiformis* it is as in *picta*.

One of the new plants obtained this year in the Florissant Miocene is of interest in the same connection. It is *Heyderia coloradensis* sp. nov., an incense cedar very closely allied to the living *H. decurrens* (Torrey) K. Koch, of California. The larger leaves are about 5½ mm. long, perhaps less acutely pointed than in the living plant, but in arrangement and general structure quite the same. I follow Dr. N. L. Britton in separating *Heyderia* from the *Libocedrus* of the southern hemisphere; the genus contains two living species, one in California, the other Asiatic. Our fossil agrees very closely with a specimen in the herbarium of the New York Botanical Garden which was collected by Torrey in 1865 in the grove of *Sequoia gigantea* in California. As showing the persistence of a "plant association," it is interesting to note that the fossil species also grew by or under *Sequoia* trees, as is proved by a fragment of *Sequoia haydeni* on the same piece of shale, touching the *Heyderia*. *Sequoia haydeni,* the Florissant redwood, is the *Hypnum haydeni* of Lesquereux, a fragment of it having been originally described as a moss!

T. D. A. Cockerell
University of Colorado,
Boulder, Colorado,
September 1, 1907

CENSUS OF FOUR SQUARE FEET

The approximate numbers of the fruits and seeds, the insects and other invertebrates present on a given area are data for which the student of economic problems has frequent need. It is important, therefore, to have a more accurate conception of the abundance of these items than is derivable from offhand estimates. The present paper is offered as a contribution to the knowledge of this subject, with the explanation that the results herein detailed are not held applicable to any classes of surface other than those examined, nor to any region but that of Washington, where the collections were made. However, it is probable they safely may be used as a basis for reasonable analogies with respect to other localities.

Pausing to note only that the investigation was undertaken primarily because of its relation to the study of bird food, the method used was as follows: areas, two by two feet, of forest floor and of grassy meadow, were examined in November and March, respectively. Everything on the surface of these plots and the ground itself, to the depth a bird easily can scratch, was removed and all plant and animal objects of classes known to be used as food by birds were counted. The following were obtained from the four square feet in the woods: Coleoptera 12, Hemiptera 7, Hymenoptera 8, spiders 11, other Arthropods 26, Annelids 9, Gasteropods 11, cocoons and insect eggs 27, or altogether 112 animal items; in addition there were 194 seeds and fruits. Assuming, as we may in perfect justice, that the plot in question was in no way exceptional, the analysis indicates that on the average there are present on each acre of forest floor in this locality 1,216,880 animals of the kinds above specified and 2,107,810 fruits and seeds.

From the four square feet of meadow there were collected: Coleoptera 61, Hemiptera 20, Hymenoptera 940, spiders 53, other Arthropods 127, Annelids 33, Gasteropods 20, cocoons and eggs 20, or altogether 1,254 animal objects; there were also 3,113 seeds. The averages per acre for meadows, therefore, are: Animals, 13,654,710, and seeds, 33,822,745. On first thought these estimates seem incredible. Hence in order to show that they are the result of the summing up of numbers, individually so small, that no one would question them, I present the following complete lists[1] of the living invertebrates and seeds from each area.

WOODS: Invertebrates: *Chilopoda* 7; *Oligochæta* 9; *Thysanura* (including 1 *Japyx* sp.) 15; *Homoptera* (*Gypona* sp.) 2; *Heteroptera* (*Euschistus fissilis* 2, *E. tristigmus* 1, *Cryphula parallelogramma* 1, *Rhyparochromus* n. sp. 1) 5; *Coleop-*

[1] For the greater part of the identifications of insects the writer is indebted to Messrs. E. A. Schwarz, O. N. Heidemann and Nathan Banks.

tera (*Arthmius globicollis* 6, *Ctenistes piceus* 2, *Sunius prolixus* 1, *Glyphonyx recticollis* 1, *Telephorus* sp. (larva) 1, *Odontota* n. sp. 1) 12; *Lepidoptera* (caterpillars) 2; *Hymenoptera* (*Ponera pennsylvanica* 1, *Aphænogaster aqua* 1, *Lasius americanus* 6) 8; *Pseudoscorpionida* 1; *Araneida* (*Xysticus transversus* 1, *Ceratinella emertoni* 1, *Anyphæna saltabunda* 1, *Oribata angusticeps* 1, *Philodromus ornatus* 1, *Synemosyna formica* 1, *Ceratinopsis interpres* 1, *Chthonius pennsylvanicus* 1, *Fuentes vittata* 1, *Lycosa pratensis* 1, *Theridula sphærula* 1) 11; *Acarida* 1; *Gastropoda* 11. Total, 85. Cocoons and Eggs: *Orthoptera* (eggs of *Diapheromera femorata*) 2; *Lepidoptera* (cocoons) 6; *Diptera* (Pupariæ) 6; *Araneida* (egg sacs) 4; unidentified: 3 eggs; 4 cocoons. Total, 27. Grand total, invertebrates, cocoons and eggs, 112. Seeds: *Juniperus virginiana* 9; *Panicum* sp. 89; *Carex* sp. 1; *Quercus* sp. 2; *Liriodendron tulipifera* 57; *Rubus* sp. 7; *Chamæcrista fascicularis* 6; *Trifolium repens* 4; other Leguminosæ 17; *Viola* sp. 2; *Cornus florida* 1. Total, 194.

MEADOW: Invertebrates: *Chilopoda* 4; *Oligochæta* 33; *Thysanura* 102; *Homoptera* (*Liburnia* sp. 4, *Agallia 4-maculata* 8, *Tettigoniidæ* 3, *Goniognathus palmeri* 1) 16; *Heteroptera* (*Corimelæna atra* 3, *Capsidæ* 1) 4; *Coleoptera* (*Pterostichus lucublandus* 2, *Stenolophus conjunctus* 1, *Cryptobium pallipes* 1, *Scopæus opacus* 11, *Stilicus rudis* 1, *Erchomus læviusculus* 5, *Falagria venustus* 1, *Apocellus sphæricollis* 6, *Euæsthethus americanus* 1, *Philonthus thoracicus* 2, *Tachyporus jocosus* 1, *Diochus schaumii* 6, *Mycetoporus flavicollis* 2, *Trichopteryx haldemani* 6, *Melanophthalma americana* 2, Lampyridæ (larva) 1, Elateridæ (larvæ) 3, *Tomoderus constrictus* 7, *Sitones hispidulus* 1, (unidentified larva 1) 61; *Lepidoptera* (caterpillars) 6; *Hymenoptera* (*Tetramorium cæspitum* 933, *Lasius* sp. 2, *Formica* sp. 1, *Chalcididæ* 4) 940; *Araneida* 53; *Acarida* 15; *Gastropoda* 20. Total, 1,254. Cocoons and Eggs: *Heteroptera* (Pentatomid eggs) 2; *Orthoptera* (grasshopper eggs) 4; other insect eggs 2; unidentified pupa cases 12. Total, 20. Grand total, invertebrates, cocoons and eggs, 1,374. Seeds: *Andropogon* sp. 46; *Panicum* sp. 39; *Chætochloa viridis* 138; *Eragrostis* sp. 8; *Eulalia zebrina* and other grass seed 2,783; *Allium vineale* (bulblets) 3; *Rumex obtusifolius* 2; *Amaranthus* sp. 4; *Portulaca oleracea* 1; *Pyrus* sp. 1; *Chamæcrista nictitans* 5; *Trifolium repens* 3; *T. pratense* 1; *T.* sp. (sprouting) 18; *Robinia pseudacacia* 6; *Vicia* sp. 1; *Euphorbia maculata* 4; *Vitis* sp. 1; *Verbena urticæfolia* 3; *Paulownia tomentosa* 1; *Ambrosia artemisiæfolia* 1, *Bidens bipinnata* 40; *Sonchus asper* 1; unidentified 3. Total, 3,113.

The most interesting point about the estimates, for the woods and the meadows, aside from their astounding magnitude (contrasted to previous figures based wholly on hypothetical grounds), is the wide discrepancy between them. The population of the meadow is so much more dense than that of the woods. Weighing the items separately, it is easily seen which contribute most largely to the discrepancy. Of the very great number of Hymenoptera (940) found in the pasture, 933 were of one species of ant (the cosmopolitan *Tetramorium cæspitum*). Yet there was no ant colony on the plot; hence direct evidence is lacking that the number found is exceptional. Only 8 ants, however, were found in the forest. Further, the meadow yielded 102 spring tails to 15 in the woods where the decaying leaf mold seems the optimum home. Turning to seeds, it must be admitted that 2,716 of the 3,113 seeds found in the meadow were of a single gramineous species, but this hardly can be termed extraordinary since an abundance of grass seeds must be expected in a meadow. However, to be entirely on the safe side let us subtract these strongly contrasting elements from the totals above stated. Still there remain 397 seeds and 239 animals for the meadow plot, an average of more than double the number secured in the woods.

This result is in harmony with many of the conspicuous phenomena of sylvan and campestran life. Witness the variety and copiousness of the vegetation of roadsides and meadows; their wide expanse of flowers attracts a humming swarm of insects. Enter the deep forest, comparative monotony attends and 'tis quiet as the tomb. As one progresses through the more open woods to the meadows again, step by step, variety and number increase. In no respect are phenomena of this sort better exemplified than in the relative density of the bird population. It is a matter of repeated observation that birds are more abundant in open country, but it has remained for Professor S. A. Forbes first to give the matter definite expression founded on careful investigation. In his valuable paper of April, 1907, "An Ornithological Cross Section of Illinois in Autumn," the account of a trans-state survey in which 4,804 birds were counted, it is stated that the number of birds per square mile of woods was 785, and in pastures 1,551. While a mere coincidence, yet it is of interest that these figures bear the same relation to each other as do the numbers of the principal food elements.

Another point of interest in connection with the close investigation of the surface fauna relates to dead insects. Insects number so many, that even if we admit, as we do in the case of other animals, the death of each is a tragedy, it stands to reason that this tragedy can not in every case be enacted by captor and prey. Many must die of other causes and simply fall to the ground. What becomes of them? Some are eaten by sarcophagous insects, but are any to be found? The question was raised in the writer's mind by the finding of some suspiciously old and apparently weathered fragments of insects in bird stomachs (segments of Millipeds in the mourning dove, a practically entirely vegetarian species, and of adult June bugs in winter stomachs of some other birds). Were not these possibly picked up as fragments? It is now the writer's opinion that this is more than possible.

At any rate there is no lack of dead insects to be picked up by any bird desiring them. On the plot of forest floor were found nine dead invertebrates entire, and the fragmentary remains of 36. Fewer of such remains were found in the meadow, perhaps because the multitude of ants disposed of a large proportion of them. But even here there were 8 intact bodies and 14 broken. On the basis of these figures there are tangible remains of 240,030 departed insects on each acre of meadow and 488,925 on each acre of woods. Of both the living and the dead there are a host, but the dead of ages reduced to dust are insignificant beside the living of a single season.

W. L. McAtee

QUOTATIONS

AGRICULTURAL EDUCATION

To one very important condition of success both advocates and opponents of *la petite culture* in England pay, we suspect, too little regard—namely, the improvement of agricultural education, for the heads as well as for the rank and file of the industry. In too many of our country districts it is hardly yet realized that education is necessary at all. Landowner and tenant-farmer are alike disposed to lay blame for the rural exodus on such education as is given to the laboring classes—an education which, it may be admitted, has not always been best adapted to fit them for a country life and pursuits. But they forget that education is, after all, but an incident of the great social and economic changes that have come over English life in the past half century; and that, if all our elementary schools could be restricted to-morrow to teaching "the three R's" and all boys sent out to farm work at ten or eleven years of age, there would still remain the daily newspaper, the bicycle, and the excursion train to give the laborer that wide outlook and "progressive desire" which is what really draws him away from the land. So far from there being, as Squire Oldacre and Farmer Hodge are apt to think, too much education already, what is needed is much more of it, but of a different kind; education in the elementary school that will bear directly on country life and inspire some taste for it; education continued afterwards in evening schools or technical instruction classes to widen the knowledge and sharpen the wits of those who are to cultivate the soil, and to instil into them at least the beginnings of scientific method. The day of rule-of-thumb is over, in agricultural as in other industries; the day of science—that is, of trained and organized knowledge—has begun, and the nation or class that despises it must fall behind. It is not undue treatment in freight charges, or unpatriotic preference for foreign goods, that enables the small Danish butter-farmer, for instance, to undersell the Englishman on his own markets, but superior education and scientific method applied to the organization of his industry; and we may be sure of this, that it will be useless to keep a man on the land, or to bring him back to it, by the inducement of ownership or any other attraction, unless we can educate him to do the best for himself and for the land, in an age which calls for cultivated intelligence and scientific method.—The London *Times.*

CURRENT NOTES ON LAND FORMS

RELATION OF VALLEYS TO JOINTS

There have been various articles published on the relation of drainage lines to joints, involving a problem of which the gorge of the Minnehaha below its falls may be taken as an example. It is sometimes pointed out that the course of this gorge has been determined by the arrangement of the joints in the horizontal rock series through which the gorge has been cut. There can be little question that the process of weathering has taken advantage of the joints in the widening of the gorge, and that its walls exhibit joint faces more or less frequently; but it is also evident that the gorge has been cut backward along the course that the stream had on the drift cover up-stream from the falls; and that the relation of the gorge to the joints is therefore one of accidental superposition, and not of submissive guidance.

On the other hand, it is often plain that a group of master joints may guide the development of a new (subsequent) branch stream which grows by headward erosion in the bare walls of a young valley; for in such cases there is no stream falling into the valley from the upland above. Subsequent streams of this origin may be common in some districts; but if they pass into maturity, they will probably wander on their flood plains so as to depart more or less from the guiding joints beneath the valley floor; and if afterwards rejuvenated by elevation, it is eminently possible that they may stray away from the joints that originally led them. The chance of such straying will increase with the lateness of the stage at which the first cycle of erosion is interrupted by rejuvenating elevation.

VALLEYS OF SOUTHWESTERN WISCONSIN

E. C. Harder presents a discussion of part of this problem in a thesis entitled "The joint system in the rocks of southwestern Wisconsin and its relation to the drainage network" (Bull. Univ. Wisc., no. 138; Science series, iii., 1906, 207–246). He first determined by numerous observations the dominant joint directions in a certain part of the Wisconsin driftless area; he next determined, apparently from maps, the dominant stream directions of the same district. Then he compared these two sets of dominant directions, independently determined, and finds that "the prominent directions of jointing correspond with the prominent drainage directions" (p. 232). "Many other forces [than joints] may have been present to modify the result," but their influence is thought to have been small (p. 234). Further investigation is looked to for additional results.

In all cases of this kind, in which the more or less precise coincidence in the directions of a large number of lines is the chief guide to the conclusion, several critical questions arise. First, what are the limits of error in the determination of the measured directions, and what are the limits of discordance in cases that are classed as coincidences? Second, what are the possibilities of coincidence by chance instead of by causal relation? Third, is the conclusion that a causal relation exists between the two sets of lines whose directions coincide, supported by independent evidence that the supposed cause can produce the inferred effect? Fourth, are other causes shown to be inoperative?

Joint directions are determinable easily within small limits of error; but stream directions are much less easily determined, because stream lines are as a rule so irregularly curved. Moreover the curved streams of the mature valleys of driftless southwestern Wisconsin demonstrably depart to-day from their earlier courses to a greater or less extent; and it is therefore not clear whether the present or the earlier courses are to be regarded as joint controlled. Some close analysis, with a quantitative statement as to the percentage of total stream length that is reducible to definite directions and with a statement of the amount in tabulating the measures, is here much needed. A quantitative discussion of coincidence is also desirable.

On the second point, there is opportunity for a mathematical discussion of the theory of chances, for there may, of course, be a considerable number of accidental agreements in two sets of directions such as are here considered. On the third point, it is only reasonable to ask that joints should be shown competent to determine the direction of the drainage lines under consideration, for if they possess no such competence, then all the coincidences of direction would have to be attributed to chance. The problem here appears to be briefly as follows: Given an ancient land area, subject to normal processes of erosion in many successive (incomplete) cycles of erosion; in what way can the originally consequent drainage be influenced by underground joints? It can hardly be supposed that the joints were at the beginning of such power as to have determined the course of the original drainage—that would be possible only if they were gaping fissures or faults. The original drainage was presumably consequent on the original slopes and inequalities of the land surface. As to streams of later development, it is possibly the case that in a district of resistant rocks, rapidly given great altitude, the headward growth of subsequent streams along joints in the walls of the consequent stream valleys might in time replace the minor consequents; but we have at present no sufficient inductive basis for such a conclusion; perhaps the case brought forward by Iddings may be of this kind, but there the argument of coincidence has not been supplemented by any argument of competence. On the other hand, a region of relatively weak rocks, slowly elevated to a moderate altitude—and this is a supposition appropriate to the Wisconsin district under consideration—the opportunity for the growth of subsequent streams along joint lines would be very poor; the valley sides would usually be cloaked with waste, so that the capacity of the joints to guide the development of new streams would be small as compared with the capacity of the existing streams to persist in their courses. There remains the possible tendency of streams to change their courses by lateral shifting so as to come into relation with underground joint systems; but on this point we have little information. Finally there is the possibility of other causes than joints for stream directions in the district studied. Some other causes certainly have operated in some instances, for there are various streams indicated on Harder's maps, unrelated to neighboring joint directions (for example, Underwoods creek, near Avoca, Pl. III.). In this connection there should be a critical examination of the stage of development of each stream; for while a stream in a vertical-walled gorge might well be closely related to a joint system, it is quite otherwise with a stream that is swinging on the flood plain of an incised meandering valley. Streams of the latter class appear to occur not infrequently in the district studied, but no special mention is made of them in the text: surely the coincidence of an intermeander tangent with a joint direction can mean little; for the tangent has in all probability changed its direction and its location during incision, and these changes have been almost inevitably controlled by the changes in the adjacent meanders rather than by underground joints.

In all these respects additional study is needed before demonstration can be reached. The fact of frequent coincidences, if well attested, is therefore a good first step in an inquiry which we hope Harder may continue to follow.

BLOCK MOUNTAINS IN NEW ZEALAND

The south-central part of the southern island of New Zealand possesses a group of block mountains, "probably not less remarkable than the ranges of the Great Basin between the Sierra Nevada and the Wasatch," of which a brief description is given by J. Parks, professor of mining in the University of Otago ("The Geology of the Area covered by the Alexandra Sheet, Central Otago Division," N. Z. Geol. Survey, Bull. 2, N. S., 1906). The older rocks of the district are chiefly deformed mica schists. They have been reduced to a peneplain, which is now uplifted and scored in its seaward portion by deep, narrow valleys. Farther inland, the peneplain has been broken into a number of sub-parallel blocks, of which the higher ones form mountain ranges, generally trending northeast-southwest, and reaching from 5,000 to 6,000 feet altitude; while the relatively depressed blocks are buried under heavy basin deposits of lacustrine, fluviatile and glacial origin. The ranges are not forested and expose a large amount of bare rock; they are as a rule flat topped; "the skyline of the Hawkduns for a distance of twenty miles appears as even as the ridge of a house"; they have no lateral spurs or foothills, but descend to an almost straight base line. The basin deposits have been more or less terraced and dissected. A rough cross-profile suggests that some of the heaved blocks are bounded by faults on both sides, and that, though retaining old forms on their flat uplands, they have lost much of their edges by new erosion.

The few pages from which the above statements are gleaned are only incidental to the chapters on geological and economic problems to which the body of the report is devoted; the student of physiography must, however, be grateful if he gets even so much as these few pages from a professor of mining, whose first responsibilities are elsewhere directed. Yet is it not probable that, if a well-systematized plan for the physiographic description of block mountains were in general use among geographers, there would not so often be occasion to regret that significant physiographic features are passed over without mention in a geological report? To illustrate: When a comet is discovered, it is customary for astronomers to secure at once certain previously planned observations, according to a standardized method; and from these observations the elements of the comet's orbit are promptly calculated according to an accepted scheme. As a result, the chief items which astronomers have come to agree upon as essential regarding comets are immediately determined and placed on record. No such standardized method of procedure is yet adopted by geographers, still less by explorers; and as a result it is largely a matter of chance whether the description of a new member of an already known class of land forms—block mountains, for example—will include its essential elements or not. In a case of the kind above cited, the most important elements would probably be: the general structure of the region, briefly stated at first, with details added later when needed; the stage of erosion that the region had reached when block-faulting took place; the relation of the fault lines to the preexistent structural lines and topographical features; the number and attitude of the heaved and of the thrown blocks; systematic account of the main drainage lines, sufficient to show whether they persist from the previous cycle as antecedent streams in spite of the adverse faulting, whether they are revived into new activity by favoring deformation, whether they are of a new generation consequent upon the slope of the tilted or faulted faces of the displaced blocks, or whether they are developed as subsequent streams by headward erosion along newly exposed weak structures; definite indication of the stage reached in the work of erosion by the several kinds of streams on their valley lines, and in the work of gradation by weathering on the fault faces and valley sides, with particular reference to the manner in which the features produced in the new cycle are related to those still holding over from the previous cycle and to those produced directly by faulting; indication of the stage reached in the work of aggradation (and afterwards of degradation) over the thrown blocks; and finally, as many specific details as possible, not described empirically, but systematically presented as instances of the above-named elements.

It will always be difficult for even the best trained physiographers to secure a complete record of all desired elements of land forms; but the knowledge of land physiography will be immensely advanced when work in the field is carried on in view of carefully standardized and generally accepted schemes, and when published reports are so phrased as to make explicit reference of observed items to their proper class, and explicit statement that such and such elements were not determined. W. M. D.

JAMES CARROLL

Major James Carroll, Surgeon U. S. A., died at his home in the city of Washington on September 16, after an illness of about seven months.

Major Carroll was born in England June 5, 1854. When about fifteen years of age he emigrated to this country, and on June 9, 1874, enlisted in the United States army, and served as private, corporal, sergeant and hospital steward from that date to May 21, 1898, when he was appointed an acting assistant surgeon.

While still a soldier he began the study of medicine at the University of the City of New York during the session 1886–7. After a break of a year he resumed his medical studies in Baltimore at the University of Maryland, 1889–91, and received his degree from that institution.

He was appointed first lieutenant, assistant surgeon, in the medical corps, October 27, 1902, and promoted to the grade of major-surgeon, by special act of congress March 2, 1907, on account of his services in connection with the discovery of the mode of transmission of yellow fever, and the courage shown by him in subjecting himself to experiment with a view to demonstrating the method of transmission by a mosquito.

Doctor Carroll's was the first experimental case of yellow fever. He suffered a very severe attack to which he attributed a heart trouble, which finally caused his death.

Doctor Carroll's interest in the subject of yellow fever did not cease with the discovery of the method of its transmission, but he continued to make many independent contributions to the literature on the subject.

The Havana Yellow Fever Commission, appointed upon the recommendation of Surgeon General Sternberg, U. S. A., in 1900, consisted of Major Walter Reed, Surgeon, U. S. A.; Dr. James Carroll, Dr. Jesse W. Lazear and Dr. A. Agramonte. The death of Dr. Carroll leaves Dr. Agramonte, a Cuban physician, as the only surviving member of the commission.

The bacteriological and experimental investigations of the commission were to a large extent conducted by Dr. Carroll. During Major Reed's absence in the United States the inoculations by means of infected mosquitoes were begun.

On August 11, 1900, Dr. Lazear made the first experiment, but nine distinct inoculations on persons, including himself and Acting Assistant Surgeon A. S. Pinto, were unsuccessful. We know now that these failures were due to two facts—first, that patients after the third day of the disease can not convey the infection to the mosquito, and second, that after having bitten a yellow-fever case the mosquito can not transmit the disease until after an interval of at least twelve days. On August 27 a mosquito was applied to Dr. Carroll which happened to fulfil both of these conditions. The result was a very severe attack of yellow fever in which for a time his life hung in the balance.

G. M. S.

SCIENTIFIC NOTES AND NEWS

The Silliman lectures by Professor William Bateson will be given in the Peabody Museum at Yale University on October 8 and the following days. The subject of the course is "The Problems of Genetics."

The Herter Lectures before the Medical Department of the Johns Hopkins University will be given this session by Edward A. Schäfer, LL.D., F.R.S., professor of physiology in the University of Edinburgh, at the end of April, 1908. The Turnbull Lectures on poetry will be delivered by Professor A. V. Williams Jackson, of Columbia University, on Persian Poetry, probably in February.

Professor Otto Pfleiderer, of the University of Berlin, began a series of six lectures in German on "The German Philosophy of Religion," at Harvard University, on September 30.

The Hon. James Mackintosh Bell, director of the New Zealand Geological Survey, will lecture at Harvard University on October 11 on "Travel in Little Explored Parts of New Zealand."

Dr. W. McM. Woodworth, of the Museum of Comparative Zoology of Harvard University, has undertaken to edit the proceedings of the Seventh International Zoological Congress.

The London *Times* states that the Flückiger gold medal has been awarded to Professor Edouard Heckel, the director of the Colonial Institute at Marseilles. The medal was founded by Dr. F. A. Flückiger, of Strasburg, in 1893, and is awarded every five years, in recognition of steps taken to promote the advancement of scientific pharmacy, irrespective of nationality. Mr. E. M. Holmes, the curator of the museums of the Pharmaceutical Society of Great Britain, received the first medal, and the second was presented to Dr. C. Schmidt, of Marburg.

Captain James M. Phalen and Lieutenant Henry J. Nichols, assistant surgeons, U. S. Army, have been appointed members of the army board for the investigation of tropical diseases, replacing Captains Percy Ashburn and Charles F. Craig, assistant surgeons, who have been ordered to return home, their tour of duty on foreign service having expired.

Dr. Harold L. Lyon has resigned his position as assistant professor of botany at the University of Minnesota to accept a position as assistant director of the pathological laboratory on the experiment station maintained by the Hawaiian Sugar Planters' Association, at Honolulu.

Mr. Homer D. House has resigned the associate professorship of botany and bacteriology in Clemson College, South Carolina, and will spend the coming year at the New York Botanical Garden.

Mr. Edward C. Johnson, formerly assistant in botany at the University of Minnesota, has been appointed assistant pathologist in the Department of Agriculture.

Professor Henry S. Munroe, head of the department of mining of Columbia University, has returned, after a five-months' trip in South America. He spent most of his time in Bolivia.

Professor Charles Harrington, of the Harvard Medical School, attended the Congress of Hygiene and Demography, which met at Berlin at the close of September.

Dr. James G. Hardy, professor of mathematics at Williams College, and Dr. H. F. Clelland, professor of geology, have been given leave of absence for the second half of the present academic year.

The autumn lectures at the New York Botanical Garden will be delivered in the lecture hall of the museum building of the garden, Bronx Park, on Saturday afternoons, at 4 o'clock, as follows:

October 5—"The Salton Sea and its Effect on Vegetation," by Dr. D. T. MacDougal.

October 12—"Collecting Fungi in the Wilds of Maine," by Dr. W. A. Murrill.

October 19—"The Forms and Functions of Leaves," by Dr. C. Stuart Gager.

October 26—"The True Grasses and their Uses," by Mr. George V. Nash.

November 2—"The Giant Trees of California: their Past History and Present Condition," by Dr. Arthur Hollick.

November 9—"The Progress of the Development of the New York Botanical Garden," by Dr. N. L. Britton.

November 16—"Edible Roots of the United States," by Dr. H. H. Rusby.

Professor Leveson Francis Vernon Harcourt, emeritus professor of civil engineering at University College, London, died on September 14, at the age of sixty-eight years.

The U. S. Civil Service Commission announces an examination on October 16–17, to fill vacancies as they may occur in the position of scientific assistant in the Department of Agriculture, at salaries ranging from $840 to $2,000 per annum, depending upon the experience and qualifications of appointees. As a result of this examination certification will be made to fill two vacancies in the position of scientific assistant in rural engineering (road making), Department of Agriculture, at $840 per annum. The department also desires to secure one or two scientific assistants in animal husbandry who are qualified in the special branch of horse industry.

The British government has made an additional grant of $2,500 a year to the Liverpool School of Tropical Medicine, making $5,000 a year for five years.

A Pasteur Institute was opened at the University of Minnesota in August, and has been under the charge of Dr. Orinna McDaniel. Seventeen persons have received treatment for threatened rabies.

In a note on additions to the Zoological Garden, the London *Times* states that in point of importance, from a scientific point of view, three young Chinese alligators (*Alligator sinensis*) undoubtedly head the list. Up to 1879 it was generally believed that alligators were confined to the New World, though in 1870 Swinhoe established the existence of a saurian in the Yang-tsze-kiang, which he described as "a young crocodile about 4 feet long." Nine years later, however, M. Fauvel, a French official of the Chinese Customs, published an account of the animal, which proved to be an alligator, closely allied to the well-known species of the Southeastern United States, known as the Mississippi alligator, from which, however, it differs considerably in its much smaller size. The coloration of the upper parts is greenish black, with yellowish vermiculations, and greyish below. According to M. Fauvel this reptile was the origin of the mythical dragon of the Chinese. In 1880 stuffed specimens reached this country; two living examples were received at the Zoological Gardens in 1890, of which one is still alive, and two were exhibited at Frankfort-on-the-Main in the same year. From that time, however, no living examples appear to have been imported till now. The gayal herd in the cattlesheds has been increased by the birth of a calf, which is of good augury, for before the arrival of the small herd in April last these animals had not been represented in the collection for some time. A young clouded leopard (*Felis nebulosa*) has been received and placed in the small mammals' house. Although usually reckoned among the larger cats, the name "tiger," formerly applied to this animal, conveys an erroneous impression, for its size does not exceed that of a small leopard. There is a good deal of variation in the ground-color of the fur, which ranges in different individuals from greyish to yellowish brown, fading into white on the under-surface. The new arrival belongs to the dark form, and is said to have come from Sumatra. Two rare monkeys have been received and placed in the insect house. One is the red-faced ouakari (*Brachyurus rubicundus*), an entirely arboreal species from the region of the Amazon; it is of small size, with a short tail. The fur is reddish-brown in hue, and the face a deep red, as is suggested in the popular name. A red-eared guenon (*Cercopithecus erythrotus*) may be readily distinguished by the color of the inside of the ears, and perhaps more readily by the red nose-spot.

UNIVERSITY AND EDUCATIONAL NEWS

The state legislature has appropriated for the Michigan College of Mines, at Houghton, $75,000 for a library and museum building and $43,000 for a new central heating and power plant.

Folwell Hall, erected for the University of Minnesota at a cost of $415,000 for the work of the College of Science, Literature and Arts, was opened at the beginning of the present academic year. The new building for the agricultural department, erected at a cost of $250,000, was opened during the summer.

Mrs. W. G. Farlow has given $1,000 to Radcliffe College, Harvard University, the interest of which is to be used for the purchase of scientific and mathematical books for the library.

The Lowell Institute, in cooperation with Harvard University, will offer during the current academic year two free courses of lectures corresponding closely in subject matter, methods of instruction, examinations and scale of marking with History 1 and English *A* as given in Harvard College. The lectures will be given in the buildings of the Harvard Medical School at 8 P.M.

Professor Alfred C. Cole, of the Ohio State University, has been elected professor of physics at Vassar College, succeeding Professor LeRoy C. Cooley, who has retired at the age of seventy-four years, after thirty-three years' service.

At Wellesley College, Dr. Carl M. Wiegand, of Cornell University, has been appointed associate professor of botany, and Dr. Daniel Starch, who is on leave of absence from the Ohio State University, has been appointed acting instructor in psychology.

Dr. H. E. Wells has recently resigned the professorship of chemistry at Allegheny College to accept a similar position at Washington and Jefferson College. Professor Edwin Lee, of Mount Union College, has been appointed to fill the vacancy thus left open at Allegheny College.

At Bowdoin College Mr. Ralph B. Stone has been appointed instructor in physics and mathematics, and Mr. H. M. Hastings, instructor in descriptive geometry.

Dr. Hiram Bingham has been appointed instructor in South American geography in Yale University.

Changes in the staff of the botanical department of the Ohio State University for the current year are as follows: Professor Schaffner has been given leave of absence for the year to study in Germany, and Dr. A. Dachnowski (Michigan) has been appointed as substitute. Professor Griggs has spent the summer at Port Renfew Minnesota Botanical Station, studying the Kelps. Miss Detmers, instructor, botanized in California and Alaska until September 15. Dr. Kellerman has been given leave of absence for the winter term to conduct a peripatetic School of Botany in Guatemala.

The following elections and promotions have been made at the Iowa State College for the year 1907–8: *Division of Agriculture*—J. A. McLean and Wayne Dinsmore have been promoted to associate professorships of animal husbandry; J. B. Davidson to a professorship of agricultural engineering; E. B. Watson to an assistant professorship of soils, and John Bower to an assistant professorship of dairying. *Division of Veterinary Medicine*—R. R. Dykstra has been promoted to an associate professorship of veterinary medicine, and C. H. Stange and W. E. Madson to assistant professorships. *Division of Science*—W. F. Coover has been promoted to an associate professorship of chemistry; Mrs. Alice Dynes-Feuling has been appointed professor of domestic science, and Miss Helen Donovan has been promoted to an associate professorship and Miss Ruth Morrison to an assistant professorship; Alexander S. Thompson has been appointed director of music, and Mrs. A. S. Thompson, instructor of voice. *Division of Engineering*—W. H. Meeker has been promoted to a professorship of mechanical engineering, W. M. Wilson to an associate professorship, and R. A. Norman has been appointed assistant professor; J. E. Kirkum has been appointed associate professor of civil engineering and H. C. Ford, assistant professor; L. C. Hodson has been promoted to an associate professorship of mining engineering and I. A. Williams to an associate professorship; F. A. Fish has been promoted to an associate professorship of electrical engineering, and W. B. Anderson and A. H. Hoffman have been appointed assistant professors.

The following changes have occurred in the teaching and station force of the biological department of the North Dakota Agricultural College and Experiment Station: Mr. F. J. Pritchard, assistant professor of botany, has resigned to take up advanced work in plant breeding at Cornell University. Mr. F. J. Seaver, late fellowship student in Columbia University and graduate of Iowa State University, has been elected to fill the vacancy. Mr. T. D. Beckwith, of the Department of Agriculture, Division of Water Purification Investigations, has been elected assistant professor of bacteriology and plant pathology, and will be associated with Professor Bolley in special soil investigations in the experiment station work.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, OCTOBER 11, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

PRELIMINARY MEDICAL EDUCATION[1]

AMONG medical men interested in the advance of their profession few questions are attracting more attention at the present time than is that of the character of their professional education, and going a step farther, it might be said that opinion is now pretty well settled on this point that the important part of the medical education is the beginning of it, or perhaps better, the preparation for it.

Questions of the relations of medical education to medical practise have been discussed by college faculties, medical societies, state boards of examiners and other bodies, and out of all their discussions some tangible results are beginning to follow, as shown by the rapidly increasing requirements for entrance to or graduation from medical schools, which are now insisted upon by those in authority. Recently, through its Council on Medical Education, the American Medical Association has begun to take a very active part in the discussion, and will undoubtedly exert a great influence in shaping opinion. The association has had for years a committee on education, but as the membership changed from year to year, little of real value was accomplished. In 1904, however, a permanent body known as the Council on Medical Education was created, the functions of which are to determine the actual condition of this branch of profes-

[1] Based on a Report to the Council on Medical Education of the American Medical Association, presented April 29, 1907.

sional education in the United States, and make recommendations for its improvement. The council has held three conferences, the last one of which was in Chicago in April.

An important feature of this conference, which was attended by eighty-four delegates from various schools, societies and examining boards, were the reports made by the chairman, Dr. A. D. Bevan, and the secretary, Dr. N. P. Colwell, on the results of a personal inspection recently made of the one hundred and sixty medical schools of the country, with respect to their facilities for doing the work for which they are chartered. Many of these schools were found to be sadly lacking in everything considered essential in an educational institution, and exist merely as commercial ventures. It may be safely said that fully one half of our medical schools have no moral right to exist. Some of these are an actual menace to the public good. The report of the chairman took up also the questions of curriculum and standards in medical education. It emphasized the fact that the most serious problem confronting the schools of medicine in this country to-day is that of the entrance requirements. Various recommendations for the advancement of these were made.

Leaving out of consideration the fraudulent commercial concerns masquerading as schools or colleges of medicine, it can not be questioned that many of the really meritorious institutions are attempting to do more in four years than can be successfully accomplished with the student body as now constituted. In the last two or three decades scientific medicine has made enormous strides, and the majority of entering students are not properly equipped to take advantage of all that is offered them, especially in the newer pathology and etiology. The developments in physiological chemistry and bacteriology have brought new ideas into the science, and to comprehend them, and make practical use of them the young man beginning the study of medicine must bring to his work a far better preparation than was thought necessary ten or fifteen years ago. It has frequently been suggested that in order to give more time for this training a fifth year should be added to the medical curriculum; in other words, the course should be made to cover five years in place of four, and in the freshman year the work should be wholly scientific. In principle this suggestion is not bad, but, unfortunately, few medical schools seem willing to accept it. On the other hand, the great majority of medical teachers insist that the work of the medical school should be in the line of professional, and not preparatory, study, and that all really general or preliminary work should be done before the medical school is entered. The extent of this preliminary work is now the problem to settle.

An ideal condition would seem to be this, that the student should complete a four years' course for the bachelor's degree before taking up the medical course of four years, but few institutions are prepared to make such a requirement, and the situation in Johns Hopkins Medical School and Harvard Medical School can not be duplicated elsewhere in this country for some years. In fact, it is often asserted that the conditions of medical study in these schools are *not* the ideal conditions, and although excellent, are not in every way desirable. This view, which I may say I do not fully agree with, is based on certain facts which must not be lost sight of. These are some of the facts: It is everywhere apparent that the most highly educated physicians are not always the most successful in the practical treatment of disease. Over-education creates in many men a sort of therapeutic skepticism which is a decided drawback in every day practise. In spite of our great advances in knowledge there is still much in medicine that is empiric, and a quick intuition and sympathetic manner may go further than actual scientific ability. A large part of every-day practise is country or village practise, and among a class of people who do not care for or understand refinement of any sort. Among such people general culture is not appreciated and may even be a detriment to actual success. This may sound paradoxical, but the observation has been made over and over again that the rough-and-ready man who is familiar with the language of the field and shop and who can speak it with the people is successful, where the user of the choicest English may fail utterly, not, of course, because of the English, but because of acquired mental peculiarities which may go with it. The practitioner can not be too far ahead of the people with whom he has to deal. Considering practically the medical man's patrons, it must be admitted that in the United States his income is *relatively* low. Of course I am not thinking here of the fortunate surgeon who has achieved a reputation in a large city and whose fees may be anything he chooses to ask, but I refer to the every-day practitioner of general medicine, the man who has been called the family physician, and who is expected to attend to all kinds of ailments. For the time he spends and the work he does his pay is far from high, and possibly not high enough to warrant a longer time in preparation. From what was intimated above, it does not follow that a longer course of study would bring greater pecuniary reward. Wages of those who work with the hands only have advanced more rapidly than has the somewhat uncertain income of the professional man.

With these and similar facts before him the young man through with the high school hesitates at the outset of a course which may lead him through eight years of work before he begins to earn a living, and, all sentiment aside, that is what most men have to work for. And medical men who have been at the grind for years, also hesitate in recommending such a course of study. What preparation, then, can be made for the medical school which is more in harmony with actual conditions if not with ideals? Is it possible to find a compromise course which will mark an advance, and yet not be so extensive as to be impracticable?

At the present time the best of our medical schools seem to require graduation from a four years' high school course for matriculation, and this, we are all agreed, is not enough. Many authorities are asking that, following the high school course, two years of regular college work should be taken before the regular medical course of four years is begun. This is probably a just requirement, but it appears to be still in advance of what may be insisted upon. As a compromise the Council on Medical Education has recommended a preliminary year of work in sciences and language, in addition to the high school course of four years, as the practical minimum which should be accepted by medical schools in good standing. A very considerable number of the best schools have promised to adhere to this scheme.

In order to work out some of the details of such a plan a special committee on preliminary medical education, consisting of Professors George A. Piersol, of Philadelphia, Charles R. Bardeen, of Madison, and the writer of this article, was appointed last fall, and has since made a brief report with some recommendations. At the outset, it may be said that the members of this committee, as individuals, are agreed that a four-year college course preliminary to medicine is an extremely valuable acquirement, and should be recommended wherever possible. We are agreed, also, that two years of college work are better than one, when devoted to preliminary scientific study. But in favoring and urging a one-year course as outlined below we are working on a perfectly definite proposition on which the leading medical schools may be able, for the present, to unite. For the moment we are interested in this question: What should be considered as a year of work in science and language, valuable as a preliminary to medical study, and how may this work be taken? Some time before the appointment of our committee the council made a direct effort, through correspondence with a number of the more prominent universities and colleges of the country, to discover the amount of work which should be considered as a year's equivalent in the several topics, and how much of this work in sciences and languages could be completed in a single year at the various institutions addressed. In other words, it was sought to learn how far the usual, or an elective, freshman course would go toward satisfying the requirement of the council with reference to this preliminary year.

The replies received by the secretary, Dr. Colwell, were far from satisfactory; in fact, in many cases they were very misleading and gave no clear idea of what the universities could do in the matter which would be of value in helping on with the plans of the council and the medical schools interested in the proposition of raising the standard of work in medical education. It was even evident that in some of the answers the university and college authorities had dodged the issue.

With these facts in view our committee decided to ask for more definite information, and in such a way as to leave no loophole for misunderstanding. Accordingly, the following circular was printed and sent to all the colleges, universities and technical schools listed in the last report of the Commissioner of Education. There are about 500 names in the list, and the circular letter was sent out in February last.

THE CIRCULAR LETTER

Chicago, Feb. 25, 1907.

Dear Sir:—Because of the rapid advances made in medical science in the last ten years it is becoming necessary to greatly increase the work given to students of medicine to enable them to take advantage of the modern points of view and follow understandingly the many valuable recent discoveries. It is not possible to increase the work within the limits of the four-year courses as now given in our best schools of medicine, as these courses are already overcrowded. On the other hand, it does not appear to be at present possible to lengthen these courses to five years, as has been sometimes suggested. The only remaining alternative is to require of students beginning the study of medicine a broader preliminary training than is usually called for from young men or women entering the medical school. This training should embrace some of the work now given in the medical school in the first or freshman year, with certain subjects in addition, and may be outlined as follows:

1. A year's work in general biology.
2. A year's work in chemistry.
3. A year's work in physics.
4. A year's work in a modern language, preferably German.

All of this work is supposed to be of the grade given in the freshman or later years of our best colleges. It may be and should be preceded by elementary high school work in the same subjects, especially in the languages. It is understood that a year's work which may be counted toward the bachelor's degree is the equivalent of four recitations or lectures a week in each of four subjects through the usual nine months' course.

The following statement may make clearer what is understood by a year of college work in the several subjects:

Biology.—The course here should include lectures or recitations, and laboratory exercises amounting to about six hours of work a week through one college year. In the laboratory the following types, or their equivalents, should be studied: (*a*) a protozoon (a ciliate and ameba); (*b*) a celenterate (hydroid, hydra or sea-anemone); (*c*) an annelid (earthworm); (*d*) an arthropod (preferably a decapod); (*e*) a vertebrate (preferably a frog or fish), with a view of a general comparison of the plan in internal structure with that of the human body. When possible a study of tissues should be made, first with the unaided eye and then with the microscope, to demonstrate the relation of cells to intercellular substance, as in epithelium and connective tissue. It is desirable that the students should study other fresh typical specimens of elementary tissues, as muscle, nerve and blood.

If the college work in biology is wholly or largely of a zoologic character, as outlined above, it is desirable that it should have been preceded by some work in botany in the high school.

Chemistry.—The student entering the medical school should have completed a substantial course in general inorganic chemistry, with experiments, elementary qualitative analysis, an outline, at least, of volumetric analysis, including the theory of the fundamental processes, and finally, a short course in organic chemistry sufficient to serve as an introduction to physiological chemistry. All this work in chemistry should consume, at least, about ten hours of recitation and laboratory work per week through a year.

Inasmuch, however, as few freshmen courses cover as much ground as is here indicated, the work in general inorganic chemistry, with laboratory experiments and qualitative analysis, may be taken at present as the minimum amount which would satisfy the needs of the medical schools under the new requirement.

Physics.—This college work is supposed to be preceded by an elementary or preparatory course in the high school or academy. The subjects here of the greatest importance for the study of medicine are heat, light and electricity. Satisfactory work in these branches should cover probably three recitation hours and five or six laboratory hours through a college year. The student should acquire some practical knowledge of the microscope, the spectroscope, of thermometry and specific heat, and some familiarity with simple electric measurements.

Languages.—In addition to the work of the high school or academy in these subjects the student should have enough college training to enable him to read one foreign language, preferably German or French, with some degree of ease.

Up to the present time most of our medical schools have drawn their students from the graduates of the high schools. A few medical schools have required college graduation for entrance, but it is recognized that this relation is not yet, in general, realizable. It is hoped, however, that in order to meet the urgent demand for better preliminary education now being made by the leading schools of medicine, the colleges of the country will be prepared to furnish in the first years of their courses to prospective medical students such a curriculum as is outlined above.

This letter is sent out by a committee of the Council on Medical Education of the American Medical Association in an effort to discover just what the colleges of the country can do for the instruction of this class of students who usually do not enter college at all, but who now, under the press of changing conditions, must do some college work before being considered properly prepared to enter upon the study of medicine.

Will you kindly answer the following questions:

How much of the work outlined above is your institution prepared to give in *one year* to students who have a high school training?

How much of this work can you give in *a year and a half*, that is to the middle of the sophomore year, to students equipped in the same way as above?

If not at present able to furnish the courses in the specified time, can you, in view of the apparent demand, give such courses beginning with the college year 1908–9?

The point to be kept in mind is that the college should be able to furnish this desired instruction within a period corresponding to the freshman and perhaps a part of the sophomore year. A blank is enclosed for a reply, which will be greatly appreciated, as will also any comments or suggestions which you may make.

In presenting its report the committee desires to prepare for publication a list of those colleges which are or will be able to offer courses substantially like those outlined above.

Yours truly,

C. R. Bardeen,
G. A. Piersol,
J. H. Long,
Committee

The phrase "preliminary year in biology, chemistry, physics and languages" is somewhat vague, and the committee, after much discussion, undertook to define it to some extent, as appears in the wording of the circular letter. To be of real value the courses taken in a preliminary year should make it possible for the student to begin a higher grade of work immediately after entering the medical school. At the present time most of our medical schools teach the elements of biology, chemistry and physics, and it is probably no exaggeration to say that two thirds of the time of the medical freshman is taken up with work which may be, or in fact should be, done elsewhere, and better, too.

It was this consideration which led our committee to outline in a general way what should be covered in the several preliminary courses. It will be seen that the suggested exercises in biology cover work which would serve as a beginning in histology and physiology as well as in comparative anatomy; the chemistry work would cover that given in our usual medical freshman year, while the courses in physics would take the place of work now given in a perfunctory way in many of our medical schools, but which is becoming every year more and more necessary as the many relations of this fundamental science to medicine become more and more tangible.

A modern German classification divides physiology into the two groups of studies comprised under the titles of bio-chemistry on the one hand, and bio-physics on the other. A glance through any one of the larger manuals of physiology in use in our medical schools discloses a justification of this division, and suggests also the desirability of relegating much matter from the class-room in physiology to the class-room in physics. Besides this, it is becoming evident that modern pathology is making every day wider inroads not only into the fields of chemistry, but also into the domain of physics, and taking all things together, the committee felt that it was not going too far in calling for the amount of physics suggested in the circular letter. No explanation of any length was made in reference to the language work, as little difficulty from this direction was expected.

RESULTS OBTAINED

Now as to the results. The replies received were 215, of which the larger number were plain and satisfactory; a few were not as clear as might be desired, from which it follows that a perfectly sharp classification can not be made from the data secured. But the results are close enough for the present purpose. Sixteen of the answers came from state universities, 8 from agricultural and technical schools and 191 from other institutions, some of which include the best-known colleges and universities in the country. The replies from 15 of the state universities and from 7 of the agricultural and technical schools showed a good general agreement with our proposed courses of study. The replies from 78 other institutions were also favorable, although it appears likely in a few cases that the schools in question have not the facilities for properly doing the work called for. On the other hand, about 30 well-known institutions made replies which could not be looked on as wholly favorable.

The situation in some of the older schools seems to be best expressed by the comments made by President Hadley of Yale, as follows:

> The demand for places in our undergraduate courses is so far in excess of what we can readily meet that we can hardly arrange to take men for one year, with a view of letting them leave us at the end of that time. We must, I think, arrange our courses for men who expect to stay longer.

In this list along with Yale we must place Cornell, Princeton, Trinity, Williams, Lafayette, Union, Tufts, Vanderbilt, Bowdoin, Oberlin, Hamilton, Amherst, Syracuse and others of known rank. It is evident that the schemes of instruction in these schools are not flexible enough to allow a freshman to elect as large an amount of work as our committee suggested. The greatest difficulty seems to be with the work in physics, which naturally presupposes some acquaintance with trigonometry, and which in consequence is usually thrown over to the sophomore year. The work in chemistry, biology and languages could in most cases be provided for.

HOSTILITY TO THE PLAN

The replies from about 80 institutions gave evidence of lack of interest in the matter, lack of equipment for the work, or, finally, a distinct hostility to the plan. As illustrating the last situation the answers from two small colleges, one in Pennsylvania and one in Illinois, may be quoted. The first reads as follows:

> In reply to your letter I would say that we can not justly give the course you suggest in less than two years, except in rare cases. We have found, in our experience, that the students who took a full B.S. course received the best results. We even discourage the short two years' course, because it has so little of general culture work, and the American college stands for culture. If professions will continue to admit men on purely technical preparation and disregard the college, the college nevertheless must stand for the ideals that have made it. Your suggested one-year course is unpractical. You require so much laboratory work in chemistry and physics that none but the exceptional freshman can take them. The number of hours of your proposed course outnumber the hours which educators, knowing the capacity of the human brain and mind, have fixed as a maximum. Should your plan obtain the work must be superficial. *For some time we college men have watched the plans of the medical profession and we are astonished that there is so little appreciation of sound pedagogics.* (Italics mine.)

From the president of the Illinois school the following reply came:

> In response to your inquiry concerning our work in science relative to its value for medical education, permit me to say that we offer all and more than you require, but not in the freshman year. We carry science study through four years of the college course. It appears to us on careful consideration that what you require as preliminary to the medical course could not be well crowded into one year. Three different lines of science study with extended laboratory practise is more than students can advantageously carry in one year, not to speak of the addition of a modern language. Certainly, such crowding could hardly meet the requirements of a good college course. Besides, freshmen are not qualified for the more advanced work in the sciences. Moreover, it seems hardly fair to us that colleges should be asked to do such hurried preparatory work for the professional schools. Why might not law and theology come with similar requests? In what manner could any college do justice to its students under such pressure? Would it not be perfectly fair for the professional schools to adjust their courses to the needs of college graduates? That would certainly greatly improve professional efficiency. We are quite ready to maintain such courses as the professional schools can recognize; but we can not see our way clear to comply with the requests of your letter of inquiry.

It is evident that these men do not fully understand the situation and in addition that their answers are dictated by a somewhat natural self-interest; but in the opinions of other men better able to appreciate our position, we have noticed a similar doubt as to the wisdom of attempting so much work in a single year. In this connection there are two questions to consider: first, the practical one of arranging hours to avoid a conflict of studies, and yet present all the work suggested to be taken, and, second, the possibility of carrying this number of hours successfully. In actual time the scheme provides for about 25 hours of work each week through the college year, divided between class-room and laboratory, and omitting organic chemistry. Now, allowing for a reasonable division of time in the work in the sciences, this is not more than a fair student should be expected to carry, and not more than students carry well in many of our best schools. It must be admitted that students who are expected to devote a good fraction of their time to athletics and fraternity interests can not carry such courses, but we are far from believing that the present tendency in these matters in some of our schools is a desirable one or one which may be expected to persist.

The writers of many of the replies received by us seem to assume that the proposed preliminary science course is the work of medical practitioners who have devoted but little time to the study of working conditions, and further that the courses involve difficult or advanced scientific studies. Both notions are absurdly wrong and it is evident that the presidents of a few of the colleges are not very familiar with the work of our active medical men on the one hand, or with elementary scientific studies on the other. It may be added that the members of our committee are not practitioners of medicine, but we have drawn many valuable suggestions from practitioners as well as from teachers.

This work may call for more than one year's time from many students who attempt it, we admit, but that it is really more than can be accomplished in one year is not to be admitted yet. Any one who is familiar with science teaching will recognize that we have here merely the elements of such work, and it is a fact well known to many of us who have dealt with medical students for a number of years that some of the state universities actually give such courses, and successfully, to freshman students.

Our committee has been accused of advocating a departure from an "ideal" course. We have admitted all the time that the scheme is not perfect, but we are concerned with the practical question of what we can get, rather than with what we should like to have. I firmly believe that the difficulty is not so much with our proposed course as with the ideas which obtain in some quarters as to what is a fair amount of work for a young freshman who has completed four years of study in a good high school. I believe that with such a training honestly completed our schedule may be carried through in another year of college work. With this as a beginning, possibly in time a second year may be added to the requirement.

But the point of importance is the amount of work and not the name. The Council on Medical Education has spoken of it as a *preliminary year*, but if it actually calls for more than that time the student should be required to spend it, since it seems that little short of this would answer as a preparation for modern medicine. That the applicant for entrance to the medical school has this minimum amount of knowledge should be determined through the examinations of an independent board, and not through the professional school, or by certificate of the college or preparatory school. We all know what such entrance examinations amount to, and an important step forward will be taken when the right to enter upon the study of medicine, as well as the right to practise is passed upon by authorities other than the college faculties. The standard in such entrance examinations should be made as uniform as possible for the whole country, and to aid in bringing about such a desirable situation is one of the objects of the present movement.

J. H. Long

SCIENTIFIC BOOKS

Pragmatism, a New Name for Some Old Ways of Thinking: Popular Lectures on Philosophy. By William James. New York, Longmans, Green and Co. 1907. Pp. xiii + 310.

Tron de l'air! as I used to hear the Gascons of the *Quartier* exclaim, long ere I knew of "toughs" and "tender-feet," of "Cripple-Creekers" and "Bostonians" in philosophy (p. 12 f.). The picturesque phrase springs to my lips again, set agog by the refreshing spectacle of a "big pot," as the English say, courageous and independent enough to avow himself an anarchist in things speculative (p. 28 f.). For Professor James bethumps the high priests, sacred and profane, of contemporary philosophy, with a kind of holy joy. And, so far as my limited observation goes, this joy is a pronounced and sprightly characteristic of "the oddly-named thing pragmatism" (p. 33). In a word, pragmatism has been misunderstood (p. 197), even made a mockery and jest (p. 233), as Mr. James alleges, because, to this point, it excels in the negative *nuance*.

Accordingly, I for one welcome this authoritative addition to the pragmatic canon if, peradventure, it may serve to unravel certain excusable puzzledoms. So, to begin with, What is pragmatism? Professor James directs the second of his lectures to this set question, with the following results:

The pragmatic method is primarily a method of settling metaphysical disputes that otherwise might be interminable. . . . The pragmatic method in such cases is to try to interpret each notion by tracing its respective practical consequences (p. 45). Theories thus become instruments, not answers to enigmas, in which we can rest (p. 53). The attitude of looking away from first things, principles, "categories," supposed necessities; and of looking towards last things, fruits, consequences, facts (p. 54). Ideas (which themselves are but parts of our experience) become true just in so far as they help us to get into satisfactory relation with other parts of our experience (p. 58). Truth is *one species of good*, and not, as is usually supposed, a category distinct from good, and coordinate with it. The true is the name of whatever proves itself to be good in the way of belief, and good, too, for definite, assignable reasons (pp. 75–6).

Later, our anarchist, wishing doubtless to conserve his reputation, commits himself thus:

Pragmatism, pending the final empirical ascertainment of just what the balance of union and disunion among things may be, must obviously range herself upon the pluralistic side (p. 161). Common sense is *better* for one sphere of life, science for another, philosophical criticism for a third; but whether either be *truer* absolutely, Heaven only knows (p. 190). The truth of an idea is not a stagnant property inherent in it. Truth *happens* to an idea. It *becomes* true, is *made* true by events. Its verity *is* in fact an event, a process (p. 201). "The true," to put it very briefly, is only the expedient in the way of our thinking, just as "the right" is only the expedient in the way of our behaving (p. 222).

Although, more than likely, I can not see these fluid matters from the pragmatic angle, "the pragmatic movement, so-called," which "seems to have rather suddenly precipitated itself out of the air" (p. vii), appears, *more Jacobo,* to embody a perfectly definite tendency. The "Anglo-Hegelian school" (p. 17) which has dominated the British universities for a generation, and energized mightily in certain American institutions, begins to pay the penalty of success and sacrosanctity. The bedewed gospel of the first generation has been overlaid by crystallizing commentary in the second. Hence, unmoved by the earlier enthusiasms and unaffected by their ramified causes, contemporary critics can stand forth unabashed and say of the "personal faith that warms the heart of the hearer" (p. 279): "It is far too intellectualistic" (p. 70); for it "truth means essentially an inert static relation" (p. 200); it rests "in principles after this stagnant intellectual fashion" (p. 95); "the theory of the Absolute, in particular, has had to be an article of faith, affirmed dogmatically and exclusively" (p. 159); "for rationalism reality is ready-made and complete from all eternity, while for pragmatism it is still in the making, and awaits part of its complexion from the future" (p. 257). On the whole, then, pragmatism betokens a protestant attitude towards such catholic tendencies and formulations of the orthodox university philosophy of the hour. In this respect, as Mr. James recognizes aptly on his title-page, it is nothing but "a new name for some old ways of thinking." To fine, the point, it is the familiar reaction of nominalism against standardization of experience according to archetypes "laid up in heaven." Nevertheless, it must not be confounded with its medieval, or even its British (Locke, Berkeley, Hume, Mill) forerunners; it does possess originality, just because it springs from present stress. The "new" astronomy, physics and chemistry, the sciences of life, above all, the amazing exfoliation of the human sciences, particularly psychology, forbid us to rest in Hegel, or even in "hegelisms" (a horrid word, Mr. James!) resurrected at Oxford after forty years and tricked out in the King's English. Pragmatism has the courage, the temerity, the "cheek," the "gall," the folly—call it what you like, to stand up and say "no." Meanwhile, the elementary condition of its logic, the vacuity (intentional, as some allege) of its metaphysics, and its besetting sin, confusion of psychological with epistemological problems, prevent it from settling down into any such sediment as might be labelled *universalia post rem*. Briefly, the pragmatic "things," which preexist principles and genera and species, are not "tea-trays in the sky," or even "black cows in the night," but rather palpitating human individuals gurgling along their several, and peculiarly private, psychological "streams." Pragmatism presents no commission to exalt objects at the expense of "universes," but it exhibits touching faith in persons as opposed to presumed spiritual unities that catch them up and carry them off willy-nilly. Here its "humanism" centers, and here its significance as a centrifugal force in current thought pivots. "Rationalism sticks to logic and the empyrean. Empiricism sticks to the external senses. Pragmatism is willing to take anything, to follow either logic or the senses and to count the humblest and most personal experiences. She will count mystical experiences if they have any practical consequences. She will take a God who lives in the very dirt of private fact—if that should seem a likely place to find him" (p. 80). Therefore, I would urge, let us listen to the new message, let us keep the ring in order that it may have free play to come to clear self-consciousness (cf. p. vii). Yet, let us feel free to put questions, especially very elementary questions. Mayhap pragmatism can open up a world of what it calls "the real," possibly it can bring us down from the dizzy realm of ideas and force us to revalue what it terms "the concrete phases of existence." But, at least, it must afford us every chance to ask what all this may be and purport. For, as the "rationalist" would quote,

I lived with visions for my company
Instead of men and women years ago,
And found them gentle mates, nor thought to know
A sweeter music than they played to me.

And visions come to all schools.

Thus, I rub my eyes when I read this: "When old truth grows, then, by new truth's addition, it is for subjective reasons. We are in the process and obey the reasons" (p. 63); and I inquire: How distinguish between "old" and "new" without something "purely retrospective" (p. 102) in which both share equally? What are these "subjective reasons" if there be no universe basal to subjective and objective alike—where do you catch the characterization? What is "the process" as distinguished from "we," and what the "reasons"? How do we get at either, if they have not "been already *faked*" (p. 249)? Once more: "The finally victorious way of looking at things will be the most completely *impressive* way to the normal run of minds" (p. 38). Very likely. But, what is "the normal run" as differentiated from the "minds"? If you *can* lay hold upon it, what becomes of your "noetic pluralism" (p. 166)? It won't do to run off airily on the declaration "that all things exist in minds and not singly" (p. 208); for the *why* of the relation between "kinds" (which are not singles) and singles (which are never effective components of experience save in "kinds") is precisely the great problem of speculative thought. Again, Professor James writes, with admirable truth, "in every genuine metaphysical debate some practical issue, however conjectural and remote, is involved" (p. 100). But, then, if "we break the flux of the sensible reality into things . . . at our will" . . . if "we create the subjects of our true as well as of our false propositions" (p. 254), how are we to distinguish the "metaphysical" from the "practical"? Further, "I myself believe that the evidence for God lies primarily in inner personal experiences" (p. 109). What does this imply exactly? What are we forced to conclude as involved in the very possibility of the statement? It is all very well to hold that "the 'Absolute' with his one purpose is not the man-like God of common people" (p. 143); the problem remains, clamant as always. Where does the commonalty of this God find root? Meseems Mr. James himself can furnish forth reply: "The whole *naif* conception of thing gets superseded, and a thing's name is interpreted as denoting only the law or *Regal der Verbindung* by which certain of our sensations habitually succeed or coexist" (pp. 185–6). And, if so, is Mr. James not making common cause with the much derided "rationalists"? They, indeed, may have sacrificed "facts" to "principles," but pragmatists may all too easily sacrifice "principles" to "facts." And, after all, the traffic of philosophy is over the kind of universe in which it *has* so eventuated that facts and principles both disappear when separated. To appeal to the pragmatic method—if too much "ism" be bad for Green, it is equally bad for Mr. James. Thus the large riddle remains, Why are men always cozened by "isms"? Mr. James has not escaped the fate of more ordinary mortals. He writes sometimes like a gospeller; he would be a mediator; and when the gospel shall have been formulated, we shall know what pragmatism may import and where it proposes to take final stand.

Despite his humorous anarchism, Professor James has won to responsibility, and a book from his pen counts as an event. I am therefore bound to record the opinion that the present volume fails to rise to the level of its author's reputation. There is something too much of "the large loose way" (p. 215) about it. Of course, pages are illuminated by flashes from the psychologist whom we know and in whom we rejoice. Speaking of Leibnitz, he says: "What he gives us is a cold literary exercise, whose cheerful substance even hell-fire does not warm" (p. 27); he offers this really delicious etching of Spencer: "His dry schoolmaster temperament, the hurdy-gurdy monotony of him, his preference for cheap makeshifts in argument, his lack of education even in mechanical principles, and in general the vagueness of all his fundamental ideas, his whole system wooden, as if knocked together out of cracked hemlock boards" (p. 39); while these declarations remind one of many passages in the *Principles:* "The rationalist mind, radically taken, is of a doctrinaire and authoritative complexion: the phrase '*must be*' is ever on its lips. The bellyband of its universe must be tight. A radical pragmatist, on the other hand, is a happy-go-lucky anarchistic sort of creature. If he had to live in a tub like Diogenes he wouldn't mind at all if the hoops were loose and the staves let in the sun" (pp. 259–60). On the other hand, some cheap stuff, which one hates to see, has been allowed to creep in. Here is one of its mannerisms: "Pragmatism is uncomfortable away from facts. Rationalism is comfortable only in the presence of abstractions" (p. 67); "The more absolutistic philosophers dwell on so high a level of abstraction that they never try to come down" (p. 19); "the philosophy of such men as Green . . . is pantheistic" (p. 17). Here is another, and very different: "The actual world, instead of being complete 'eternally,' as the monists assure us, may be eternally incomplete, and at all times subject to addition or liable to loss" (p. 166); and here is a third, like unto the second: "Talk of logic and necessity and categories and the absolute and the contents of the whole philosophical machine-shop as you will, the only *real* reason I can think of why anything should ever come is that *some one wishes it to be here*" (pp. 288–9). To pirouette, even in a half-conscious way, between the substantive and transitive, the static and dynamic, the universal and particular, the one and many, may be a good "stunt" in a popular lecture-course, but one does not care to have Professor James stereotyped in this attitude. "Between the coercions of the sensible order and those of the ideal order, our mind is thus wedged tightly" (p. 211). Very true, very likely. But here we are confronted with problems, and to suppose the statement fraught with solutions is to pay ourselves with words. In this very connection, the worst foes of pragmatism may be of its own household. The arrant rubbish now being piled up by certain pedagogical *chiffonniers*, for example, may prove far more fatal than all the flouts of the "genuine Kantianer" (p. 249). To the collectors of this stuff one can only exclaim with Touchstone, "truly, thou art damned, like an ill-roasted egg all on one side."

It surprises me, too, to see that Professor James exhibits some *naïevté* in his attitude towards the "rationalistic" school. "In influential quarters Mr. Schiller, in particular, has been treated like an impudent schoolboy who deserves a spanking" (pp. 66–7). Mr. James seems to have forgotten his previous remark: "No one can live an hour without both facts and principles, so it is a difference rather of emphasis; yet it breeds antipathies of the most pungent character" (p. 9). He can hardly be oblivious of the fact that a regnant intellectual or theological (ay, and scientific) group will stick at nothing to compass its ends. When its inner history—the pragmatic account of its persons—comes to be written, outsiders will be startled and disgusted to learn that the high-toned gospel of "self-realization" has been advanced by very common and very human methods. Innuendo, calumny, intrigue and even worse have played their several parts, while such persecution as the modern world permits has had free course. I am vexed to see that Mr. James has not learned to treat all this with the contempt it deserves, and has not preserved his charming humor to the extent of observing that it is as natural to man to "idealize himself into dirt" as into heaven. And this is the more to be regretted that British thinkers rather than American have been the marks for this refined mud-slinging.

Let me add, in conclusion, that pragmatism, as here outlined, may or may not be excellent science. Readers of Science must judge for themselves; those of them who are addicted to the fallacy of reification will find it a good cathartic. It is only raw material for philosophy. And, as I indicated above, I hope that, undeterred by pontifical anathemas, Professor James and his allies will proceed to *articulate* the philosophy which they believe themselves to possess. In any event, they are entitled to the satisfaction of knowing that, more than other contemporary groups, they contrive to keep the philosophical stream in sweetening motion. But whither it still remains for them to tell. So far as it has received voice, then, pragmatism is an avowed compromise. It is not beatified into a complete creation, attained and to be maintained. On the contrary, it rests a method of approach to thinking, especially from one incidental side. Whether it can overcome age-long antagonisms time alone will tell. In any case, it represents a real attempt at accommodation—a stage which, in the nature of the case, will pass away ere many moons. And then? Why, then, friend and foe alike will proceed to the *Bearbeitung der Begriffe*, a task rejected by these Lowell Lectures in rather cavalier style.

R. M. Wenley
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Catalogue of the Crosby Brown Collection of Musical Instruments of all Nations. III. Part I., Africa. New York. The Metropolitan Museum of Art. 1907. Pp. xxii + 79; pl. 26.

This is a new volume continuing the series of catalogues of this fine collection, to which there have been various references in Science from time to time. Gallery 37 is devoted to the "instruments of savage tribes and semi-civilized peoples"; those from Oceanica and America will be dealt with in future volumes; the present one relates wholly to Africa. The "Egyptian type case" shows that most types of African and even European instruments were well developed thousands of years ago. The plates show a great variety of harps, lyres and lutes, as well as many forms of the curious Negro *Zauze*, sometimes misleadingly called "nail-fiddle" although the metal tongues are plucked, not bowed. (It is to be hoped that in a later edition the incorrect name "key" for the vibrating tongues or bars of this instrument will be changed.) Flutes and similar wind instruments do not appear to be numerous or highly developed, but many horns, especially of ivory, are figured. The drum and the xylophone or *Marimba* require many pages.

The introductions and indexes are similar to those in former volumes and are good; the ethnographical notes are fuller than ever and add many interesting details.

Charles K. Wead

Washington, D. C.,
June, 1907

SOCIETIES AND ACADEMIES

THE AMERICAN MATHEMATICAL SOCIETY

Six years ago the summer meeting and colloquium of the society was held at Cornell University. In the intervening years the Society has met successively at Evanston, Boston, St. Louis, Williamstown and New Haven. This year the summer meeting was again convened at Cornell University, on Thursday and Friday, September 5–6. Forty-seven members were in attendance. By close economy of time the scientific proceedings were condensed into two sessions on Thursday and a morning session on Friday. Friday afternoon was devoted to an excursion on Lake Cayuga, Mr. H. H. Westinghouse, of the university, having kindly placed his steam yacht at the members' disposal. The evening gatherings at the Town and Gown Club also furnished pleasant opportunities for social intercourse.

The first session opened with an address of welcome by Professor Wait, head of the university department of mathematics. At the close of the meeting resolutions were adopted expressing the society's appreciation of the generous hospitality of the university and its officers.

The president of the society, Professor H. S. White, occupied the chair, being relieved by Professors Fine and E. B. Van Vleck. The council announced the election of the following persons to membership in the society: Thomas Buck, University of Chicago; Arnold Dresden, University of Chicago; T. H. Hildebrandt, University of Chicago; W. J. King, Harvard University; J. O. Mahoney, High School, Dallas, Texas; J. F. Messick, Randolph-Macon College; H. W. Powell, College of the City of New York. Six applications for membership in the society were received. The total membership is now 569.

The following papers were read at the meeting:

L. E. Dickson: "Modular theory of group matrices."

W. B. Ford: "Sur les équations linéaires aux différences finies."

R. D. Carmichael: "On the classification of plane algebraic curves possessing fourfold symmetry with respect to a point."

R. D. Carmichael: "Note on certain inverse problems in the simplex theory of numbers."

W. B. Carver: "The ten special Γ^4_6, configuration in the Pascal hexagram."

E. O. Lovett: "Generalization of a problem of Bertrand in mechanics."

E. O. Lovett: "The invariants of a group which occurs in the problem of n bodies."

E. R. Hedrick: "A peculiar example in the theory of surfaces."

E. R. Hedrick: "A smooth closed curve composed of rectilinear segments."

R. D. Carmichael: "On certain transcendental functions defined by a symbolic equation."

D. C. Gillespie: "On the canonical substitution in the Hamilton-Jacobi canonical system of differential equations."

G. A. Miller: "The invariant substitutions under a substitution group."

G. A. Miller: "Methods of determining the primitive roots of a number."

Virgil Snyder: "On a special algebraic curve having a net of minimum adjoint curves."

James McMahon: "The differential geometry of the vector field. Second paper: lamellar field."

L. E. Dickson: "Commutative linear groups."

L. E. Dickson: "A simple derivation of the canonical forms of linear transformation."

Edward Kasner: "Geometric interpretation of integrating factors."

Edward Kasner: "The conformal representation of geodesic circles."

A. R. Schweitzer: "On the relation of right-handedness in geometry."

F. L. Griffin: "On the law of gravitation in the binary systems, II."

F. L. Griffin: "Certain trajectories common to different laws of central force."

E. W. Davis: "Colored imaginaries. I, Imaginaries in the plane."

E. W. Davis: "Colored imaginaries. II, Imaginaries in space."

C. H. Sisam: "On the equations of quartic surfaces in terms of quadratic forms."

Virgil Snyder: "On the range of birational transformation of curves having genus greater than the canonical form."

G. A. Miller: "Third report on recent progress in the theory of groups of finite order."

Oswald Veblen: "Continuous increasing functions of ordinal numbers."

H. S. White and Miss K. G. Miller: "Note on Lüroth's type of plane quartic curve."

W. B. Fite: "Concerning the degree of an irreducible linear homogenous group."

Arthur Ranum: "Concerning linear substitutions of finite period with rational coefficients."

R. P. Stephens: "Certain curves of class n having $n-2$ tangents in any given direction."

A. L. Van Benschoten: "Curves of genus 4 which remain invariant under birational transformation."

M. E. Sinclair: "On a discontinuous solution in the problem of the surface of revolution of minimum area."

Maurice Fréchet: "Sur les opérations linéaires (troisième note)."

A. G. Greenhill: "The elliptic integral in electromagnetic theory."

The next meeting of the society will be held at Columbia University on October 26. The San Francisco section met at the University of California on September 30; the Southwestern Section will meet at Washington University on November 30, and the Chicago section at the University of Chicago on December 30–31. The annual meeting of the society will be held at Columbia University on December 27–28.

F. N. Cole,
Secretary

SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

Twenty-fourth meeting.—Carnegie Institution's Station for Experimental Evolution, Cold Spring Harbor, Long Island, New York. June 22, 1907. President Flexner in the chair.

Members present: Atkinson, Beebe, Carrel, Davenport, Donaldson, Ewing, Field, Flexner, Gibson, Gies, Hatcher, Lusk, Meltzer, Meyer, Shaffer, Wallace, Wadsworth.

Members elected: C. H. Bunting, Rufus I. Cole, Charles W. Duval, William W. Ford, Frederick P. Gay, Isaac F. Harris, James W. Jobling, Oskar Klotz, Paul A. Lewis, Thomas B. Osborne, H. T. Ricketts.

Abstracts of the Communications[1]

Demonstrations of Methods and Results of Pedigree-breeding of Plants and Animals: Charles B. Davenport.

Four series of pedigreed poultry were shown to illustrate certain laws of inheritance, as follows: (1) Darwin's case of "reversion," (2) The production of a frizzle-silky race, (3) Particulate inheritance of plumage color, (4) Independence in inheritance of the different characters.

There were also demonstrations of inheritance of characters in canaries, of Œnothera (evening primrose) and its mutants, of branching and branchless sunflowers, of variability of chromosomes in Œnothera and its mutants, and of inheritance of abnormal wing venation in the vinegar fly, Drosophila.

Further Studies of the Effects of the Exposure of Sperm to X-rays: Charles R. Bardeen.

Eggs of *Rana pipiens* fertilized by sperm exposed to Roentgen rays for one hour all develop abnormally. The abnormalities begin to appear during the gastrulation period. Cases of spina bifida are not uncommon. In a lot of several hundred eggs, nearly all of which were fertilized, only one specimen survived two weeks. This was much stunted in growth and very abnormal in shape. Of 80 eggs of the common toad exposed only 15 minutes to Roentgen rays only 4 larvas survived one month. Most of the larvas were markedly abnormal in shape. Of the sur-

[1] The abstracts presented in this account of the proceedings have been greatly condensed from abstracts prepared by the authors themselves. The latter abstracts of the communications appear in Number 7 of Volume IV. of the society's proceedings, which may be obtained from the Secretary.

vivors, two are large and apparently normal and two are undersized. Only one individual out of 150 eggs, fertilized by sperm exposed 37 minutes to the rays, has survived one month and this individual is only half the normal length and breadth. In a group of 250 eggs, fertilized by sperm exposed to Roentgen rays for an hour and ten minutes, all exhibited marked abnormalities of development and the least abnormal larva and longest survivor died a week after the eggs were fertilized.

The susceptibility of sperm of anura to X-rays is in marked contrast to that of paramecia. Exposure of paramecia for 12 hours to rays of the same intensity caused no visible effects on form, rate of division or process of conjugation.

The author exposed the sperm of the toad to heat at 50° and 65° C. for from 15 to 20 minutes. This exposure destroyed the fertilizing power of most of the spermatozoa, but the few eggs fertilized by such sperm developed normally. Sperm exposed for from 15 to 20 minutes to the following solutions: 1/40 per cent. formol, 12.5 per cent. ethyl alcohol, 1 per cent. NaCl, 1/32 per cent. HCl and 1/32 per cent. KOH, had the power of fertilizing toad eggs. Practically all of the resulting larvas that have been preserved appear normal at the end of one month after fertilization of the eggs. Sperm exposed to stronger solutions of the same substance for 15 to 20 minutes seems to lose power of fertilizing. No abnormal larvas have developed from the few eggs thus fertilized.

On the Absorption of Toxins by the Nerves: Cyrus W. Field.

In a large number of animals into which both tetanus and diphtheria toxin had been injected, Field found that the toxin was present in the peripheral nerves leading from the inoculated area; and by the use of the right dose, and at a certain time, free toxin could be demonstrated in the cord, although the other tissues of the body, including the blood, liver, spleen and kidneys, contained no free toxin.

Not only is this true for diphtheria and tetanus, but it is likewise true for the toxin produced from *B. botulinus* and also for colloidal ferric hydrate. In the case of colloidal ferric hydrate, by removing the nerves and cord, and subjecting them to treatment with a solution of hydrogen sulphide, Field was able to detect the presence of iron. By using small doses he was able to show the presence of these colloids in the nerves near the points of injection and in the spinal cord, but of none whatever in the other tissues, except at the points of inoculation.

The author concluded that tetanus toxin does not travel by way of the axis cylinder because of any specific attraction of the nerve tissue for this toxin, but it passes up because the lymphatic flow of the nerve is progressing constantly from the periphery to the center. For this reason the toxin, when injected subcutaneously or intramuscularly, is taken up by the nerves and passes to the cord; and the first symptom to develop is the local tetanus because the local cells are the first that come in contact with the toxin.

It is a well-known fact that in giving diphtheria or tetanus toxin intravenously a much greater dose is required to cause death than when either is injected subcutaneously or intramuscularly. The reasons for this are first, that the toxin injected into the blood may be combined with some of the constituents of the blood and therefore rendered inactive; second, that by injection into the blood the toxin is diluted to a very great extent, whereas when injected subcutaneously, a portion passes into the lymphatics of the nerves and is not mixed with the general body fluids, before it reaches the central nervous system.

The author's general conclusion was that tetanus does not travel up a nerve by reason of any specific attraction of nervous tissue, but because the lymphatic flow in a nerve is from the periphery toward the center.

On the Formation of a Specific Precipitin in Rabbits after Inoculation with Colloidal Platinum and Colloidal Silver: Cyrus W. Field.

Some time ago in testing the precipitating effect of rabbit serum on various positive and negative colloids, Field found that such serum precipitated colloidal platinum and colloidal silver to a fair degree. Serum from one rabbit precipitated colloidal platinum completely at 1–100, slightly at 1–200 and not at all at 1–500. This serum precipitated colloidal silver completely at 1–10, partially at 1–100 and not at all at 1–250. After receiving three injections of colloidal platinum in three weeks this rabbit's serum then precipitated colloidal platinum completely at 1–1,000, slightly at 1–1,250 and not at all at 1–1,500, whereas it precipitated colloidal silver completely at 1–100, slightly at 1–250 and not at all at 1–500.

Serum from another rabbit originally precipitated colloidal platinum completely at 1–50, partially at 1–100 and not at all at 1–250. The same figures held good for colloidal silver. After three injections of colloidal silver during three weeks, this rabbit's serum precipitated the colloidal silver completely at 1–500, partially at 1–1,000, and not at all at 1–1,250, whereas colloidal platinum was completely precipitated at 1–200, partially at 1–500 and not at all at 1–1,000.

In other words the precipitating power of the serum of the first rabbit, after it received three injections of the colloidal platinum, had increased from 1–100 to 1–1,000 (= *ten times*), whereas for the colloidal silver there was only a very slight increase. Serum from the second rabbit, which received colloidal silver, increased its precipitating power from 1–100 to 1–500, whereas for the colloidal platinum, from 1–100 to 1–250. In both these rabbits there was then an increase in the precipitating power of the serum after injection of these colloidal metals, and it would seem that they increased more for the metal injected than for the other.

Remote Results of Transplantations of Blood Vessels: Alexis Carrel.

The results of arterio-arterial, veno-venous and arterio-venous anastomoses have remained excellent for many months. No stenoses or aneurisms have been observed on the arterial anastomoses even six to seven months after operation. No stenosis occurred after venous anastomosis: a cat, in which an Eck fistula was made eighteen months ago by Carrel and Guthrie, is still in good health. The same is true of an arterio-venous anastomosis: the jugular vein and the carotid artery of a dog were anastomosed by Carrel and Guthrie twenty-two months ago, and now strong thrills and pulsations can easily be detected by palpation of the jugular vein. The modifications of the vascular walls are produced mainly by the changes of blood pressure. No great change occurs if the blood pressure of the transplanted vessel be not modified. Segments of carotid, aorta or vena cava of one animal, transplanted in the carotid, aorta or vena cava of another animal of the same size and species, do not undergo any important anatomical modification. If blood pressure is diminished, the wall of the transplanted vessel becomes thinner. Six months after the operation, it was found that the wall of the carotid transplanted in the external jugular vein was thinner than the normal one. If blood pressure is increased, hypertrophy of the wall ensues. A segment of external jugular vein interposed between the cut ends of the carotid artery was a little dilated and its wall was as thick as the arterial wall, eight months after the operation. In other cases, there was no dilation of the lumen of the vessels. As a rule when a vein is anastomosed uniterminally to an artery, its lumen is found to be dilated, six or seven months after the operation. Nevertheless, after one year the lumen may progressively diminish in size, as was seen in a dog operated upon twenty-two months ago.

It may be concluded that transplanted blood vessels adapt themselves to the pressure by thinning or thickening their walls.

The Dependence of Gastric Secretion upon the Internal Secretion of the Salivary Glands: John C. Hemmeter. (Communicated by S. J. Meltzer.)

The relations of the gastric secretion to the salivary glands are illustrated by the following clinical and experimental observations:

1. In four cases of Mikulicz's disease, with

normal conditions of the blood, the stomach was found to secrete no gastric juice during the course of the disease. Mikulicz's disease consists of a benign chronic swelling of all the salivary and lacrimal glands.

2. In dogs with accessory stomachs (Pawlow) the removal of all the salivary glands abolishes permanently all gastric secretion.

3. The gastric secretion is not started in such dogs by feeding them with food masticated and well insalivated by other normal dogs.

4. The abolished gastric secretion is temporarily resumed by peritoneal or intravenous injections of extracts made of salivary glands of normal dogs.

5. This temporary resumption takes place even if the stomach be completely isolated from the central nervous system.

These observations justify the conclusion that normal gastric secretion depends upon the internal secretion of the salivary glands.

The Influence of Diuresis upon the Toxic Dose of Magnesium Salts: S. J. Meltzer.

A dose of 2 grams of magnesium sulphate per kilo is absolutely fatal for the rabbit; the animal dies of respiratory paralysis in less than an hour. All the animals recovered from the effects of such a dose, however, if an intramuscular injection of diuretin was given soon after the subcutaneous injection of the magnesium salt. Diuretin is theobromin and acts as a diuretic. The deeply narcotized animals usually urinate about fifteen or twenty minutes after its injection; by that time, at least, the bladder can be felt to be full. The largest dose that should be given is about 0.1 gram. In larger doses diuretin itself is liable to become toxic.

When the dose of the magnesium sulphate exceeded 2 grams per kilo, the injection of diuretin alone could not save the animals. But if, in addition to the diuretin, an intravenous infusion of 0.9 per cent. solution of sodium chloride was instituted, animals recovered from doses of magnesium sulphate amounting to as much as 2.25 grams per kilo. When still larger doses of the magnesium salt were given, the animals usually died of respiratory paralysis in less than fifteen minutes and before any diuresis could have been effected. Animals recovered from doses as large as 2.5 grams per kilo, if, in addition to the diuretin injection and the venous transfusion, artificial respiration was early resorted to. For doses larger than 2.5 grams per kilo all three measures together usually proved of no avail; with this dose the early death of the animal is usually due greatly to paralysis of the heart.

The Toxicity of Magnesium Nitrate when given by Mouth: S. J. Meltzer.

It is a daily experience that large doses of magnesium sulphate can be taken by mouth without any other than a purgative effect. Meltzer has given to rabbits, by mouth, 7 grams or more of magnesium sulphate (in molecular solution) per kilo, without any unfavorable effects. The same applies also to magnesium chloride and various other magnesium salts. Meltzer has, however, discovered that magnesium *nitrate,* when given *by mouth,* is capable of producing a toxic effect like that of magnesium sulphate when introduced subcutaneously.

When a dose of 6 grams of magnesium *nitrate* per kilo (in molecular solution) is given by mouth to a rabbit, the animal soon becomes paralyzed and narcotized, and dies in from thirty to forty minutes of respiratory paralysis. Fifteen or twenty minutes after the administration, the appearance as well as behavior of the animal is exactly like that of one which received magnesium sulphate subcutaneously (2 grams per kilo). A dose betweeen 4 and 5 grams per kilo causes in general the same symptoms, but in a gradual way; the animal dies after five or six hours. A dose of between 3 and 4 grams causes no serious effects, but for six or eight hours after its administration the animal remains in a soporous state; it sits in one place with eyes closed and head drooping; a loud noise wakes it up and it attempts to move about or to eat, but in a few minutes it falls asleep again.

This toxicity of the magnesium nitrate is apparently due to its greater absorption from the gastro-intestinal canal. It is certainly not due to diminished elimination through the kidneys; on the contrary, it acts in some degree as a diuretic, and, when given by subcutaneous injection, the animal withstands a somewhat greater proportionate dose of the nitrate than of the sulphate or chloride, probably because the nitrate increases somewhat the diuresis.

Meltzer believes that the effects observed can not be attributed to the nitrate radical (NO_3). He studied the toxic effects of sodium nitrate after administration by mouth and compared the resultant symptoms with those seen after administration of magnesium nitrate; the contrast was sharp. Even with a dose of 12 grams of the sodium nitrate per kilo there is never such anesthesia or paralysis as that caused by the magnesium salts; on the contrary, the animal is all excitement and restlessness. Besides, the late death of the animal after administration of sodium nitrate is due to circulatory disturbances, whereas after poisoning with magnesium salts the animal dies of respiratory paralysis.

On the Promoting Influence of Heated Tumor Emulsions on Tumor Growth: Simon Flexner and J. W. Jobling.

The authors gave the results of a study of an effect on the growth of a transplantable sarcoma of the rat which is produced by inoculation of rats with an emulsion of the tumor cells, previously heated for half an hour to 56° C. This emulsion was injected into the peritoneal cavity and the fragments of living tumor were introduced beneath the skin. The promoting effect on the growth of the tumor fragments to be described became evident in several sets of experiments in which the tumor emulsion (*unheated*), blood serum, bouillon, salt and Ringer solutions were injected in the same manner, with which substances this promoting effect was not obtained. When the inoculation of the fragment of the tumor was made twenty-four hours after the injection of the unheated emulsion, no difference was noted between the control rats and the rats injected with the enumerated materials, including the *heated* emulsion. But when the fragments were inoculated ten or more days (up to thirty days) later, then the number of tumors which developed in the rats receiving the *heated* emulsion tended to exceed the controls and the other series mentioned; they grew with greater rapidity so as to reach double the size of the controls or even a still greater size, and showed a far smaller percentage of recoveries (retrogressions). This promoting influence was exerted on the tenth day after inoculation, and various indications suggested that it was less effective at the expiration of thirty days. On the other hand, it appeared that when the injections of heated emulsion were repeated once or twice at ten-day intervals, the conditions of the animal favoring the growth and persistence of the tumors were maintained and possibly were even still further increased.

On the Chemical Inactivation and Regeneration of Complement: Hideyo Noguchi.

It was found that all acids and alkalies are able to inactivate complements when used in sufficient concentrations. With monobasic acids it takes about 1 c.c. of $n/40$ solution to inactivate 1 c.c. of active serum. About 1 c.c. of $n/50$ solution of the acid is, as a rule, neutralized by the inherent alkalinity of the serum.

With alkalies 0.3 c.c. (ammonium hydrate 0.8 c.c.) is sufficient for inactivation. The acids and alkalies are, when used without serum, hemolytic in the quantities stated. But when mixed with the serum they—serum and chemicals—lose their activity mutually.

Alkaline salts of strong acids are not anti-complementary unless a certain limit of concentration is exceeded. Sodium carbonate is anti-complementary in a relative, but not in an absolute sense. All other salts employed are strongly anti-complementary, the magnesium salts being the least inhibiting. Calcium and barium salts of strong acids are absolute anti-complements, while the carbonates of these elements may or may not be active upon complements.

Complements which are inactivated by acids can be reactivated by neutralizing the acids with alkalies, and *vice versa*. The action of various acids, alkalies and salts upon complements renders the complement-deviation phenomenon for forensic purposes less safe, because the materials are often impure in practical cases.

Various soluble salts of oleic acid are accelerators of the complementary action of serum.

A Study of the Influence of Lecithin on Growth: A. J. Goldfarb.

The author's experiments included three series of over 1,200 tadpoles. In each series the lecithin varied in strength from 1/150 per cent. to 2 per cent. (the toxic concentration). In one series (1) the tadpoles were not fed, in another (2) they were given minced worm, in the third (3) they were given a liberal supply of plant débris.

The tadpoles that were kept in lecithin solutions did not show any greater increment in weight or size than the controls of the same series. There was a marked difference, however, in both the size and weight of tadpoles of one series compared with the tadpoles in the corresponding solution of another series, due to the kind (and presumably the amount) of food given. Individuals of series 1 were smallest and weighed least; those of series 3 weighed from 3 to 6 times as much and were twice as broad as the tadpoles in the same strength of solution in series 2.

Young kittens (over 50 in number) were treated as follows:

Series 1. Lecithin was injected subcutaneously daily in doses of from 0.0006 to 0.004 gram. Control animals received subcutaneously equal volumes of physiological salt solution. The increase in weight was somewhat greater in the kittens that received the lecithin.

Series 2. Lecithin was injected subcutaneously in doses of from 0.01 to 0.32 gram daily. The kittens that received the lecithin gained, in some cases, as much as 7 per cent. over the control animals.

Series 3. Lecithin was fed daily in amounts of from 0.01 to 0.32 gram. With very few exceptions, these kittens weighed from 2 per cent. to 12 per cent. more than the controls.

The best results were obtained in the feeding experiments, with doses of from 0.04 to 0.16 gram daily; yet under these conditions, the actual difference in weight between the kittens fed with lecithin and those not so fed was small, amounting on an average to about 7 per cent. Whether the same quantity of any other fatty or simple nutrient compound would result in an equal increment has not yet been determined, but will be investigated with other matters bearing upon the interpretation of the results recorded above.

Comparative Data for the Elementary Composition and the Heat of Combustion of Collagen and Gelatin: Charlotte R. Manning and William J. Gies.

Comparative elementary analyses, as well as determinations of the heat of combustion, of many samples of connective tissue collagen and gelatin, have indicated that there is a closer agreement between the mother substance and its derivative, on these two planes of comparison, than the prevalent idea of their chemical relationship would indicate. The following sample data show this quite clearly:

	C Per Cent.	H Per Cent.	N Per Cent.	Heat of combustion. Cal.
Tendocollagen[2] ..	48.85	8.01	18.02	5,387
Tendogelatin ...	48.28	7.84	17.56	5,350

The differences between the above figures for nitrogen and hydrogen contents harmonize with the observation by Emmett and Gies that nitrogen is eliminated as ammonia when collagen is converted into gelatin by treatment with hot water, and also strengthen their conclusion that gelatin is not a simple hydrate of collagen.

On the Fate of Elastose after its Subcutaneous or Intraperitoneal Injection: a Preliminary Inquiry into the Origin and

[2] Each of these products was desiccated (before analysis) to constant weight by the Benedict-Manning process *in vacuo.* See the *American Journal of Physiology,* 1905, XIII., p. 309.

Nature of Bence Jones's Protein: REUBEN OTTENBERG and WILLIAM J. GIES.

Bence Jones's protein and crude elastose not only have several proteose properties in common, but unlike the ordinary proteoses, each is precipitated from its aqueous solution when the latter is gently warmed. Bence Jones's protein occurs in the urine of patients suffering from sarcoma of bone marrow or from osteomalacia. Bone contains considerable elastin-like material (osseoalbumoid). The possibility that Bence Jones's protein may be a derivative of osseoalbumoid, and the great desirability of making our knowledge of this elusive protein more definite, led the authors to undertake a study of a preliminary phase of the work that will be necessary to determine the points at issue.

They sought first to ascertain whether crude elastose, when injected subcutaneously or intraperitoneally, is eliminated in the urine and whether it can be detected there by the heat-precipitation test. When thus introduced in dogs, crude elastose, obtained by peptolysis of ligament elastin prepared by Richards and Gies's method, not only promptly appears in the urine, but may be identified in it by the heat-precipitation test. This observation makes it clear that if elastose is formed in bone or in any other tissue by any pathological process, the elastose thus produced may pass into the urine without material alteration of the characteristic property referred to.

Before proceeding further in this connection, the authors intend to prepare osseoalbumoid (bone elastin?) in sufficient quantity to permit of a determination of the nature of its proteoses and their fate when injected into animals.

WILLIAM J. GIES,
Secretary

THE AMERICAN PHILOSOPHICAL SOCIETY

A STATED meeting of the society was held on Friday, October 4. The following papers were read:

DR. EDGAR F. SMITH: "New Results in Electrolysis."

PROFESSOR SIMON NEWCOMB: "A Study of Correlations among Terrestrial Temperatures, as indicating Fluctuations in the Sun's Thermal Radiation."

R. H. MATHEWS, L.S.: "Language of the Burdhawal Tribe in Gippsland, Victoria."

DISCUSSION AND CORRESPONDENCE

SMELTER SMOKE

IN an article recently published in the *Journal of the American Chemical Society* (July, 1907) on gases *vs.* solids, an investigation of the injurious ingredients of smelter smoke, by Professor W. Clarence Ebaugh, the results of the investigation are contrary to previous experiments along this line as well as to the experience of the writer, and it appears to him that the conclusions are based on misleading and inadequate data.

The writer is very much averse to criticizing the work of a brother scientist, but since the results of this work, if uncontradicted, will undoubtedly be used in many cases between smelters and injured parties, it would only seem proper to point out the fallacy of the arguments. Not to be misunderstood in the beginning, the writer wishes to explain that he is firmly of the opinion that the solid emanations which arise from a smelter (including perhaps, soluble copper, arsenic and lead compounds) are injurious to vegetation in so far as they reach it, but that such emanations reach as far as sulphur dioxide or have so injurious an action appears to be decidedly doubtful and has certainly not been proven in the paper published by Professor Ebaugh.

On page 953, of his article, Professor Ebaugh says:

> In the first place, the injury (in the Salt Lake Valley) does not occur simultaneously over a large area; on the contrary, it seems to be restricted in its range. Secondly, it is rarely found that a number of crops grown successively in a given locality show the effect of smelter smoke, etc.

The above assertions are, of course, only the personal opinion of Professor Ebaugh but in the main they are diametrically opposed to the experience of the writer who has examined smelter injury at Redding, Cal., Ducktown, Tenn., and at Anaconda, Mont. In every case examined by the writer the injury *did* occur simultaneously over a large area, if by a large area is understood the country around the smelter for from five to twenty miles, depending upon the direction of the prevailing winds. Again, it has been the writer's experience that successive crops in a given locality *did* show the effect of smelter fumes. This is especially shown in the vicinity of Ducktown, Tenn., where the same deciduous trees surrounding the smelter are injured each year until they finally succumb.

On page 953, Professor Ebaugh also gives a table showing the amount of sulphur dioxide per million parts of air found in the atmosphere in the vicinity of the smelters in the Salt Lake Valley and in his discussion of this table ends it by saying, "Nevertheless, the very small amount of sulphur dioxide found is certainly surprising." The force of this last sentence is to lead one who knows nothing about the matter to believe that such amounts as were found are insignificant and would not be injurious. Let us look at the figures of 524 cases examined. In 213 cases, or 40.66 per cent., the amount of sulphur dioxide is one part per million, or more, of the air. By actual experiments of careful workers[1] it has been shown that plants are injured by repeated treatments of one part sulphur dioxide per million parts of air. Again, as explained by Professor Ebaugh himself, such results as were obtained in the above table are practically valueless since the concentration of sulphur dioxide might be, say, one to 1,000, for a short while and hence do serious injury, while if this amount were spread over an average time of twelve to twenty-four hours, it would amount to a very little.

On page 954, Professor Ebaugh with the following data: (*a*) size of stacks, (*b*) sulphur dioxide content of stack gases, (*c*) width and thickness of the visible smoke column at a given time and place, calculates roughly what the sulphur dioxide content of the atmosphere would amount to. The writer is unable to see with the above data how such a calculation could be made with even rough accuracy. Even if such calculation could be made, however, the results are valueless in judging what the sulphur dioxide content of the atmosphere might be at varying distances from the smelter, since on some days and when the fumes float in certain directions, as up ravines, etc., the sulphur dioxide content of the atmosphere of these ravines might be ten times that of a point on the level country much nearer the smelter and yet in both cases the three factors above be practically the same.

[1] See Haselhoff and Lindau's work on "Injury to Vegetation by Fumes."

On page 956, Professor Ebaugh says:

Concerning paragraph 5, it should be noted that in the open country one seldom finds sulphur dioxide acting for a long-continued time in one place, etc.

The writer has in some of the regions which he has visited seen the smelter smoke act on the same side of a mountain range and on the same plants for days at a time and has been told by competent parties residing in the country, that this action in the same direction often continued for weeks.

On pages 957 and 958, Professor Ebaugh gives his data in regard to the injurious effect of sulphur dioxide on foliage. Note that in every case but one (where one part sulphur dioxide to 50,000 parts of air were used and twelve fumigations on sugar beets) injurious results were noted. Even with the above data, which at the best were not conclusive, because more fumigations should have been used on the sugar beets not injured by twelve fumigations, Professor Ebaugh draws the following conclusion on page 969:

By no means is sulphur dioxide to be considered as harmless, especially in an enclosed space and in a moist climate, but we are forced by the weight of the evidence to the conclusion stated in the introduction, viz., that heretofore undue emphasis has been laid upon the injurious effect of sulphur dioxide upon growing plants, and that the harmful action of the solid emanations from the smelters—the so-called flue dust—has been seriously underestimated.

The writer is absolutely unable to see that the weight of evidence points in the direction indicated by the above quotation. Judging by the results on fumigation with sulphur dioxide carried out by him in conjunction with the results obtained by using the solid emanations on plants, we can at least say, "not proven."

On pages 962, 963, 964, 965, 966 and 967, are given tables showing: (1) the chemical composition of the flue dust; (2) the lead, copper and arsenic content of hay around a smelter; (3) the lead, copper and arsenic content of the dust from rafters in barns around the smelter; (4) the action of mixtures of flue dust and soil on sugar beets; (5) the action of aqueous solution of flue dust on sugar beets.

His results on the composition of the samples of hay around the smelter and the composition of the dust from rafters in barns, etc., are of only limited value since he does not give the distances from the smelter at which each of these samples was taken. His results on the effect of the mixture of flue dust and soil, as well as his results with the water solution on sugar beets, are practically valueless, since the actual amount of flue dust added to the leaves and its relative weight as compared with the leaves are not given. In other words, it is impossible from the data given to judge how much of the flue dust (including arsenic, copper, etc.) was added to each leaf. Without the above data it is impossible to tell whether the amount of lead, copper and arsenic added by dusting or spraying corresponds to the amount of these substances actually found in the hay around the smelter, or not. Here again the experiments are incomplete and here again one may say, "not proven."

On the whole, then, it is at once evident that the series of experiments carried out by Professor Ebaugh do show that the solid emanations from a smelter in certain strengths are extremely toxic to plants. They do not show, however, that such solid emanations are injurious when added in the strengths which may settle on the leaves around a smelter.

Again, all the fumigation experiments with sulphur dioxide, carried out in the above article, except one, show that the leaves were injured and many of the experiments (such as they were) on treating plants with the diluted solid emanations show injury, yet with the proofs as evenly balanced as they are, the author of the article claims that "we are forced by the weight of evidence to the conclusion stated in the introduction, *viz,* that heretofore undue emphasis has been laid upon the injurious effect of sulphur dioxide upon growing plants, and that the harmful action of the solid emanations from the smelters—the so-called flue dust—has been seriously underestimated."

Finally, the writer would draw attention to the country in the vicinity of Ducktown, Tenn. Here, well-marked injury to forests can be noted at a distance of about twenty-five miles from the smelter, yet solid emanations which might have any injurious effect on foliage consist almost entirely of copper compounds since arsenic is not present in appreciable amounts, if at all. It is well known that grape foliage, apple foliage and foliage of certain other plants can be treated with about 1 part of copper sulphate, to 400 to 500 parts of water, without injury. It is hardly possible to believe that the copper compound from the smelter could be carried in more than a trace (if even to this extent) for a distance of twenty-five miles. It is less possible to believe that they could be carried in such quantities as to amount to 1/400 of the rain that might fall upon them, yet here we have a case of decided injury at a distance of twenty-five miles. Add to the above reasoning the fact that the sulphur trioxide content of the injured foliage can be shown to be greater than that of the uninjured foliage beyond the range of damage and that the leaves of the trees have the nearly characteristic appearance of sulphur dioxide injury, and it is impossible to reach any conclusion except that the trees were injured by sulphur dioxide.

While it is possible, in fact extremely probable, that in actual practise solid emanations in the vicinity of a smelter do injure vegetation to a greater or less extent, this fact has not been proven by the above experiments.

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THE ARTIFICIAL PRODUCTION OF MUTANTS—A SUGGESTION

In Science for September 13, 1907, Professor Spalding calls attention to the importance of Dr. MacDougal's discovery that new modifications can be made in plants by injecting various substances into the capsules of plants before the ovules are fertilized. I wish to suggest the desirability of a study of these artificially produced plant forms with a view to ascertaining whether the production of the new forms is coincident with a change in the number of chromosomes. It has recently been shown that deVries's *Enothera gigas* has twice as many chromosomes as the parent species, and a year ago I suggested that perhaps all of deVries's mutants may differ in a similar way from *Enothera lamarkiana.*

It is a very interesting question, should we find these mutations due to increase or decrease in the number of chromosomes, just what importance these mutations have in evolutionary progress. It certainly seems to me that we are a little hasty in ascribing to them fundamental importance. So far as we have any evidence on the subject, it seems to me that these mutants must be looked upon as aberrant forms, and in a certain sense degenerates. That all evolutionary progress depends upon these so-called mutations seems to me to be entirely out of the question, assuming, of course, a change in the number of chromosomes to be at the basis of mutation in the deVriesian sense. Too many distantly related species have the same number of chromosomes.

W. J. Spillman
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AN ALLEGED DIPHTHERITIC ANTITOXIN

To the Editor of Science: Notwithstanding previous denials on my part in the local papers and before the Columbus Academy of Medicine letters are being sent out by a local firm connecting my name with an alleged discovery of a new diphtheritic antitoxin.

I wish to state that such statements are absolutely unwarranted, as I have made no tests or investigations of any character concerning the preparation, nor have any such tests been made in my laboratories.

A. M. Bleile
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Ohio State University

SPECIAL ARTICLES

HEART ROT OF SASSAFRAS SASSAFRAS CAUSED BY FOMES RIBIS[1]

So far as known, the tree *Sassafras sassafras* has very few enemies among the fungi, and is commonly very free from their attacks. It has, however, been found by the writer to be quite seriously affected in Missouri by one of the Polypori. The fungus which has thus been found attacking the *Sassafras* has been submitted to Professor Chas. H. Peck, and was pronounced to be *Fomes Ribis* (Schum.) Gillet. This fungus commonly occurs only upon the stems and roots of various species of small shrubby plants. It has been found occurring on rose bushes, currant bushes, and on living stems of *Symphoricarpus occidentalis.* The occurrence of this fungus upon any of the large trees seems to be anomalous, yet in a limited district it has been found thus occurring very plentifully and destructively.

Fomes Ribis occurs quite generally throughout European countries, but it does not seem to be at all common in America. It has been reported from as widely separated points as Kansas, Missouri, New Jersey and New York.

A careful examination showed that the sporophores of this fungus were always located at points where the heartwood of the tree had been exposed either by the breaking of branches or the splitting of the main trunk. No exception to this rule was observed, although the search was quite careful throughout the locality where the fungus was found. The smallest tree which was found to be affected was about five inches in diameter, and had abundant heartwood in the stem and older branches. The *Sassafras* has but few annual rings of sapwood, and thus reaches an age at which it has heartwood very early. It is believed that in this disease it is absolutely

[1]-Published with permission of the Secretary of Agriculture.

necessary for the tree to attain the age at which it has heartwood before it may become infected by this fungus; that is, it seems to be necessary that the tree shall have heartwood and that the heartwood must be exposed by some injury before *Fomes Ribis* is able to obtain an entrance to its trunk. While there is a bare possibility of exceptions to this rule, no such were found. Practically every tree, in which wounds were found by which the heartwood was exposed, was infected and bore one or more sporophores of the fungus. *Fomes Ribis* enters the trunk of the tree apparently in the same manner as do most of the so-called "wound parasites." It obtains a foothold in one of these injuries and gradually progresses into the heartwood of the stem; once entrance has been obtained to this, the rot gradually extends upward, downward and sidewise from its first entrance into the trunk until the tree finally dies or is broken over by the wind. When the heartwood has become completely affected through its entire thickness, the adjacent rings of the sapwood seem to prematurely assume the characters of heartwood, and the rot finally extends into them also; so that in extreme cases the sapwood is found to be even thinner than it normally is. Cases were found where this process apparently extended until the tree was killed outright. A number of other cases were also found in which but a single ring of the sapwood still remained alive.

The heartwood of *Sassafras* is normally of a rather dark brown color, but when attacked by this fungus it assumes a slightly redder and lighter color. This color of the rotted wood is undoubtedly due to the fact that the mycelium of this fungus is itself of a ferruginous brown color, and thus helps to give a brown coloration to the tissues within which it is located. The wood is very porous, and the fungus fills the large vessels and tracheids with its brown mycelium, forming tangled masses which completely fill their cavities. Between the healthy and the rotted wood is a narrow black zone. Microchemical tests indicate that the fungus does not exert a very active delignification upon the cell walls, but that the tendency seems to be for a more or less complete local solution of the entire cell wall. The rotted wood seems to retain much of its original appearance, yet has been very decidedly weakened by the action of the fungus in dissolving the middle lamellæ from between many of the cells, so that they adhere to each other but slightly.

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NOTE ON THE MOVEMENT OF MOISTURE IN SOILS

In teaching physics it is particularly important, whenever practical, to show how phenomena observed in nature are explained by facts discovered in the laboratory. For this reason it is hoped that the following, though containing nothing new in physics, may be of interest to those who have the honor of instructing others.

It is known that evaporation, condensation and surface tension, all play important roles in the movement of moisture in soils. The U. S. Department of Agriculture has conducted a number of investigations on these subjects, and has reached some valuable conclusions. The effects, however, due to changes in surface tension, produced by changes in temperature, have not been considered in detail, nor do I recall having seen them mentioned anywhere else.

It has long been known that the surface tension of a liquid increases as its temperature is lowered. In the case of water at least this relation continues at the same rate to and below the ordinary freezing point, provided the liquid condition is maintained; and therefore any change in the temperature of the soil, such as takes place to a greater or less extent every day and night, must produce a corresponding movement of its moisture towards the colder parts, where the surface tension is greatest. Besides, evaporation, which is most rapid where the temperature is highest, and condensation, which is greatest on the coldest surfaces, produce moisture movements in the same direction as those made by temperature changes in surface tension, so that the several causes work together. But, owing to a variety of influencing conditions, their relative importance in producing the common effect is not easy to determine.

Evidently, since the temperature is nearly always lower at night than during the daytime, the upper layer of the soil thus cooled is usually damper in the early morning than in the afternoon; and whenever the temperature falls very greatly, the corresponding large increase in the tension and in the condensation at the cold surface will take much moisture from the warmer soil beneath. It is largely, if not wholly, this that leads to wet soils so often seen on cold mornings when there has been no rain, and to the surprising depth of mud that frequently follows a thaw. It accounts too for the considerable supply of moisture from the deeper soil in the production of ice columns—spewing of the ground.

This temperature effect on surface tension, on condensation and on evaporation also greatly conserves that moisture already in the earth and keeps it in motion. That is, the moisture is brought to the surface in greatest abundance only when the temperature there is low and therefore the rate of evaporation into the air small; and whenever the surface temperature is increased, leading to a higher rate of evaporation into the air, the moisture is drawn away to the colder portions of the soil beneath, where it is protected from the winds by the top layers which it has just left.

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BOTANICAL NOTES

A NEW EDITION OF ENGLER'S SYLLABUS

The fifth edition of Engler's "Syllabus der Pflanzenfamilien" (Borntraeger, Berlin) which appeared during the present year, differs very little from the fourth (1904). A few slight changes are made here and there, but the book is essentially unchanged. Yet it has been reprinted from beginning to end, illustrating afresh the fact that in book publishing the Germans do things better than we. Had this book been published in this country the first edition would have been electrotyped, and it is safe to say that this fact would have made it impossible for us to have had four subsequent editions in the short time which has elapsed since the appearance of the first. The electrotyping of a scientific book ought not to be permitted, for it always means that the publisher proposes to keep it in essentially its present form for as long a time as possible. Why should not American botanists insist that their publishers shall not electrotype their books, and that the editions be of a limited number of copies? We ought not to be tied to our dead and disowned ideas merely because our publishers prefer to embalm them by electrotyping.

Another suggestion which comes to one who examines this book is that the term "Thallophyta" is passing. It has long stood as an omnibus term to cover many different groups of plants. In the third edition (1903) the term was abandoned, and in its place appeared eleven coordinate terms, which were reduced to ten in the fourth and fifth editions. One looks in vain for this time-honored name for the lower plants. It has apparently gone to the limbo to which have been banished "cryptogam" and "phenogam." The Vegetable Kingdom is now divided into twelve grand divisions or phyla, namely; *Phytosarcodina, Schizophyta, Flagellata, Dinoflagellata, Zygophyceae, Chlorophyceae, Charales, Phaeophyceae, Rhodophyceae, Eumycetes* (all of which formerly were lumped together as "Thallophyta"), *Embryophyta asiphonogama* (*Bryophyta* and *Pteridophyta*), and *Embryophyta siphonogama* (*Spermatophyta*). And yet we shall doubtless have the text-books speaking about "Thallophyta" for years to come, as though the group had not been long since abandoned.

A NEW LABORATORY MANUAL

An interesting and no doubt useful laboratory manual is Müller's "Mikroskopisches und Physiologisches Praktikum der Botanik für Lehrer" (Teubner, Leipzig), a little book of 240 pages and 235 text illustrations. Twenty pages are given to the microscope and microscopical technique, and this is followed by 27 pages on the cell, 147 on the structure of phanerogams, and 44 on experimental plant physiology. The topics are well chosen, the directions clear and explicit, while the numerous illustrations help to make the text still more easily understood.

MORE AGRICULTURAL BOTANY

In preparing a book on "Forage and Fiber Crops in America" (Orange Judd Co.) for the farmer and the student of agriculture, Professor Hunt, of Cornell University, has at the same time rendered a valuable service to botany and the botanists. He has brought together many important structural and economic facts in which the general botanist is interested, but which have been difficult of access, because so widely scattered in botanical and agricultural books and periodicals. Here the botanist will find good, if rather popular, descriptions of the common grasses and other plants used for forage, and such fiber plants as cotton, flax, hemp, jute, ramie, etc. The scientific side of the discussions has been unusually well done, and the botanist is not constantly shocked, as he is too often in books of this kind, by anachronisms in nomenclature and spelling. The illustratious are well selected, and were put in to help the text, and not as pretty pictures to help sell the book. Every picture has its use as fully as every sentence in the text, which is more than can be said of many books, botanical as well as agricultural.

STUDIES IN PLANT CHEMISTRY

Under the title "Studies in Plant Chemistry, and Literary Papers" (Riverside Press) have been collected the papers and addresses of the late Mrs. Helen Abbott Michael. They are of interest to botanists as being among the first of their kind published in this country. They include such titles as "A Chemical Study of *Yucca angustifolia*" "Certain Chemical Constituents of Plants considered in Relation to their Morphology and Evolution," "Plant Analysis as an Applied Science," "The Chemical Basis of Plant Forms," "Comparative Chemistry of Higher and Lower Plants," etc. Of the author and her work Dr. Wiley, of Washington, says: "She was among the very first investigators in this country who began in a systematic way to study the relations of chemical composition to species of plants and to plant growth." And again, "The most important result of her investigations pointed out in a clear way the regular existence of certain classes of chemical bodies in certain species of plants."

Many botanists remember the author of these papers with pleasure as an attractive young woman (Miss Helen C. De S. Abbott) who twenty or more years ago used to be one of the most interested members of the American Association for the Advancement of Science. To a charming personality she added a deep and intelligent interest in the scientific work of the association, especially in chemistry and botany. In the appreciative biographical sketch by Nathan H. Dole, which fills the first hundred pages, we learn much of her life of helpfulness and usefulness, of her marriage, her travels, her scientific and philanthropic plans, and of her untimely death on the twenty-ninth of November, 1904. Her name deserves to be placed high in the short list of scientific women in America, and the botanists especially should remember her as one who wrought well and faithfully in her efforts to add to the upbuilding of a neglected department of their science.

Charles E. Bessey

The University of Nebraska

THE DENSITY OF THE ETHER[1]

1. The theory that an electric charge must possess the equivalent of inertia was clearly established by J. J. Thomson in the *Phil. Mag.* for April, 1881.

2. The discovery of masses smaller than atoms was made experimentally by J. J. Thomson, and communicated to Section A at Dover in 1889.

3. The thesis that the corpuscles so dis-

[1] Abstract of a paper read by Sir Oliver Lodge before Section A of the British Association for the Advancement of Science, Leicester, 1907.

covered consisted wholly of electric charges was sustained by many people, and was clinched by the experiments of Kaufmann in 1902.

4. The concentration of the ionic charge, required to give the observed corpuscular inertia, can be easily calculated; and consequently the size of the electric nucleus, or electron, is known.

5. The old perception that a magnetic field is kinetic has been developed by Kelvin, Heaviside, FitzGerald, Hicks and Larmor, most of whom have treated it as a flow along magnetic lines; though it may also, perhaps equally well, be regarded as a flow perpendicular to them and along the Poynting vector. The former doctrine is sustained by Larmor, as in accordance with the principle of least action, and with the absolutely stationary character of the ether as a whole; the latter view appears to be more consistent with the theories of J. J. Thomson.

6. A charge in motion is well known to be surrounded by a magnetic field; and the energy of the motion can be expressed in terms of the energy of this concomitant field—which again must be accounted as the kinetic energy of ethereous flow.

7. Putting these things together, and considering the ether as essentially incompressible —on the strength of the Cavendish electric experiment, the facts of gravitation, and the general idea of a connecting continuous medium—the author reckons that to deal with the ether dynamically it must be treated as having a density of the order 10^{12} grams per cubic centimeter.

8. The existence of transverse waves in the interior of a fluid can only be explained on gyrostatic principles, *i. e.*, by the kinetic or rotational elasticity of Lord Kelvin. And the internal circulatory speed of the intrinsic motion of such a fluid must be comparable with the velocity with which such waves are transmitted.

9. Putting these things together, it follows that the intrinsic or constitutional vortex energy of the ether must be of the order 10^{33} ergs per cubic centimeter.

Conclusion.—Thus every cubic millimeter of the universal ether of space must possess the equivalent of a thousand tons, and every part of it must be squirming internally with the velocity of light.

THE AMERICAN ELECTROCHEMICAL SOCIETY

The twelfth general meeting of the American Electrochemical Society will be held in New York City on October 17, 18 and 19 (Thursday, Friday and Saturday of the third week of October).

The meeting will be opened by an evening session on Thursday, October 17. This session as well as the morning session on Friday, October 18, will be held at the Chemists' Club, 108 West 55th Street. The morning session of October 19 will be held in Havemeyer Hall, Columbia University. Headquarters for registering and information are at the Chemists' Club. Hotel headquarters are at the Hotel Cumberland, 54th Street and Broadway.

On Friday afternoon an excursion will be made to the laboratories of Mr. Thomas A. Edison. Mr. Edison will receive the visitors personally. A special car will be provided on the Delaware, Lackawanna & Western Railroad, the train leaving West 23d Street at 2:15. On the evening of Friday a subscription dinner will be held in Liederkranz Hall. Ladies are specially invited.

On Saturday afternoon an excursion will be made to the new Pennsylvania Railroad power plant at Long Island City, the New York Electrical Testing Laboratories and other points or places of interest to be announced at the meeting. On the evening of Saturday a smoker will be tendered to the American Electrochemical Society by the Chemists' Club.

During the meetings there will be an exhibition of some novelties of electrochemical products and apparatus at the Chemists' Club.

The program of papers is as follows:

Thursday Evening

8 P.M.—Reception and session at Chemists' Club.

8:40 P.M.—Illustrated lecture on "Diamond and

Moissanite: Natural, Artificial and Meteoric," by Dr. Geo. F. Kunz.

9:30 P.M.—Lecture on "Deflocculated Graphite," by Mr. E. G. Acheson, of Niagara Falls, with demonstrations and experiments.

Friday Morning Session

9 A.M.—At Chemists' Club.

"On the Electrothermic Reduction of Iron Ores," by Messrs. Albert E. Greene and Frank S. MacGregor.

"Discussion of the Electric-Furnace Experiments for the Production of Pig Iron at Sault Ste. Marie," by Dr. Joseph W. Richards.

"Electric-Furnace Experiments," by Dr. H. N. Potter.

"Discussion of Moissan's Experiments on the Boiling Points of the Metals," by Dr. O. P. Watts.

"The Electrometallurgy of Zinc," by M. Gustave Gin.

"A New Application of Chlorine in Metallurgy," by Mr. C. E. Baker.

"The Heat Conductivity of Carbon," by Mr. F. A. J. Fitzgerald.

"Granular Carbon Resistors," by Professor S. A. Tucker.

Saturday Morning Session

9 A.M.—At Columbia University.

"Physico-chemical Notes on the Aluminates of Soda," by Mr. P. B. Sadtler.

"Action of Ammonium Persulphates on Metals," by Mr. J. W. Turrentine.

"Note on the Use of the Capillary Electrometer for Alternating Voltages," by Mr. M. G. Floyd.

"Electroscopic Determination of Radium in some Tufa at Hot Springs, Arkansas," by Dr. Herman Schlundt.

"Electrolytic Separation of Silver and Copper," by Mr. H. W. Gillett.

"Electrolytic Determination of Minute Quantities of Copper," by Mr. E. E. Free.

"Electrolytic Reduction of Nitric Acid," by Dr. H. E. Patten and Robinson.

"Electrochemical Methods for the Qualitative and Quantitative Determination of Free Silicon in the Presence of Silica, Silicates, Oxides, Free Carbon and Carborundum," by Mr. W. R. Mott.

"On the Nature of Electrolytic Conductors," by Dr. L. Kahlenberg.

"The Electrolytic Theory of the Corrosion of Iron," by Dr. A. S. Cushman. (Lecture with demonstrations.)

Professor S. A. Tucker, Columbia University, is chairman of the New York Committee. Mr. Alois von Isakovics, Monticello, N. Y., is the local secretary.

SCIENTIFIC NOTES AND NEWS

A COMMITTEE has been formed in Germany, with the Prussian minister of state as chairman, to found an institution in honor of Dr. Robert Koch. It is intended that the institution shall be devoted to research into the means of checking the diffusion of tuberculosis and that it shall be a permanent memorial of the discovery of the tubercle bacillus by Professor Koch twenty-five years ago. Appeal is made for contributions sufficient to make the institution a tribute of gratitude to Koch, similar to those with which the name of Pasteur has been honored in France and that of Lister in England.

SIR ARCHIBALD GEIKIE, as president of the Geological Society of London, welcomed the members and delegates to the centenary celebrations on the morning of September 26, and in the afternoon gave an address on the state of geology at the time when the Geological Society was founded.

DEAN M. E. COOLEY, of the engineering department of the University of Michigan, has been appointed by the Interstate Commerce Commission to act as chairman of a committee which will meet in Washington to consider devices for the automatic control of trains.

AT the forty-fourth annual meeting of the American Veterinary Medical Association, recently held in Kansas City, Mo., Dr. W. H. Dalrymple, M.R.C.V.S., Louisiana State University, Baton Rouge, was elected president for the ensuing year.

PROFESSOR THEODORE W. RICHARDS, having returned from Germany, has been reappointed chairman of the division of chemistry in Harvard University. During his absence the chairmanship was held by Professor C. Loring Jackson.

PROFESSOR T. A. JAGGAR, of the Massachusetts Institute of Technology, has returned to

Boston from his trip to the Aleutian Islands, where he spent the summer studying the volcanic conditions.

Professor Eugene A. Smith, Teachers College, Columbia University, is at present in Japan. He is spending his sabbatical year in the orient, collecting mathematical books and manuscripts bearing on the history of mathematics.

Dr. George Grant MacCurdy, curator of the archeological collection of Peabody Museum, Yale University, has during the past vacation mapped out the state of Connecticut for a systematic archeological survey, bearing particularly on the traces of the Connecticut Indians.

Dr. C. L. Muralt, of the University of Michigan, has been granted a short leave of absence, in order that he may act as consulting engineer in the electrification of the Altberg tunnel, which is being constructed by the Austrian government.

Mr. Raymond E. Priestley, a student of University College, Bristol, has been appointed geologist of the expedition to the Antarctic under the command of Lieutenant Shackleton. The party sails from Liverpool in October, for New Zealand, to join the *Nimrod*.

Professor and Mrs. David P. Todd left Lima on September 28, for the United States, by way of the Isthmus of Panama. While in Lima Mrs. Todd gave an address before the Geographical Society, her subject being "The Ainus of Japan," among whom she resided for several weeks in 1896, while the *Coronet* Eclipse Expedition was stationed in Yezo.

Professor William Bateson, of Cambridge University, is giving, on October 3 and 31, and November 1, at the Brooklyn Institute of Arts and Sciences, three illustrated lectures, entitled "Demonstrations of Mendel's Principles of Heredity."

Inaugural exercises will be held on October 18 at 2 p.m. at Urbana, Ill., to celebrate the election of Dr. Wm. A. Noyes as professor of chemistry, head of the Department of Chemistry, and director of the Chemical Laboratory of the University of Illinois. The following program has been arranged:

Address: President Edmond J. James, Ph.D., LL.D.

"The Relation of Chemistry to Agriculture," by Professor H. A. Weber, Ph.D., professor of agricultural chemistry, Ohio State University.

"The Relation of Chemistry to the Industries," by Dr. William McMurtrie, Ph.D., consulting chemist, New York City.

"The Teaching of Chemistry in State Universities," by Professor George B. Frankfurter, Ph.D., dean of the School of Chemistry, University of Minnesota.

"The Contribution of Chemistry to Modern Life," by Professor William Albert Noyes, Ph.D., professor of chemistry and director of the chemical laboratory, University of Illinois.

At 8 o'clock in the evening an inaugural banquet will be provided, and on the following morning the Chemical Laboratories will be open to the public for inspection.

During the academic year 1907–08 Columbia University offers the following series of non-technical lectures descriptive of the achievements of science and modern scholarship. While the lectures are intended primarily for the officers, students and alumni of the university, they will also be open to the public. The lectures will be given in 309 Havemeyer Hall on Wednesday afternoons at 4:10 p.m.

Oct. 16—Mathematics, Professor Keyser.
23—Physics, Professor Nichols.
30—Chemistry, Professor Chandler.
Nov. 6—Astronomy, Professor Jacoby.
13—Geology, Professor Kemp.
20—Biology, Professor Wilson.
27—Physiology, Professor Lee.
Dec. 4—Botany, Professor Richards.
11—Zoology, Professor Crampton.
18—Anthropology, Professor Boas.
Jan. 8—Archeology, Professor Wheeler.
15—History, Professor Robinson.
22—Economics, Professor Seager.
Feb. 12—Politics, Professor Beard.
19—Jurisprudence, Professor Munroe Smith.
26—Sociology, Professor Giddings.
Mar. 4—Philosophy, President Butler.
11—Psychology, Professor Woodworth.
18—Metaphysics, Professor Woodbridge.
25—Ethics, Professor Dewey.
Apr. 1—Philology, Professor Jackson.
8—Literature, Professor Peck.

Foreign papers report that an institution for promoting science and scholarship has been founded in Rome, with headquarters at the Vatican Observatory under the direction of Father Hagen. The institution is to have offices in the different countries.

The late Josephine Naprstek has bequeathed 80,000 crowns to the Naprstek Bohemian Industrial Museum in Prague. The museum, which is to a large extent ethnographical in character, was established by Herr and Frau Naprstek.

An anonymous gift of $2,500 has been received for the investigation of cancer at the Harvard Medical School. This will be used under the advice of the Cancer Commission now administering the Caroline Brewer Croft Fund.

A Bulgarian Museum of Natural History was opened in Sofia at the beginning of this month.

We learn from the *Journal of the New York Botanical Garden* Mr. Oakes Ames, of North Easton, Mass., has presented his valuable collection of living orchids to the garden. This collection is the result of many years work. It contains many valuable plants, some of great rarity.

The International Statistical Institute will hold its twelfth biennial session at Paris in 1909.

On the occasion of the seventy-eighth Congress of the German Men of Science and Physicians, held at Dresden from September 15 to 21, the city of Dresden appropriated for the meeting 20,000 Marks, 14,000 of which were spent for the entertainment of members. This has aroused objections from the public, and in the daily as well as the scientific press, the practise of public entertainment on such occasion has been criticized severely.

The International Congress of "Free Thinkers" was held from September 8 to 12, in Prague. The attendance consisted largely of scientific men and physicians. Honors were paid to the memory of Berthelot, the great chemist, formerly president of the French branch of the society.

The U. S. Civil Service Commission announces the postponement to November 6–7, 1907, of the examination scheduled for October 23–24, to fill the position of anatomist (male), at $1,600 per annum, in the Army Medical Museum. The commission further announces an examination on October 23, to fill vacancies as they may occur in the position of laboratory helper, at $600 per annum each, in the Bureau of Chemistry, Department of Agriculture, at Washington, and in other cities in which the department has established chemical laboratories. Vacancies in this position are constantly occurring. Chemical laboratory helpers will be required to render assistance in any work that does not require the training of a chemist. Their duties will be the cleaning of apparatus, the construction and repairing of apparatus, the care and storage of chemicals and apparatus, the preparation of stock solutions and of special reagents, and any other work in which they can save the time of chemists by performing labor that is essentially manual and does not require the training of a chemist, but is of such a nature that it can only be performed by one who has had training and experience in a chemical laboratory. Applicants must indicate in their applications that they have had actual experience as helpers in chemical laboratories. It is not desired that qualified chemists should apply for this examination, as the work will not be of an analytical character. Analysts are appointed from the examination for scientific assistant. Age limit eighteen years or over on the date of the examination.

Detailed statistics of the world's production of coal, by countries, are incorporated in an advance chapter from "Mineral Resources of the United States, Calendar Year 1906," on the production of coal in 1906, by E. W. Parker, chief statistician of the United States Geological Survey, which will soon be ready for distribution. It appears that the world's production of coal in 1906 amounted to about 1,106,478,707 short tons, of which the United States produced 414,157,278 tons. Since 1868, during a period of thirty-nine years, the percentage of the world's total coal produced by the United States has increased from 14.32 to 37, and this country now stands far in the lead of the world's coal producers. It has been only eight years since the United States supplanted Great Britain as the leading coal producer, yet the increase in this country has been so enormous that Great Britain can no longer be classed as a competitor. In 1906 the United States produced 43.7 per cent. more coal than Great Britain and 85 per cent. more than Germany. Exclusive of Great Britain the United States in 1906 produced more coal than all the other countries of the world combined. It may also be noted that more than 96 per cent. of the world's production of coal is mined in countries lying north of the equator, the countries south of the line contributing less than 20,000,000 tons annually.

The Allahabad *Pioneer Mail*, as quoted in *Nature*, states that the programs of work of the various scientific departments for the current year, as settled by the Indian Board of Scientific Advice, have been published. The following points are of general interest: (1) Schemes have been completed for the establishment of a central research station and agricultural colleges at Poona, Lyallpur, Cawnpor, Bhagalpur, Coimbatore, Nagpur and Mandalay, and a staff of three European specialists has been sanctioned for each; (2) new agricultural stations are to be started (*a*) at Aligarh for the improvement of cotton, (*b*) at Partabgarh for the study of rice and sugarcane, (*c*) at Jullundur, (*d*) at Bassein, and (*e*) at Bhagalpur and Bankipur (Bengal). The special investigations connected with the improvement of Indian cottons and wheats will be continued, but the scheme for the improvement of Indian tobacco will largely remain in abeyance until the appointment of a specialist for this purpose. The study of sugar-cane diseases and of practical measures for the suppression of cotton boll-worm in the Punjab will also be continued. The lead mines of the southern Shan States, the tin deposits in Mergui, Tavoy and Karenni, the oil beds in the Irrawaddy Valley and the Arakan districts, the volcano of Popa in the Myingyan district, Burma, the copper beds of Singhbhum, and the manganese mines in the central provinces, are all to be the subject of geological investigation.

UNIVERSITY AND EDUCATIONAL NEWS

By the will of the late D. Willis James, of New York City, the sum of one million dollars divided into ten portions of $100,000 each, is bequeathed to educational and charitable institutions, the former being: Columbia University, Yale University, Amherst College, Union Theological Seminary, Cooper Union and the Hampden Institute.

Miss Anna T. Jeanes has bequeathed practically all her estate, said to be of the value of $5,000,000, for public purposes, including the establishment of a hospital. A bequest of certain property, estimated to be between $500,000 and $3,000,000 in value, has been bequeathed to Swarthmore College on condition that it abandon intercollegiate sports. A committee of the board of managers has been appointed to report on the question.

The buildings of the Barnard Medical College and the Centenary Hospital, St. Louis, valued at $300,000, have been transferred to the University of Missouri, which expects to provide the two final years in medicine at St. Louis, after 1908.

A cablegram from Tientsien states that an imperial edict decrees compulsory education for everybody in China, and adds, furthermore, that the people are to be taught the principles of constitutional government, in order that they may be better fitted to elect representatives when a parliament is created. The throne expresses anxiety to establish parliamentary institutions, but adds that the success thereof depends upon the education and knowledge possessed by those called upon to govern.

A new university library, to cost one million Marks, will be erected in Tübingen.

The name of the high school in Münster was changed on August 22, to "Wilhelms Westfalian University." A school of medicine will be established.

The University of Cincinnati has established two new chairs of full rank since the beginning of the last academic year; the chair of political and social science, not yet filled, and that of geology and geography, filled by the selection of Professor Nevin Melancthon Fenneman, Ph.D., lately professor of geology in the University of Wisconsin. The successor of Professor Thomas Evans, head of the department of chemistry, whose death occurred in the early summer, is Professor Lauder William Jones, Ph.D., lately instructor in chemistry in the University of Chicago. Two professors have been retired on the Carnegie Foundation: Edward Miles Brown, English, and Wayland R. Benedict, philosophy. The former's successor has not been chosen and Associate Professor George Morey Miller is in temporary charge of the department. The new professor of philosophy is H. Heath Bawden, Ph.D., lately of Vassar College. The following appointments of assistant professors have become effective: John J. Porter, M.E., assistant professor of metallurgy; Alice C. King, M.A., assistant professor of elementary education; Frank W. Ballou, B.S., assistant professor of the history and principles of education. Professors Louis Trenchard More, physics, and Marco F. Liberma, Romance languages, have returned from leaves of absence of one year, spent in Europe.

At the University of Missouri, F. W. Liepsner, assistant in chemistry, has resigned to accept an instructorship in chemistry at the University of Virginia, and Philip L. Gile, assistant in agricultural chemistry, has resigned to accept a position in the new government laboratory in Porto Rico. Dr. Herman Schlundt has been promoted to be professor of physical chemistry. The following new appointments have been made in chemistry: Dr. P. F. Trowbridge, assistant professor of agricultural chemistry; Norman D. Hendrickson, C. R. Moulton and L. F. Shackel, assistants in agricultural chemistry; J. A. Gibson, instructor in analytical chemistry; Merle Randall, assistant; R. M. Smith, student assistant in organic chemistry; Clarence Estes, problem reader. Dr. R. B. Gibson has been appointed instructor in physiological chemistry (department of physiology).

Professor Lewis E. Young, formerly professor of mining and metallurgy at the University of Colorado, has succeeded Professor Geo. E. Ladd as director of the Rolla School of Mines.

Dr. Franklin Hamilton, pastor of a methodist episcopal church at Boston, has been elected chancellor of the American University at Washington.

Dr. H. D. Senior, associate in anatomy in the Wistar Institute, Philadelphia, has been appointed professor of medicine at Syracuse University.

Professor Douglas W. Johnson has resigned his assistant professorship in the Massachusetts Institute of Technology, to accept an appointment as assistant professor of physiography in Harvard University. The latter appointment was made a year ago, but during the past year Professor Johnson continued to give instruction in the geological department of the institute, his resignation taking effect September 1 of the current year.

Bertram G. Smith has resigned his position as instructor in biology in Lake Forest College to accept an appointment as instructor in zoology in Syracuse University. Arthur B. Clawson, formerly assistant in zoology in the University of Wisconsin, will succeed Mr. Smith at Lake Forest.

Graduates of Harvard University in zoology have accepted appointments as follows: A. M. Banta, Ph.D. ('07), professor of biology at Marietta College, Marietta, O., to succeed Professor T. D. Biscoe, retired; H. S. Davis, Ph.D. ('07), professor of biology in the University of the State of Florida, at Gainesville, Fla.; Calvin O. Esterly, Ph.D. ('07), professor of biology in Occidental College, Los Angeles, Cal.; W. M. Barrows, S.M. ('06), assistant in zoology at the New Hampshire State Agricultural College and Experiment Station, Durham, N. H.; Donald W. Davis, A.B. ('05), associate professor of biology at Sweet Briar Institute, Sweet Briar, Va.; W. G. Vinal, S.M. ('07), instructor in biology at Marshall College, Huntington, W. Va.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, OCTOBER 18, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

SYSTEMATIC ZOOLOGY: ITS PROGRESS AND PURPOSE *

It is most fitting that in this year, when the scientific world is commemorating the natal centenaries of two naturalists who have been regarded as the chief systematists of their times, consideration should be given to the subject and object of their old pursuits. Carl Linné, whose bicentenary has been celebrated, was the man who first provided an elaborate code of laws for the nomenclature of all the kingdoms of nature and set an example to others by provision of concise and apt diagnoses of the groups and species he recognized. Louis Agassiz, who was born during the centenary year of Linné, gave a grand impulse to the study of nature in his adopted country, raised it in popular esteem, taught new methods of work and directed to new lines of investigation.

Of all the students of nature from the time of Aristotle to the century of Linné, none requires present notice as a systematic zoologist except John Ray, who was the true scientific father of the Swede. Born in 1627, he flourished in England during the last quarter of the seventeenth century, and died only two years before the birth of Linné.

JOHN RAY

It was long ago truly affirmed by Edwin Lankester that "Ray has been pronounced by Cuvier to be the first true systematist of the animal kingdom, and the principal

* Address before the Section of Systematic Zoology, Seventh International Zoological Congress.

guide of Linné in the department of nature."[1] He, indeed, made a pathway in the zoological field which Linné was glad to follow, and to some extent he anticipated the brightest thoughts of the great Swede. He, for example, in a dichotomous systematic table of the animal kingdom,[2] first combined the lunged fish-like aquatic and viviparous animals in a special category (Vivipara) in contrast with all the other vertebrates, leaving to Linné only the privilege of giving a name to the class. He recognized a group of lung-bearing animals distinguished by a heart with a single ventricle, including quadrupeds and serpents, and thus appreciated better than Linné the class which the latter named Amphibia. He likewise gave the anatomical characters, based on the heart, blood and lungs, which Linné used for his classes.

THE BEGINNINGS OF SYSTEMATIC ZOOLOGY

Systematic zoology is a vast subject, and any address devoted to it must necessarily be very partial. It need only be partial for such an assemblage of masters in zoology as I have the great honor to address, and I shall confine the present discourse to a review of some of the elements which have made systematic zoology what it now is. I will venture, too, to submit reasons why we may have to take a somewhat different view of the achievements of some men than did our early predecessors. If in doing so I may appear to be dogmatic, I entreat you in advance to insert all the "ifs" and "I thinks" and "perhaps" that you may deem to be necessary. For the present purpose, the work of two who exercised, each for a considerable time, a paramount influence on opinion and procedure, deserves notice, especially because there has been much misapprehension respecting their benefits to natural science. The two were Carl Linné and Georges Cuvier; the one exercised dictatorship from the middle of the eighteenth century till some time after its close; the other was almost equally dominant from the first quarter of the last century to well into the third quarter. No other men approached either of these two in influence on the work of contemporaries or successors. The evil features, as well as the good, were transmitted to and adopted by later authors. Therefore, a notice of those features may help us to a correct judgment of the history of our subject, and may help to show why the disciples of the great Swede, as well as the great Frenchman, complicated many problems they investigated. Sufficient time has elapsed to enable us to judge knowingly and impartially.

CARL LINNÉ

Linné needs no eulogy this year, for his praises have resounded over the whole world. Born just two centuries ago (1707), he published the first edition of the "Systema Naturæ" in 1735, and his last (twelfth) in 1766. The various editions mark to some extent the steps of man's progress in the knowledge of nature during the time limited by the respective dates.

Linné's industry was great, his sympathies wide-spread, and his method in large part good. Compare the "Systema Naturæ" and other publications of Linné with works published by earlier authors, and the reason for the active appreciation and esteem which greeted his work will be obvious. The typographical dress and the clearness of expression left no doubt as to what the author meant, and enabled the student to readily grasp his intentions. His boldness in giving expression to new ideas insured success when they deserved

[1] Lankester, Edwin, "The Correspondence of John Ray," 1848, p. 485.

[2] "Synopsis Methodica Animalium Quadrupedum et Serpentini Generis," 1693, p. 53.

it. Although Ray had already recognized four of the great groups or classes of vertebrates, he had not named them and there were vernacular terms only for the birds and fishes. Linné, for the first time, applied names to the other groups, and admirable ones they were. Mammalia and Amphibia were the coinage of Linné and are still retained; Mammalia or mammals by all; Amphibia or amphibians by the majority for one of the classes now adopted.

A great advance, too—an inspiration of genius, indeed—was the segregation of the animals combined under the class of mammals. Popular prejudice was long universal and is still largely against the idea involved. Sacred writ and classical poetry were against it. It seemed quite unnatural to separate aquatic whales from the fishes which they resembled so much in form and associate them with terrestrial hairy quadrupeds. How difficult it was to accustom one's self to the idea is hard for naturalists of the present day to appreciate. Linné himself was not reconciled to the idea till 1758, although Ray had more than hinted at it more than threescore years before. At last, however, in no uncertain terms, he promulgated it. It was a triumph of science over popular impressions; of anatomical consideration over superficial views.

But mingled with the great benefactions were many views which long influenced naturalists, but which modern zoology has overthrown.

LINNÆAN CLASSES

After the tentative arrangements published in the original first, second and sixth editions of the "Systema," Linné thoroughly revised his work, and first consistently applied the binomial method of nomenclature to all species in the tenth edition, published in 1758. Six classes were admitted with equal rank, no category being recognized between the class and kingdom. The classes were the Mammalia or Mammals, Aves or Birds, Amphibia, Pisces, Insecta and Vermes. The first four of these classes mainly correspond with the Aves and nameless groups of Ray.

During the Linnæan period of activity the invertebrates were little understood, and his treatment of that enormous host, referred to his two classes Insecta and Vermes, contrasts rather than compares with that at the present time. Naturally, the vertebrates were much better comprehended, and all such then known, with a single exception, were distributed among four classes just named, the Mammalia, Aves, Amphibia and Pisces. The solitary exception of exclusion of a true vertebrate from its fellows was the reference of the genus *Myxine* to the Vermes, next to *Teredo,* the ship-worm. The first two classes were adopted with the same limits they now have, but the Amphibia and Pisces were constituted in a truly remarkable manner. The class of Amphibia was a creation of Linné, and was simply contrasted with his Pisces by having a lung of some kind ("*pulmone arbitrario*"), while the Pisces have exposed branchiæ ("*branchiis externis*"). The Amphibia, thus defined, were made to include as orders: (1) Reptiles or Reptilia, having feet; (2) Serpentes, footless, and (3) Nantes, having fins.

Under the Nantes were first grouped the lampreys, the selachians, the anglers (*Lophius*), and the sturgeons (*Acipenser*). In the twelfth edition were added *Cyclopterus, Balistes, Ostracion, Tetraodon, Diodon, Centriscus, Syngnathus* and *Pegasus.* The Nantes were added to the Amphibia partly because of the assumption that the branchial pouches of the lampreys and the selachians were lungs and partly on the authority of Dr. Alexander Garden, of Charleston, S. C., who mistook the peculiar transversely expanded and partly double air-bladder of *Diodon* for a lung. With such errors of observation as a basis, Linné apparently assumed that all the associated genera also had lungs. Gmelin, in his edition of the "Systema Naturæ" (generally called the thirteenth), corrected this error, and returned all the Nantes to the class of Pisces, thus reverting to the older view of Linné himself. The Pisces of Linné included only the genera left after the exclusion of those just named and also of *Myxine*, which last was referred to the class of Vermes between the leeches (*Hirudo*) and the ship-worms (*Teredo*).

LINNÆAN GENERA

The genera of Linné were intended and thought by him to be natural,[3] and natural groups some of the so-called genera were, but present opinion assigns to most of them a very different valuation from that given in the "Systema Naturæ." Some of the genera of invertebrates were extremely comprehensive. For example, *Asterias* included all the members of the modern classes of Stelleroidea or Asteroidea and Ophiuroidea; *Echinus* was coequal with the Echinoidea; *Cancer, Scorpio, Aranea, Scolopendra* and *Julus* were essentially coextensive with orders or even higher groups of the zoologists of the present time. Others were so heterogeneous that they can not be compared with modern groups. Thus *Holothuria*, in the last edition of the "Systema," was made to include four holothurians in the modern sense, a worm, a Physaliid, and three tunicates; in other terms, the so-called genus included representatives of four different classes, and even branches of the animal kingdom.

It has been stated by various writers that the genera of Linné were essentially coequal with the families of modern authors, but, as has been indicated, such is by no means the case. Other striking exceptions to the generalization may be shown.

Not a few of the genera of Vertebrates, although not of the superlative rank as several of the Invertebrates, were equivalent to orders of modern zoology; such were, in the main, *Simia, Testudo, Vespertilio* and *Rana*. *Simia* included all the anthropoid Primates or monkeys except man; *Vespertilio* was equivalent to the order *Chiroptera* less the genus *Noctilio; Testudo* was exactly equal to the order Testudinata or Chelonia; *Rana* to the order Salientia or Anura. A number of other genera of one or few species known to Linné were also of ordinal or subordinal value.

In striking contrast with the range of variation of such genera were others, of which several, well represented in northern waters, may be taken as examples. *Scorpæna* was distinguished simply because it had skinny tags on the head;[4] *Labrus* because it had free membranous extensions behind the dorsal spines;[5] and *Cobitis* because it had the caudal peduncle of regular height[6] and scarcely constricted as usual in fishes. These characters are of such slight systematic importance that they have not been used in the diagnoses of the genera by modern ichthyologists. Further, use of them misled even Linné as well as his successors. Some of the consequences may be noticed.

The close affinity of the "Norway haddock" or Swedish Kungsfisk or Rödfisk (*Sebastes marinus*) to the typical *Scorpæna* was unperceived and that species

[3] Classis et ordo est sapientiæ, genus et species Naturæ opus.—Linn. "Syst. Nat.," I., 13.

[4] *Scorpæna.* Caput cirris adspersum.

[5] *Labrus.* Pinna dorsalis ramento post spinas notata.

[6] *Cobitis.* Corpus vix ad caudam angustatum.

referred to *Perca* and even confounded with a *Serranus*.

The typical *Labri* of the northern seas do, indeed, have filiform processes of the fin membrane behind the dorsal spines, but most of the species referred by Linné to *Labrus* do not, and among them is a common sunfish (*auritus* = *Lepomis auritus*) of America.

The genus *Cobitis* was made to include Cyprinodonts of the genera *Anableps* and *Fundulus*, and thus were associated fishes differentiated from the Loaches by characters of immeasurably more importance than the trivial one which was the cause of their juxtaposition.

Another conspicuous instance of a trivial character used as generic, and contrasting with very important differentials of species included under the same genus, is furnished by *Esox*. The essential Linnæan diagnostic character is the protrusion of the lower jaw.[7] Nine species were referred to the genus which represent no less than eight distinct and, mostly, widely separated families of modern systematists.[8] Several of the species do not have the prominent lower jaw, and one of them (*Lepisosteus osseus* of modern ichthyology) is especially distinguished by Linné himself on account of the shorter lower jaw.[9]

But the most marked cases of insignificance of characters used to differentiate by the side of those serving for combination are found in the class Amphibia.

The genus *Lacerta* is made to include all but one of the pedate Lizards and the Crocodilians as well as the salamanders, but the "dragons," or Agamoid lizards with expansible ribs, are set apart in an independent genus.[10]

The genus *Coluber* was intended to embrace all the snakes, except those with a rattle or undivided abdominal and caudal scutes,[11] and hence the vipers and copperheads, so very closely related to the rattlesnakes, were combined with ordinary snakes instead of with their true relations.[12]

Many of the genera of Linné, in fact, were very incongruous, and the great Swede not infrequently failed to interpret and apply their characters in the allocation of species. A few cases furnished by common European or American fishes will illustrate what is meant.

Specimens of the common gunnell or butterfish were received by Linné at different times and once referred to his genus *Ophidion* and at another time to the genus *Blennius*, and the same species stands under both names in the last two editions of his "Systema."

The common toadfish of the Americans (*Opsanus tau*) was placed in the genus *Gadus* (*tau*) and a nearly related species of the Indian Ocean was referred to the genus *Cottus* (*grunniens*).

The common ten-pounder of the American coast served as the type and only species of the genus *Elops*, and also as a second species of the genus *Argentina*, although the characters given were in decided discord with those used for the latter

[7] *Esox*. Mandibula inferior longior, punctata. S. N., '58; '66, 424.

[8] The species are (1) *Sphyræna* (Sphyrænidæ), (2) *osseus* (Lepisosteidæ), (3) *Vulpes* (Albulidæ), (4) *Synodus* (Synodontidæ), (5) *lucius* (Luciidæ), (6) *belone* (Esocidæ), (7) *hepsetus* and (8) *brasiliensis* (Exocœtidæ), and (9) *gymnocephalus* (Chirocentridæ). S. N., '66, 513–517.

[9] Mandibula inferior brevior. S. N., '66, 516.

[10] *Lacerta*. "Corpus (Testa Alisve) nudum, caudatum" contrasting with *Draco*. "Corpus Alis volatile." S. N., '66, 349.

[11] *Coluber*. "Scuta abdominalia; squamæ caudales" contrasting with "*Crotalus*. Scuta abdominalia caudaliaque cum crepitaculo" and "*Boa*. Scuta abdominalia caudaliaque absque crepitaculo." S. N., '66, 349.

[12] As an example of *Coluber* a figure (tab. 3, fig. 2) of a snake with venom fangs is given.

genus, and in perfect harmony with those employed for the distinction of the former genus. Indeed, it might be properly assumed that the ascription of the *Argentina carolina* to *Argentina* was simply a matter of misplacement of a manuscript leaf, and such it may be even now considered, although the error is continued in the twelfth edition, having escaped the notice of Linné.

LINNÆAN NOMENCLATURE

The code of nomenclature devised by Linné was in many respects admirable, but he did not provide sufficiently for the principle of priority in nomenclature. He set the example of changing a name given by himself or by others, when he thought a better one could be substituted; he also felt at liberty to change the intent of a genus. A few examples of many cases may illustrate.

In 1756 the name *Salacia* was given to the Portuguese man-of-war; in 1758 the name *Holothuria* was substituted; in 1766 the latter name was retained, but with a very different diagnosis, and for the first time three holothurians in the modern sense of the word were introduced.

In 1756 the names *Cenchris* and *Crotalophorus* were used for genera, two years later renamed *Boa* and *Crotalus*. In 1756 Artedi's name, *Catodon*, was retained for the sperm whale, and Artedi's *Physeter* mainly for the killers (*Orca*); but in 1758 *Physeter* was taken up for the sperm whale, for which it has been retained ever since, except by a very few naturalists.

In 1756 and 1758 *Ophidion* was used for an acanthopterygian jugular fish—the common northern butterfish, or gunnell, now generally called *Pholis*—but in 1766, under the guise of *Ophidium*, it was transferred to the Apodes and primarily used for what is still known as the genus *Ophidium*.

In 1756 and 1758 *Trichechus* was used for the manatee alone, while the walrus was correctly associated with the seals, but in 1766 the very retrograde step was taken of associating the walrus with the manatee and retaining for the two the name *Trichechus*. Many naturalists persist to the present day in keeping the name for the walrus alone.

The example thus set by the master was naturally followed by his disciples. Many felt at liberty to change names and range of genera as they thought best and great confusion resulted, which has continued more or less down to this year of grace, 1907.

Many of the evils which have been the consequence could have been rectified if the British Association for the Advancement of Science had been logical in the code (often admirable) which it published in 1842. Instead, however, of accepting the edition of the "Systema Naturæ" (tenth) in which Linné first introduced the binomial nomenclature as the starting point, they preferred homage to an individual rather than truth to a principle, and insisted on the twelfth edition as the initial volume of zoological nomenclature. The unfortunate consequences have been manifold. Such consequences are the natural outcome of illogical and ill-considered action and must always sooner or later follow. After these many years almost all naturalists have acceded to the adoption of the tenth edition.

If the vertebrates were so much misunderstood by Linné, it may naturally be supposed that the invertebrates were equally or still less understood. Only one interesting case, however, can be referred to. In the ninth edition of the "Systema Naturæ" Linné had a monotypic genus

Salacia (p. 79) with a species named *Physalis* which was evidently a *Physalia* as long understood. In the tenth edition the name *Holothuria* was substituted for *Salacia* and no holothurians in the modern sense were recognized. In the twelfth edition all the species of the former edition were retained, but the diagnosis was altered and four holothurians of recent authors were added, and thus animals of different subkingdoms or branches were confounded in the genus. Now, if we accept the tenth edition of the "Systema" as the starting of our nomenclature, obviously *Holothuria* can not be used as it has been for these many years, and it must be revived in place of *Physalia*, notwithstanding the laments of those who are distressed by such a change. The echinoderms now called holothurians must be renamed. We can imagine the clamor that will arise when some one attempts the change.

Another fault of less moment—indeed a matter of taste chiefly—was committed by Linné. Very numerous names of plants and animals occur in the writings of various ancient authors and were mostly unidentifiable in the time of Linné. He drew upon this store with utter disregard of the consequences for names of new genera. Most of the ancient names can now be identified and associated with the species to which they were of old applied, and the incongruity of the old and new usage is striking. For example, *Dasypus*, a Greek name of the hare, was perverted to the armadillos; *Trochilus*, a name of an Egyptian plover, was misused for the humming birds; *Amia*, a name for a tunny, was transferred to the bowfin of North America. There was not the slightest justification for such perversion of the names in analogy or fitness of any kind; there was no real excuse for it. At the commencement of Linné's career (1737), the learned Professor Dillenius, of Oxford, strongly protested against such misusage for plant genera, but the sinner persisted in the practise till the end. Naturally his scholars and later nomenclators followed the bad example, and systematic zoology is consequently burdened with an immense number of the grossest and most misleading misapplications of ancient names revolting to the classicist and historian alike.

The influence of Linné continued to be felt and his system to be adopted until a new century had for sometime run its course. Meanwhile, in France, a great zoologist was developing a new system which was published at length in 1817, and anew with many modifications a dozen years later (1829).

GEORGES LÉOPOLD CHRÉTIEN FRÉDÉRIC DAGOBERT CUVIER

Georges Cuvier (born 1769) claimed[13] that before him naturalists distributed all the invertebrates among two classes as by Linné. In 1795 he published an account of memorable anatomical investigations of the invertebrates and ranged them all under six classes: molluscs, crustaceans, insects, worms, echinoderms and zoophytes. This was certainly a great improvement over previous systematic efforts, but from our standpoint crude in many respects. It was, however, necessarily crude, for naturalists had to learn how to look as well as to think.

Cuvier later essayed to do for the animal kingdom alone what Linné did for all the kingdoms of nature. So greatly had the number of known animals increased, however, that he did not attempt to give diagnoses of the species, but merely named them, mostly in foot-notes. His superior knowledge of anatomy enabled him to in-

[13] "Règne Animal," 1817, I., 61.

stitute great improvements in the system. He also first recognized the desirability of combining in major groups classes concerning which a number of general propositions could be postulated.

It was in 1812 that Cuvier presented to the Academy of Sciences[14] his celebrated memoir on a new association of the classes of the animal kingdom, proposing a special category which he called branch (embranchment), and marshaling the classes recognized by him under four primary groups: (1) the Vertebrates or Animaux vertébrés; (2) the Mollusks or Animaux mollusques; (3) the Articulates or Animaux articulés, and (4) the Radiates or Animaux rayonnés. These were adopted in the "Régne Animal." In the first (1817) edition, as in the second (1829–1830), nineteen classes were recognized, and in the latter too little consideration was given to the numerous propositions for the improvement of the system that had been suggested and urged meanwhile.

It has been generally assumed that Cuvier's work was fully up to the high mark of the times of publication, and for many years the classification which he gave was accepted by the majority of naturalists as the standard of right. To such extent was this the case that his classification of fishes and the families then defined was retained to at least the penultimate decade of the last century by the first ichthyologists of France. Nevertheless the work was quite backward in some respects and exercised a retardative influence in that the preeminent regard in which the great Frenchman was held and the proclivity to follow a leader kept many from paying any attention to superior work emanating from Cuvier's contemporaries.

It is by no means always the naturalist who enjoys the greatest reputation for the time being that anticipates future conclusions. A Frenchman who held a small place in the world's regard in comparison with Cuvier advanced far ahead of him in certain ideas. Henri Marie Ducrotay de Blainville was the man. When Cuvier (1817) associated the marsupials in the same order as the true carnivores and the monotremes with the edentates, Blainville (1816) contrasted the marsupials and monotremes as Implacentals ("Didelphes") against the ordinary Placentals ("Monodelphes"). While later (1829) Cuvier still approximated the marsupials to the carnivores, but in a distinct order between the carnivores and the rodents, and still retained the monotremes as a tribe of the edentates, Blainville (1834) recognized the marsupials and monotremes as distinct subclasses of mammals and had proposed the names Monodelphes, Didelphes and Ornithodelphes, still largely used by the most advanced of modern therologists.

Against the action of Cuvier in ranging all the hoofed mammals in two orders, the pachyderms (including the elephants) and the ruminants, may be cited the philosophical ideas of Blainville (1816), who combined the same in two very different orders, the Ongulogrades and the Gravigrades (elephants), and distributed the normal Ongulogrades under two groups, those with unpaired hoofs (Imparidigitates) and those with paired hoofs (Paridigitates), thus anticipating the classification of Owen and recent naturalists by very many years.

Cuvier's treatment of the amphibia of Linné equally contrasted with Blainville's. As late as 1829 the great French naturalist still treated the batrachians as a mere order of reptiles of a single family, and the crocodilians as a simple family of

[14] *Ann. Museum Nat. Hist.*, Paris, 1812, 19, 73–84.

Saurians. On the other hand, as early as 1816 Blainville had given subclass rank to the naked amphibians with four orders, and also ordinal rank to the crocodilians, and a little later (1822) he raised the subclasses to class rank. Still more, Blainville early (1816) recognized that the so-called naked serpents were true amphibians and gave satisfactory reasons for his assumption, though to the last Cuvier (1829) considered them to be merely a family of the ophidians. As Blainville claimed, he based his classification on anatomical facts.[15]

A pupil of Blainville, Ferdinand L'Herminier of the island of Gaudeloupe, at the instance and following the lead of his master (1827), undertook the comparative study of the sternal apparatus of birds and thereby discovered a key to the natural relationship of many types which anticipated by many years the views now current. For instance, L'Herminier first correctly appreciated the differences of the ostriches and penguins from other birds, the difference between the passerines and swifts, the homogeneity of the former, and the affinity of the humming birds and the swifts. Meanwhile Cuvier, like Linné, was content to accept as the basis for his primary classification of birds, superficial modifications of the bill and feet (toes and nails) which led to many unnatural associations as well as separations, but which nevertheless have been persisted in even to our own day by many ornithologists.

Now what could have been the underlying idea which hindered the foremost comparative anatomist of his age from the recognition of what are now considered to be elementary truths and what enabled Blainville to forge so far ahead? Cuvier manifestly allowed himself to be influenced by the sentiment prevalent in his time, that systematic zoology and comparative anatomy were different provinces. It may, indeed, seem strange to make the charge against the preeminent anatomist, that he failed because he neglected anatomy, but it must become evident to all who carefully analyze his zoological works that such neglect was his prime fault. He, in fact, treated zoology and anatomy as distinct disciplines, or, in other words, he acted on the principle that animals should be considered independently from two points of view, the superficial, or those facts easily observed, and the deep-seated, or anatomical characters. Blainville, on the contrary, almost from the first, considered animals in their entirety and would estimate their relations by a view of the entire organization. Yet the sentiment then prevalent was reflected by one who enjoyed a high reputation for a time as a "philosophical zoologist"—William Swainson. In "A Treatise on the Geography and Classification of Animals" (1836, p. 173), the author complained that "Cuvier rested his distinctions . . . upon characters which, however good, are not always comprehensible, except to the anatomist. The utility of his system, for general use, is consequently much diminished, and it gives the student an impression (certainly an erroneous one) that the internal, and not the external, structure of an animal alone decides its place in nature." It was long before such a mischievous opinion was discarded.

Cuvier was regarded almost universally by his contemporaries, and long afterwards, in the words of his intellectual successor, Louis Agassiz, as "the greatest zoologist of all time."[16] In view of the facts already cited and innumerable others

[15] "Ses bases sont anatomiques et surtout tirées de la consideration du crâne," *Bull. Sc. Soc. Philom.*, 1816, p. 111.

[16] Agassiz, "Essay on Classification," p. 286.

that could be added, however, the contemporary verdict must be somewhat modified. Cuvier was a very great man of most impressive personality, wide versatility, extraordinary industry, vast knowledge of zoological and anatomical details, an excellent historian, a useful critic, and of good judgment in affairs generally, but although a greater all-round man, as a systematic zoologist he was not the equal of a couple of his French contemporaries, Blainville or Latreille. We have either to admit this conclusion or confess that our now universally admitted views are wrong. Nevertheless, Cuvier's work was of great importance, and he first brought to the aid of systematic zoology the new science of vertebrate paleontology.

CUVIER AND PALEONTOLOGY

The animals, and especially the vertebrates, of past ages were practically unknown to the early zoologists, and when they had large collections, as did Volta of the fishes of Mount Bolca, they identified them with modern species, or, with Scheuchzer, might consider a giant salamander as a man witness of the deluge—"Homo diluvii testis"! It was not until Cuvier, with superior knowledge of skeletal details, examined numerous bones unearthed from the Tertiary beds about Paris, that the complete distinction of animals of ancient formations from living species was recognized. Then was afforded the first glimpse of extinct faunas destined to far outnumber the existing one, but so imperfect was the great paleontologist's foresight of what lay in store for the future that he enunciated a dogma which was long accepted as sacrosanct; he called it the law of correlation of structure. A striking and even amusing example of its exposition and its failure I have previously drawn attention to.

Professor Huxley, in his excellent "Introduction to the Classification of Animals" (published in 1869), in his first chapter, "On Classification in General," concluded a consideration of Cuvier's law of the correlation of structure with the following paragraphs:

> Cuvier, the more servile of whose imitators are fond of citing his mistaken doctrines as to the nature of the methods of paleontology against the conclusions of logic and of common sense, has put this so strongly that I can not refrain from quoting his words.[17]
>
> But I doubt if any one would have divined, if untaught by observation, that all ruminants have the foot cleft, and that they alone have it. I doubt if any one would have divined that there are frontal horns only in this class; that those among them which have sharp canines for the most part lack horns.
>
> However, since these relations are constant, they must have some sufficient cause; but since we are ignorant of it, we must make good the defect of the theory by means of observation; it enables us to establish empirical laws, which become almost as certain as rational laws, when they rest on sufficiently repeated observations; so that now, whoso sees merely the print of a cleft foot may conclude that the animal which left this impression ruminated, and this conclusion is as certain as any other in physics or morals. This footprint alone, then, yields to him who observes it, the form of the teeth, the form of the jaws, the form of the vertebræ, the form of all the bones of the legs, of the thighs, of the shoulders, and of the pelvis of the animal which has passed by; it is a surer mark than all those of Zadig.

The first perusal of these remarks would occasion surprise to some and immediately induce a second, more careful reading to ascertain whether they had not been misunderstood. Men much inferior in capacity to Cuvier or Huxley may at once recall living exceptions to the positive statements as to the coordination of the "foot cleft" with the other characteristics specified. One of the most common of domesticated animals—the hog—may come up before the "mind's eye," if not the

[17] "Ossemens fossiles," ed. 4me, tome 1r, p. 184.

actual eye at the moment, to refute any such correlation as was claimed. Nevertheless, notwithstanding the fierce controversial literature centered on Huxley, I have never seen an allusion to the lapse. And yet every one will admit that the hog has the "foot cleft" just as any ruminant, but the "form of the teeth"—and the form of some vertebræ are quite different from those of the ruminants and of course the multiple stomach and adaptation for rumination do not exist in the hog. That any one mammalogist should make such a slip is not very surprising, but that a second equally learned should follow in his steps is a singular psychological curiosity. To make the case clearer to those not well acquainted with mammals, I may add that *because the feet are cleft in the same manner* in the hogs as in the ruminants, both groups have long been associated in the same order under the name Paridigitates or Artiodactyles, contrasting with another (comprising the tapirs, rhinocerotids and horses) called Imparidigitates and Perissodactyles.

I need scarcely add that the law of correlation applied by Cuvier to the structures of ruminants entirely fails in the case of many extinct mammals discovered since Cuvier's days. Zadig would have been completely nonplussed if he could have seen the imprint of an Agriochœrid, a Uintatheriid, a Menodontid or a Chalicotheriid.

The value of this law was long insisted upon by many. Some of the best anatomists, as Blainville, protested against its universality, but one who ranked with Cuvier in skill and knowledge of anatomy, Richard Owen, long upheld Cuvier's view. "You may not be aware," he wrote in 1843, "that Mr. DeBlainville contends that the ground—viz., a single bone or articular facet of a bone—on which Cuvier deemed it possible to reconstruct the entire animal, is inadequate to that end. . . . In this opinion I do not coincide."[18] The many mistakes Owen made in attempting to apply the principle proves how well Blainville's contrary opinion was justified.

The numberless remains of past animals, rescued from the many formations which the animals themselves distinguished, have entailed constant revisions of systems and clearer comprehension of the development of the animal kingdom. Such revision, too, must continue for many generations yet to come.

CUVIER AND ANATOMY

The failure to sufficiently apply anatomy to systematic zoology was especially exemplified in the treatment of the fishes which absorbed so much of Cuvier's attention in later years. He, as well as his associate, gave accounts of the visceral anatomy and was led—often misled—to conclusions respecting relations by his dissections, but he failed to receive enlightenment by examination of the numerous skeletons he had made. Those skeletons, pregnant with significance for the future, had no meaning for Cuvier; he never learned how to utilize them for the fishes as he did those of the mammals. His colleague and successor, Valenciennes, in the great "Histoire Naturelle des Poissons," was equally unappreciative of the importance of comparative osteology for comprehension of the mutual relations of the groups of fishes.

CUVIER'S SUCCESSORS

The same defect in method or logic that characterized Cuvier's work was manifested by his great English successor in range of knowledge of comparative anatomy, Richard Owen. His families, for the most part, were the artificial assemblages brought together by zoologists on account of superficial characters and too often

[18] Owen, *Am. Journ. Sc. and Arts*, XLV., 1843, 185.

without rigorous attention to the applicability of the characters assigned. Much better was the work of the greatest naturalist of all, Johannes Müller, who advanced our knowledge of the systematic relations of all classes of vertebrates as well as invertebrates. But all were unable to free themselves from the incubus of the popular idea that all branchiferous vertebrates formed a unit to be compared with birds and mammals. Several propositions to segregate, as classes, *Amphioxus* and the chondropterygians had been made, and Louis Agassiz deserves the credit of claiming class value for the myzonts or marsipobranchs as well as the selachians. But it was left to Ernst Haeckel, a pupil of Müller, still happily living, to divest himself entirely of ancient prejudices and appreciate the interrelationship of the primary sections of the vertebrate branch. He for the first time (1866) set apart the amphioxids in a group opposed to all other vertebrates, then docked off the marsipobranchs from all the rest, and collected the classes generally recognized in essentially the same manner as is now prevalent. We may differ from Haeckel as to his classes of fishes and dipnoans, but his correctness in the action just noticed will be conceded by most, if not all, systematic zoologists to-day.

EMBRYOLOGY

While Cuvier was still flourishing, a school of investigators into the developmental changes of the individual in different classes, and among them the vertebrates, was accumulating new material which should be of use to the systematic zoologist. Chief of these was Karl Ernst von Baer. In various memoirs (1826 et seq.) he subjected the major classification of animals to a critical review from an embryological point of view, recognized, with Cuvier, the existence of four distinct plans which he called types and characterized them in embryological terms—*Evolutio radiata, Evolutio contorta* (molluscs), *Evolutio gemina* (articulates) and *Evolutio bigemina* (vertebrates). The last were successively differentiated on account of the embryonic changes from the fishes to the mammals. "These Beiträge," Louis Agassiz justly affirmed, "and the papers in which Cuvier characterized for the first time the four great types of the animal kingdom, are among the most important contributions to general zoology ever published."

One of the most notable results, so far as systematic zoology was involved, was the deduction forced on Kowalevsky by his investigation of the embryology of tunicates, that those animals, long associated with acephalous mollusks, were really degenerate and specialized protovertebrates. This view early won general acceptance.

While embryology was very successfully used for the elucidation of systematic zoology its facts were often misunderstood and perverted. For instance, the cetaceans were regarded as low because they had a primitive fish-like form, although it must be obvious to all logical zoologists of the present time that they are derived from a quadruped stock; snakes have been also regarded as inferior in the scale because no legs were developed, although it would be now conceded by every instructed herpetologist that they are descendants of footed or lizard-like reptiles. *Ammocœtes* was considered as higher than *Petromyzon* "inasmuch as the division of the lips indicates a tendency towards a formation of a distinct upper and lower jaw," but we now know that *Ammocœtes* is the larval form of *Petromyzon*. Innumerable still more pertinent examples might be adduced for the inferior systematic grades, orders, families, genera, species, etc. The words high and low were used when generalized and specialized were really meant and those words, pregnant with mischief, often led their users astray as well as the students to which they were addressed.

PHILOSOPHICAL ZOOLOGY

As knowledge of the various animal groups increased and countless new species were piling up, yearning arose to discover principles underlying the enormous mass of accumulating details, and the excogitations of various naturalists resulted in some curious speculation and expression in classificatory form. They called their outpourings philosophy or philosophical zoology, and philosophers they were called by others.

Some of the philosophers grouped animals according to supposed degrees of nervous sensibility;[19] some according to the relations of parts to a center or an axis;[20] some under groups supposed to correspond with different systems of the body, as the alimentary, the vascular, the respiratory, the skeletal and the muscular,[21] and some would accord to each of the senses definite groups.[22]

Equally, if not more extravagant, views were entertained by many naturalists that creative power delighted in the symmetry of numbers and in circular arrangements. It was contended that all groups of animals represented analogous groups in successively diminishing circles; that in a perfect system there were a definite number of subkingdoms, an equal number of classes in each subkingdom, of orders in each class of suborders, of families, of genera, of subgenera, etc. Some maintained that three was the regnant number, others upheld four, others seven, but the most numerous and influential school contended for five. Exactly what the philosophers thought they meant, or what strange visions they may have conjured up may never be known. But for a time (1822–42) the school of quinarians, as they were called, claimed most of the naturalists of Britain. The most zealous of the school (William Swainson) was especially displeased with the developmental hypothesis of Lamarck and characterized the ''speculations'' of the great Frenchman ''not merely as fanciful, but absolutely absurd.''

But it was the much-contemned hypothesis of descent with modifications that was destined at last to relieve biological science of the wild and irrational speculations and

[19] Lamarck (1812) contended for three categories of animals: (1) apathetic animals and (2) sensitive animals among the invertebrates, and (3) intelligent animals, equivalent to the vertebrates.

[20] Blainville (1816) proposed to divide the animal kingdom into three subkingdoms: (1) the Artiomorphes, having a bilateral form, (2) the Actinomorphes, having a radiate form, and (3) the Hétéromorphes (mainly sponges and protozoans), having an irregular form.

[21] Oken (1802–47) gave expression to his varying views in several differing classifications. In one scheme (El. Physiophilosophy, 1847, 511 et seq.) he claimed that there were five "circles" corresponding with the "animal systems": (1) Intestinal animals (Protozoa and Radiates); (2) Vascular, sexual animals (Mollusks); (3) Respiratory, cutaneous animals (Articulates); (4) Sarcose animals (Vertebrates except mammals), and (5) Aistheseozoa, or animals "with all . . . organs of sense perfectly developed" (mammals).

[22] Oken maintained (1802–47): "that the animal classes are virtually nothing else than a representation of the sense-organs, and that they must be arranged in accordance with them. Thus, strictly speaking, there are only five animal classes: Dermatozoa (skin or touch animals), or the Invertebrata; Glossozoa (tongue animals), or the fishes . . .; Rhinozoa (nose animals), or the reptiles . . .; Otozoa (ear animals), or the birds; Ophthalmozoa (eye animals), or the Thricozoa (mammals). . . . But since all vegetative systems are subordinate to the tegument or general sense of feeling, the Dermatozoa divide into just as many or corresponding divisions, which on account of the quantity of their contents, may be for the sake of convenience also termed classes."—Oken, El. Physiophilosophy, 1847, p. xi. For the many other assumptions on similar and divergent lines the reader must refer to the "Elements of Physiophilosophy" (1847).

classifications of the nature-philosophers, physiophilosophers, circularians, quinarians, trinitarians, septenarians, and their like that flourished during the first half of the past century.

DEVELOPMENT THEORY

Although there had been previous indications of belief that transmutation of species might have been a cause for the diversity of animal life, Jean Baptiste Pierre Antoine de Monet de Lamarck (1809) first framed a hypothesis that had a logical basis, although weakened by unproved postulates. In view of those weaknesses, it was easy to bring forth many facts that seemed to militate unanswerably against it, and such were well put forward by Cuvier; as the hypothesis, too, was very unpopular, it was for a long time stifled. In the meanwhile geological and paleontological investigation, comparative morphology, physiology and embryology, as well as systematic zoology, were revealing innumerable facts that pointed all in the same direction and were only explicable collectively by the assumption that they were the result of original community of origin and subsequent deviation by gradual changes from time to time. The facts were at length collocated with extreme skill by Charles Darwin (1859) and a rational explanation of their evolution by means of natural selection made the new development theory acceptable to well-informed naturalists and logical thinkers generally.

SEQUENCE OF GROUPS

It had been almost the universal custom from olden time, as well as during the Linnæan era, to commence the enumeration or catalogues of animals with the forms exhibiting most analogy with man and consequently the highest in the scale of organic nature. As long as species were assumed to be individually created this was perhaps the most natural course, and at least had the advantage of proceeding from the comparatively known to the almost unknown. A significant and noteworthy exception to this mode of procedure among the old naturalists was afforded by Lamarck (1809 et seq.), the precursor in this respect as well as in recognition of descent, of the modern school.

When it became generally recognized that there had been always a progression and development from antecedent forms, naturally there was a change in the manner of exposition of a series, and the lowest forms were taken as the initial ones and followed by those successively higher in the scale of beings. Even when old prejudices were administered to and the highest animals put first in a work, it was often done in a reversed series; that is, after the supposed natural ascensive series had been determined on, that series was simply reversed in order that the highest should be the first and the lowest the last. Many of our text-books of zoology still have this characteristic, but are being rapidly replaced by those exhibiting the phyletic series.

HISTOLOGY

One of the most noteworthy modifications of systematic zoology was the fruit of histological research. In 1839 Theodor Schwann, incited by the brilliant results of Matthias Jacob Schleiden's researches (1838) in vegetal histology, and at the suggestion of Johannes Müller, undertook investigations which led him to consider that the animal frame was built up from innumerable cells variously modified to form the different systems and organs of which it is composed. Ultimately the animals thus developed were segregated by Ernst Haeckel, and the animal kingdom was limited to them, while the simple unicellular animals which had been already designated as Protozoa were associated with unicellular plants under the general term Protista. One of the prominent features of this idea was accepted by Thomas Henry Huxley (1874) with, however, the very important modification of retaining the old name Protozoa as the collective name of the animals and taking a suggested name of Haeckel's (Metazoa) for the multicellular animals.

GRADUAL DELIMITATION OF GENERA

As has been already noted, the animal genera of Linné were mostly extremely comprehensive, answering, when natural groups, to families, superfamilies, and even orders or classes of modern naturalists. Such contrast, however, with others of the Linnæan genera, and when this fact became recognized and it was discovered that the large genera embraced types exhibiting many differences in detail, the latter were subdivided; early in the past century, at first owing especially to French and German naturalists, the subdivision of old genera on approximately present lines was commenced and applied at different times to various classes. It is noteworthy that in some instances the authors of the new genera quite abruptly changed their minds regarding the nature of such groups. For example, Lacépède, in 1798, in the closing lecture of his course at the Museum of Natural History, recognized only 51 genera of mammals, but a few months later (in 1799), in a "tableau," admitted and defined 84 genera.

It seems to be generally supposed that there has been an uninterrupted tendency among zoologists to refinement and increase of number of genera to the present time, but such is by no means the case. Half a century ago and more some ornithologists subdivided old genera and made new ones to an extent to which none of the present time is prepared to go. For example, Charles Bonaparte, Prince of Canino, required eleven genera of gulls to include those now congregated in one. About the same time, some herpetologists were equally radical. Leopold J. F. J. Fitzinger, in 1843, distributed species which are now combined by all in the genus *Anolis* among no less than fifteen genera. The genus *Bufo*, as now understood, was split by some herpetologists into a dozen or more. These are only samples of numberless analogous cases.

THE OLD AND THE NEW

A comparison of systematic zoology at its dawn with that of the present time is rather a contrast of different themes.

The old naturalists believed that all species of animals were created as such by a divine fiat; the modern consider that all animals are derivatives from former ones and that their differences have been acquired during descent and development.

The Linnæans based their systems on superficial characteristics, and the moderns take into consideration the entire animal.

The early systematists assumed that characters drawn from structures or parts most useful to the animals were the best guides to the relationship of the animals; the latest ones have learned to distrust the evidential value of similarity of structures unaccompanied by similarity of all parts. The former were guided mainly by physiological characters; the latter take morphological ones.

The Linnæans confined their generalizations to few categories—genera, orders, classes; the moderns exhibit the manifold modifications and coordinations of all structural parts in many categories—genera, subfamilies, families, superfamilies and various higher groups.

The old naturalists believed more or less in the existence of a regular chain of beings from high to low; the new ones recognize the boundless ramifications of all animal stocks.

The elders assumed certain forms as highest and ranged their series from high to low; the sons commence their series with the most generalized types and progress from the less generalized to the more specialized.

PROSPECTS AND NEEDS

In numerous old systematic and descriptive works—but in many cases not very old—the skeleton and other anatomical details were noticed in connection with the species described, but not seldom some of those details, if rightly interpreted, would be in contravention of the classification adopted. In fact, the anatomy was to all intents and purposes treated as an offering of curious but useless information. Such conceptions, happily, are mainly—but not entirely—of the past, and we may live to welcome the day when every animal will be treated as whole. Systematic zoology will then be regarded as the expression of our knowledge of the entire structure and as an attempted equation of the results obtained by investigations of all kinds. In fact, systematic zoology is simply an attempt to estimate the relative importance of all structural details and to correlate them so that their relative values shall become most evident. It is the scientific outcome of all anatomical or morphological knowledge and the aim is to arrange the animal groups in such a manner as to show best their genetic relations and the successive steps of divergence from more or less generalized stocks.

One consummation devoutly to be wished for is general acceptance of a standard for comparison and the use of terms with as nearly equal values as the circumstances admit of. There is a great difference in the use of taxonomic names for the different classes of the animal kingdom. The difference is especially great between usage for the birds and that for the fishes. For the former class, genera, families and orders are based on characters of a very trivial kind. For example, the family of Turdidæ, or thrushes, relieved of formal verbiage, has been distinguished from neighboring families solely because the young have spots on the breast, but even this distinction is now known to fail in some instances. Extremely few, if any, of the families of oscine birds are based on characters of a kind which would be regarded as of family value in other classes of vertebrates. On the other hand, many of the families and genera of fishes are made by some excellent authorities to include types separated by striking peculiarities of the skeleton as well as the exterior. The mammals are a class whose treatment has been mostly intermediate between that for the birds and that for the fishes. Its divisions, inferior as well as comprehensive, have been founded on anatomical characters to a greater extent than for any other class. Its students are numerous and qualified. Mammalogy might therefore well be accepted as a standard for taxonomy, and the groups adopted for it be imitated as nearly as the differing conditions will admit. The families of birds would then be much reduced in number and those of fishes increased. All the active herpetologists and ichthyologists of the United States have subordinated their own beliefs and ideas as to what would have been most desirable, to a greater or less extent, to approximate the desirable reduction of the terms admitted by them to a standard uniform with that adopted by mammalogists. If others would likewise sacrifice their own predilections, the lamentable inequality of usage now prevalent would be much less;

such congruity would be to the great advantage of comparative taxonomy.

In these days of extreme specialization one of the greatest needs in our universities is a professor of systematic zoology with whom conference may be held as to the propriety of any systematic modification resulting from special investigation of the anatomy of any organ or part, or of any group of animals. Such conference might prevent the publication of many propositions due to exclusive consideration of an isolated subject. Perhaps the designation of systematic morphology might better indicate the nature of the suggested course. The consummation, however, it must be admitted, is more desirable than probable.

I have intentionally refrained from any consideration of the work of living zoologists. If I had undertaken this, the task of selection would have been very difficult, and at any rate the time demanded for proper consideration would have been much more than that requisite for the reminder of past discoveries. The progress of systematic zoology during recent years has been in accelerated ratio, and not a few of those whose achievements have helped to put zoology at its present level are in Boston to-day. It is from the summit of the elevation they have enabled us to reach that we look back to the deeds of old masters and can determine, better than their contemporaries or immediate successors, their relative merits.

Theo. Gill

SCIENTIFIC BOOKS

Anatomical Terminology with Special Reference to the [BNA]. By Professor Lewellys F. Barker. Philadelphia, P. Blakiston's Son & Co. 1907.

The necessity for both exactness and simplicity in the nomenclature employed in the descriptive sciences has always been recognized, and in anatomy several attempts have been made to establish a terminology which would be acceptable to the great body of anatomists and eliminate from anatomical nomenclature the ponderous mass of synonyms with which it is burdened. Henle in his classic "Handbook" accomplished much towards the desired end, and since 1880 Professor B. G. Wilder has labored assiduously for the cause. But it was not a matter for accomplishment by a single individual working independently; it required concerted action. And although endeavors had been made to enlist the sympathies of the American Association for the Advancement of Science and the Association of American Anatomists in the work, for one reason or another little definite progress was made.

In 1887 the pressing need of an authoritative revision of anatomical nomenclature was brought to the attention of the German Anatomical Society, then but recently organized, and in 1889 it established a commission to deal with the matter, appointing upon the commission Professors von Kölliker (chairman), O. Hertwig, His, Kollmann, Merkel, Schwalbe, Toldt, Waldeyer and von Bardeleben, Professor Krause being later selected as editor-in-chief and representatives of Great Britain and other countries being also included. For six years the commission labored with the difficulties assigned for its consideration, and in 1895 it presented a report to the society, submitting a list of some 4,500 terms, carefully selected from the 30,000 or more, principally synonyms, which may be collected from the various standard text-books. The society received and adopted the commission's report at its meeting in Basel, a circumstance which has gained for the list the appellation of the Basel Anatomical Nomenclature or, more briefly, the BNA, and the report, drawn up by Professor His, was published as a supplement number of the *Archiv für Anatomie und Physiologie*.

This is neither the time nor the place for a discussion of the work of the commission; suffice it to say that its results have been widely accepted and that a uniformity of anatomical nomenclature has by it been brought within easy reach. The original report, however, has not been sufficiently accessible in this country, and Professor Barker has done good service for anatomy in republishing the list of accepted terms in their Latin form as originally adopted, giving also a literal translation of each term; and, in the few cases when a term differs to any great extent from the English usage, the familiar term is also added. The nomenclature is thus made accessible in a convenient form for all who require a knowledge of anatomical terms, and the introduction to the book, in which are given an interesting account of the work of the commission and a discussion of the advantages of a uniform terminology, is worthy of careful perusal by all who are in any way interested in anatomy.

The translations of some of the Latin terms are open to criticism in that convenience has occasionally been sacrificed to literalness; it seems unnecessary, for instance, to translate *intestinum jejunum, intestinum ileum* and *intestinum cæcum* by empty intestine, twisted intestine and blind intestine, when the adjectival portions of the Latin terms are already in common use in English text-books. There seems little likelihood that the Latin terms will be generally employed by English-speaking people, nor is it necessary that they should be; their use merely adds an additional burden for the student and savors somewhat of pedantry. It would perhaps be a further aid to the cause of uniform terminology if, let us say, the American Association of Anatomists would select for each BNA term an English form; the great majority of Professor Barker's translations, and they are intended merely as translations, could be adopted as they stand, and, with some few modifications, the entire list given an authority which it now lacks.
J. P. McM.

The Labyrinth of Animals. (Including mammals, birds, reptiles and amphibians.) By Albert A. Gray, M.D., F.R.S.E., Surgeon for Diseases of the Ear to the Victoria Infirmary, Glasgow. London, J. & A. Churchill. 1907. Vol. I. Pp. 197; 31 stereoscopic photographs.

This volume deals with the labyrinths of Primates (man, yellow-faced baboon, black ape, green monkey, Hocheur monkey, Mona monkey, common marmoset, mongoose lemur, slow loris); Cheiroptera (Indian fruit bat, pipistrelle); Carnivora (tiger, lion, cat, puma, dog, aard-wolf, mongoose, otter, common weasel, crab-eating raccoon, common seal, gray seal, Cape sea-lion); Ungulata (the beisa antelope, Indian gazelle, common sheep, dromedary, common pig, horse); Edentata (three-toed sloth, Tamanduan ant-eater); and Rodentia (common hare, common rabbit, common mouse, common rat, hairy-footed jerboa). It is intended to bring out a second volume dealing with rodents, insectivora, cetacea, sirenia, marsupalia, monotremata, birds, reptiles and amphibia.

The method of study employed is as follows: The labyrinth with the bone immediately about it is fixed in a five- to ten-per-cent. formaline solution, embedded first in celloidin and then in paraffin, delcalcified in hydrochloric acid and then washed. There remains a cast of the organ in paraffin and in this the membranous structures are embedded. The object is now placed in xylol, which removes the paraffin and leaves the organ transparent. It is then photographed from two points of view by taking one picture, then slightly rotating the object-holder and taking the other picture. Each picture represents the image seen by one eye. The pictures are mounted like ordinary stereoscopic photographs and are studied with a stereoscope. In publishing these photographs they are pasted on rather heavy cardboard, two to a page, and the book is accompanied by a pair of prisms, with which, after a little practise, good stereoscopic images may be obtained.

Dr. Gray is evidently a skilled preparator. In the photographs the objects are magnified, usually from four to six diameters, and through the stereoscope they stand out with a beautiful distinctness.

Each photograph is accompanied by a few lines of descriptive text. In addition brief summaries are given of the chief characteristics of the labyrinth of animals of various species and orders. References are made to the more important papers dealing with the comparative anatomy of the labyrinth. There is no attempt at a prolonged treatment of the speculative aspect of the subject, although there is a short chapter in which there is discussed the value of the labyrinth in the determination of phylogenetic problems. The semicircular canals vary more from species to species than the cochlea does. There are two types of cochlea: sharp pointed, carnivora and rodents; flat; cetacea, primates, ungulata, cheiroptera, sirenia, and insectivora. The edentata have an intermediate type. Both types are found in the marsupalia.

At the end of the volume there is given a very important table of the chief measurements of each of the labyrinths studied.

Stereoscopic illustrations of organic structures are likely to be more and more utilized as simpler methods of taking the photographs and of studying them are devised. Dr. Gray has been undoubtedly successful in both respects. There are, however, some disadvantages in relying wholly upon this method of illustration. Only one object can be viewed at a time, so that quick comparison of two or more objects is difficult. The value of the book to one who has not a great deal of time to devote to its perusal would be much increased were diagrammatic outlines of the objects studied arranged in groups. With the more important similarities and differences thus emphasized the details revealed by the stereoscope could be followed with greater ease and interest.

The author has, however, furnished a rich lot of material for the comparative anatomist, and has made a distinct contribution to anatomical technique.

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HERPETOLOGY OF JAPAN AND ADJACENT TERRITORY

"Herpetology of Japan and Adjacent Territory" forms an important addition to scientific literature and is the work of Dr. Leonhard Stejneger, curator of the division of reptiles and batrachians in the United States National Museum. Even a superficial examination of this work shows Dr. Stejneger's painstaking methods in handling his subject. His manner of simplifying descriptions, interspersing paragraphs helpful to the novice, besides giving some attention to habits, produces a work of far broader use and interest than a strictly technical compilation. The author has taken uniform care to present a résumé under the head of each order, suborder, family and genus, this plan being very satisfactory to the reader in bringing his information strictly up-to-date. The tendency of boiling down descriptions of families and genera to concise and pertinent paragraphs shows considerable study. Strong characteristics are brought to the front and the student is saved wading through the mass of descriptive matter favored by many scientific writers —which matter is often remarkable for its repetition. Throughout the work, there is an effort, by means of foot-notes, to define the meaning of the technical names—both generic and specific—a method we have noted in previous work by Dr. Stejneger. An excellent idea—applied to the treatment of the serpents—is the presence of the popular Japanese name over the description of each species. This condition should make the work very useful to the collector in Japanese territory.

The thirty-five plates show judicious selection. Regarding them the author explains:

> The plates are mostly reproductions of important illustrations more or less inaccessible to those for whom this work is chiefly intended. Very often these illustrations represent type specimens, and in nearly every instance are based on specimens collected in the regions covered by this work. The expensive Fauna Japonica is long since out of print, and the reproduction of the best figures from this classic will be welcome to the majority of students of Japanese herpetology.

In the text are numerous pen drawings by Mr. R. G. Paine—to the number of over four hundred. Altogether the work may be said to be profusely illustrated and, with its numerous keys, fine bibliography and list of localities in Japan, the Riu Kiu Archipelago and Formosa (with their synonyms) arranged in the form of a consulting and descriptive list, should be of much value to all students of herpetology.

In his enumeration of species Dr. Stejneger shows us that 50 species of amphibians are to be found in Japan and adjacent territory. Of the order *Caudata* (salamanders and newts) there are 13 species. The *Salientia* (order of frogs and toads) is represented by 37 species. Seventeen species of *Rana* (genus of typical frogs) occur in the territory treated. The reptiles are elaborately represented, though the serpents greatly predominate in number of species. The lizards occur to the number of 29 species—these the members of 15 genera. Sixty-one species of snakes are enumerated, representing 26 genera. Among the serpents are 25 poisonous species, which are the members of 13 genera. Among the venomous snakes the members of 6 genera and to the number of 13 species are marine or the inhabitants of bays or the mouths of the larger rivers. The author's treatment of the strictly aquatic snakes—the Hydrinæ—is particularly interesting in adding to knowledge relating to the distribution of these reptiles. Of the order of turtles and tortoises 11 genera are quoted and 14 species described as inhabitants of the area involved.

While Dr. Stejneger's work is uniformly valuable to the herpetologist there is a tendency throughout to alter the nomenclature of families and genera. The author explains:

> With regard to the nomenclature of families, genera and species, the author adheres strictly to the "International Rules of Zoological Nomenclature" adopted by the International Congresses of Zoology. Changes in nomenclature necessitated by these rules, therefore, must not be laid to any desire of the author to alter names, but to the necessity of conforming strictly to the laws now generally accepted by the working zoologists of the world.

To the writer of this review it seems that the laws mentioned should have some limitation. This search for "priority" by technical students is discouraging many young students of zoology, who, after mastering various scientific names in works that have supposedly brought them strictly up-to-date, find in subsequent works an imposing array of unfamiliar titles. The adjustment of "priority" appears to be as remotely distant as ever: for with the greater number of scientific works appearing we find suggestions by the authors as to sweeping changes in nomenclature. It seems a pity to batter down names that have for years been generally accepted. Few zoologists are much benefited by perusing exhaustive lists of synonyms and the preparation and study of these must detract from actual observations of the subjects involved.

Among long-standing names that have fallen by Dr. Stejneger's decisions is the term for a great class—the Batrachia. This, the author explains, is a synonym pure and simple of the much older term *Salientia,* standing for the order of frogs and toads. That these changes in nomenclature are difficult to follow is in evidence from the cover of Dr. Stejneger's publication where the author's title is given "Curator, Division of Reptiles and Batrachians," while to be strictly up-to-date and correct, as pointed out in the text, it should be "Curator, Division of Reptiles and Amphibians." Among other changes in nomenclature might be mentioned the well-established genus of snakes *Coluber*—changed to *Elaphe,* and, as an instance that is liable to bring about some confusion, the use of the term *Coluber* in place of *Pelias* among the vipers. Also, according to the author, the family term Viperidæ must go. A new name, the Cobridæ, is substituted for it. Dr. Stejneger arranges in the family Elapidæ the subfamilies Elapinæ and Hydrinæ (Hydrophinæ). It appears inconsistent to follow this arrangement with the designation of the Cobridæ (Viperidæ) and the Crotalidæ as distinct families.

To the strictly technical worker these discussions and changes in nomenclature are barely confusing—and may be of considerable interest. They certainly show a great amount of thought and work on the part of the author. To the less advanced student, however, the new terms appear formidable, set former knowledge at variance and bring about a vague query as to whether it is worth while to adopt any particular system of classification while zoological nomenclature remains liable to such changes. In view, however, of the general excellence of Dr. Stejneger's publication, these criticisms must be classed as quite superficial.

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DISCUSSION AND CORRESPONDENCE

A PLAN OF PUBLICATION FOR AGRICULTURAL EXPERIMENT STATION INVESTIGATIONS

The passage of the Adams Act marked a new era in the development of the agricultural experiment stations and is destined to exercise a great influence on the character of the investigations and the publications issued. The investigations carried on under the Hatch act, while largely scientific, have nevertheless, in the main, been of general character intended primarily to meet the immediate needs of farmers and orchardists.

When the stations were first established as a result of the Hatch Act, agriculture was in a chaotic condition, there being scarcely any available trustworthy literature. The first work of the stations was thus, naturally and properly, largely pioneer work. This work has been carried forward with energy and success and "scientific farming," so called, has been rescued from disrepute and established on a basis of trust and confidence. With the systematizing and advance of our knowledge and the development of a trained corps of scientific agricultural workers, the necessity for more profound research on agricultural problems has become more and more apparent. Station workers, heretofore, have generally been unable to undertake very extensive research on fundamental problems, owing to lack of funds, the demand for immediate information on lesser problems, routine duties in answering correspondence and the multitudinous duties incident to the work of organization and the promotion of agricultural knowledge. With the passage of the Adams Act, which is expected to be used exclusively for fundamental research, the character of the work will be largely changed and extensive experiments will be carried out on the fundamental problems of agriculture, which will not have in view their immediate practical value. Heretofore the bulletins published in the series of the various stations have been largely of practical nature and adapted to the immediate needs of agriculture. True, very many bulletins have been published containing excellent scientific matter, but these were largely out of place in the regular series of bulletins as maintained by the stations. In several stations scientific and technical series of bulletins were started to accommodate such scientific papers which were not suited for general distribution. Owing to the confusion in quoting such publications and other reasons, all such special series have, I believe, been discontinued.

As a result of the Adams Act there is certain to be many bulletins prepared in the near future of purely scientific nature, which will not be satisfactory for publication in the regular series of station bulletins. It behooves station authorities, therefore, to carefully consider the means of publication and devise some satisfactory method which will meet the present requirements and provide for future needs. The writer has given this matter considerable thought and desires to suggest the plan described below for consideration.

The writer would suggest the establishment of a series of agricultural journals or memoirs to be edited and published under the direction of the Association of Agricultural Colleges and Experiment Stations. The field of agricultural research could be divided up and a separate series maintained for each division, as, for instance, a separate series for each of the following subjects:

Agronomy,
Horticulture,
Plant Pathology,
Plant Physiology and Anatomy,
Plant Biology and Breeding,
Soil Investigation,
Dairy Investigation,
Animal Husbandry,
Poultry Investigation,
Animal-breeding,

Animal Pathology,
Entomological Investigation,
Etc.

As a method of handling such publications an editing committee of three station workers could be appointed by the association for each subject, who would examine, edit and pass on the suitability of papers submitted for publication in the scientific journals. Papers for publication could be forwarded direct to the chairman of the proper committee by the directors of the various stations and in case the committee considered them unsatisfactory for publication in the journal, they could be returned to the director of the station with the recommendation that they be published in his regular series of station bulletins or remodeled to fit them for publication in the journal.

Such journals, if established, the writer believes, should not be distributed free of cost except possibly a single set to the library of each station, and to the Department of Agriculture and the Congressional Library. Aside from these a regular price per volume should be charged for subscription as is done for standard periodicals.

The funds from subscriptions would in considerable measure pay for the expense of publication. Each station should probably pay a certain limited annual stipend for regular maintenance and privilege of participation in the enterprise, and after the above funds are exhausted, any deficit at the end of the year could be assessed against the stations publishing articles during the year, in proportion to the pagation published. In this way the publication could be easily financed and probably at less expense than any station could now publish and distribute similar articles which are sent gratis.

This scheme of publication if put into operation would necessitate the employment of a business manager and assistants and the establishment of a headquarters from which all arrangements for publication and distribution could be made. This office, however, should exercise no function except as related to the business of publication.

Many important reasons can be assigned why some such scheme of publication as the above should be put into operation. The writer assumes that it must be clear to every one that some different source of publication from those now existing in the stations must be provided.

Purely technical papers on the cytology of heredity or on soil bacteriology, for instance, while of the utmost fundamental value might, if published in the regular series of station bulletins, be actually ridiculed and bring a station into disrepute with certain classes of their constituents. In any case such technical papers intended for specialists have no place in our present series of bulletins, which are intended for general distribution, and would be largely lost to the people for whom they are intended, when published in such a place.

It may be argued that the time has now come when each station should publish a separate scientific or technical series of bulletins. I would answer that the scientific publications of any one station will not be sufficient in number to attract special notice and justify the publication of a special series, and even if this were the case it would be a poor place to publish such matter, where all subjects are run together in one series, and considering the number of stations publishing. What all writers and stations desire is to place their good matter where it will receive the most attention and be most easily preserved and found. Every one knows from experience, that the literature which is always preserved and most easily accessible is that found in standard periodicals which are issued in volumes and indexed. If special journals were established for the different important subjects, investigators would know immediately where to look for articles on any particular subject. They could subscribe for and receive regularly the journals representing the subjects in which they are especially interested and would know when they had looked over all of the available experiment-station literature on a given subject. I am something of a plant-breeder, yet I do not doubt that some rather important matter on breeding has been issued by some of our experiment stations which I have not seen. If, however, we had a journal of plant-breeding in which every breeder in the experiment stations would describe in full or at least in summary his important results, I could soon look over that journal and feel confident of knowing what had been accomplished by the experiment-station workers.

Purely scientific articles could be published, possibly in some of the existing scientific journals, but these will not meet the requirements. The station is given public funds for conducting investigations and it would seem necessary that they have a recognized place of publication. They can not be altogether dependent on private sources of publication. Many articles in any case will find their way to established scientific periodicals and a liberal amount of such publications should, the writer believes, be encouraged. He feels, however, that it is absolutely necessary to have distinctive publications for the stations which will represent their work.

A modification of the above plan which might more nearly meet the views of some persons would be to publish separate bulletins numbered consecutively under each series or subject, *i. e.*, Agronomy Bulletins, 1, 2, 3, etc., or Dairy Industry, 1, 2, 3, etc. Similar to the publications of the Carnegie Institution, except classified under different subjects so that it would not be so difficult to determine what had been published on a given subject. Each bulletin in this case to be sold separately. While there are many points in favor of such separate publication and sale, the writer believes that all things considered, a periodical publication which can be subscribed for by the volume meets more of the requirements. The writer has submitted the substance of this paper to several of his colleagues for criticism and suggestions. In a letter regarding the matter, Director L. H. Bailey states:

I have gone over your proposition for a series of publications and I like it very much. . . . I feel that the series should have unity and solidarity. Rather than to have the series of journals I think there ought to be one series of memoirs, perhaps broken up into parts representing the different subjects. These parts could be published separately. References then could be made to the memoirs as a whole with a designation as to Botany series, Plant Breeding series, Poultry series, and the like, much as is done at the present time with the Annales des Sciences. The assessment against the institutions for such publication could not be made against the Adams Fund, as that can not be used for publication. I suspect that most of the institutions already mortgage their Hatch Fund for publication as heavily as they ought. However, I am sure that some way could be found whereby the money could be secured.

Doctor T. L. Lyon writes as follows:

I have looked over the plan you propose for publishing the technical results obtained by the several experiment stations. This strikes me as an extremely good plan and I see no reason why it could not be put into execution. I should like to make one suggestion that I think might make the plan work a little more smoothly. I notice that you provide for expense of publication by charging for the several publications, and dividing these publications into series based upon the subjects of which they treat. In order that due economy shall be exercised in the publication, the committee in charge of each series should receive annually a sum of money proportional to the amount received in subscriptions, which together with the subscription fees should be available for meeting the expense of publication. An arrangement of this kind will, I think, result in having each series appeal to a sufficient constituency to make its publication worth while. I have given some attention to the arrangement of series that you propose. It seems to me that if there is any improvement to be made in your arrangement it would be in decreasing the number of series. I have thought of the following arrangement:

Plant Production (including investigations in soils, plant nutrition and propagation, atmosphere and water).

Plant Life (including anatomy, composition, physiology and pathology).

Principles of Breeding.

Dairy Investigation.

Animal Production (including improvements by breeding, nutrition, care and management).

Veterinary Science (including anatomy, composition, physiology and pathology).

Entomology.

Engineering.

This reduces the number somewhat and includes one subject not included in your classification. I believe that the time has come when we must have technical journals in subjects pertaining to agriculture just as they have in all other branches of scientific work.

Professor J. W. Gilmore writes:

This scheme seems to me eminently feasible and I believe is a distinct step in arranging and systematizing our station literature. I would like to hear a discussion, however, along three lines at least:

1. Scheme of classification.

2. Whether station workers might not receive any or all of the series free on request.

3. What may be the attitude of the now-established scientific journals toward the scheme.

Would it be well to invite discussion along these lines?

The methods and means of publication for scientific station matter is a subject in which all experiment-station investigators are vitally interested, and the writer has thought it desirable to publish his thoughts on the subject, hoping to stimulate a general discussion out of which sentiment may crystallize so that some advanced step may soon be taken by the station authorities.

H. J. Webber

Cornell University

ON THE EFFECTS OF MAGNESIUM SULPHATE ON PLANTS

In the issue of Science of August 16, Professor William J. Gies publishes a letter, in which my refutation of an unjust attack is subjected to an analysis which I cannot regard as going to the essential point. I must, therefore, once more and more distinctly state that my inferences as to the *poisonous action* of *magnesium sulphate* on plants can, of course, only relate to the conditions of my experiments and that *I nowhere have made the assertion that these poisonous actions would be observed also at still higher dilutions than those I had used,* for I was very well acquainted with the truth that the action of a poisonous substance decreases with the dilution and that beyond a certain dilution even a stimulating action can take place.

I have further pointed out that the poisonous effects of that salt are modified by the lime content of the cells; the more lime there is present in the cells, the more magnesium sulphate will be required to exert a poisonous action. From this standpoint my own observation on the stimulating action of magnesium sulphate[1] under certain conditions, becomes intelligible.

Oscar Loew

SPECIAL ARTICLES

THE SPARK CHRONOSCOPE

Eight years ago I published a description of a new chronoscope in a technical monograph. Eight years of continued use, in which the instrument has been tested for convenience, durability, adaptation and accuracy, give such assurance of satisfaction that I am moved to bring the instrument to the attention of a wider circle of scientists through the columns of this journal. I would especially invite comparison with other instruments on the three fundamental qualities of accuracy, economy in operation and adaptability.

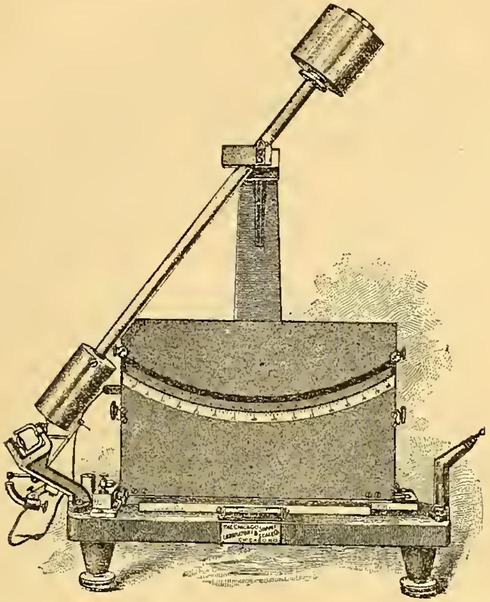
The following brief description is essentially an extract from the original account in *The University of Iowa Studies in Psychology,* Vol. II., p. 155 *ff.*

Of the hitherto known forms of apparatus for measuring short intervals of time, the graphic spark apparatus is the most accurate and the pendulum apparatus the most convenient. In the chronoscope that is shown in the accompanying figure, the spark method of recording is combined with the pendulum action.

The cut is reduced to a scale one sixth of the size of the apparatus. The pendulum is shown in the starting position. The lower bob terminates in a knife edge which rests upon the projecting edge of a mechanical release key. The action of this key is soundless and gives the pendulum no impetus in either direction. On the other side of the apparatus is a spring key which catches the pendulum at the

[1] *Cf.* "Flora," 1893; observations on the growth of the roots of *Tradescantia,* in my article on the "Physiological Functions of Lime and Magnesia."

end of the swing. When the pendulum is released from this, it swings back with little assistance to the starting point and makes all necessary adjustments automatically. On the



back of the lower bob is an index point which runs at the upper edge of the scale and serves as a spark point.

The record is made upon a smoked paper which is seen through the slit above the scale. This paper is stretched upon two rollers; it also rests upon an insulated metal plate which serves as an electrode and keeps the paper straight and smooth back of the scale. Back of this plate is a third roller by means of which the tension of the paper may be adjusted. The paper support is built on a carriage so that it may be removed and replaced without disturbing the rest of the apparatus. In preparing the paper this carriage is removed and the paper is smoked as on an ordinary kymograph drum. As a complete record consists in a single spark which may be recorded at once, several hundred records may be made with one preparation of the paper. The paper is moved, as needed, by a thumb screw at one end of the upper roller.

In reaction experiments the stimulus is given automatically by the apparatus when the pendulum indicator passes the zero point on the scale. A double rocking lever at this point makes one circuit and breaks another, either of which may be used in giving the stimulus. These contacts are adjustable platinum and mercury contacts and their adjustment may be verified by direct sight. The closing or opening of the circuit is soundless, and the stopping of the lever in a soft rubber clutch makes no sound that can be heard a few feet away.

The reaction, or termination of the interval to be measured, is indicated by a spark on the sensitive paper at the edge of the scale. The spark is produced by interrupting the primary circuit of an ordinary induction coil. One secondary terminal is connected with the insulated plate on which the paper rests and the other is connected with the body of the apparatus. The point of the pendulum indicator is the nearest metal to the plate; therefore the spark flies from this point, through the sensitive paper, to the plate.

The scale is graduated empirically by the most reliable graphic method into hundredths of a second, and each unit is divided into halves. The average space of one unit is 5 mm. on the arc of the scale. With this adjustment the scale covers 0.80 sec. and the records are read in half-hundredths with ease and accuracy. This division is the most convenient and appropriate to use in reaction experiments. The variation in the movement of the pendulum is negligible because the pendulum is carefully constructed and balanced and moves without friction. The variation in the make contact is also negligible because the platinum terminal moves much faster than the pendulum indicator. The spark tends to take the shortest course between the point and the plate, but it may be deflected. The maximum distance between the spark point and the paper is 1 mm. The maximum deflection of the spark may be estimated to be about 45°. That amount of deflection is not liable to occur for the maximum distance, but if it did the maximum variation would be ± 1 mm. on the scale, which is equal, on the average, to ± 0.002 sec. The average distance between the spark point and the paper is about .5 mm. and the average angle of deflection of the spark is less than half of 45°; therefore the average variation in the spark is less than ± 0.001 sec.

The chronoscope may be adapted for the measurement of longer intervals, as in the study of association, by two minor changes which can be made in a minute. A small weight is fastened on the top of the upper bob. This makes the pendulum swing so slowly that it takes three seconds to cover the arc of the scale. A corresponding scale, graduated empirically in hundredths of a second, is clamped over the regular scale. The accuracy is nearly proportional to the speed of the pendulum.

Similarly, if there should be a demand for finer readings than those obtained by the standard adjustment, an extra weight may be placed on the lower bob that will cause the pendulum to cover the arc of the scale, for example, in one third of a second. If the corresponding scale is graduated in thousandths of a second each unit will occupy, on the average, 1 mm. of space. The degree of accuracy will be nearly proportional to the speed, because the latent time of the spark is negligible and the action is frictionless.

Much of the value of a chronoscope lies in its adaptation to the attachment of a variety of accessories. The possession of the soundless make and break contacts for the stimulus circuit makes it possible to connect all sorts of electric stimulus apparatus, such as the telephone receiver, the touch key, the tachistoscopes, etc.

For regulating time-exposures, a movable pendulum contact is attached to the front of the base and adjusted, by reference to the scale, for any desired length of exposure from a hundredth of a second to three seconds. This contact may be used either as a make or break and the circuit may be completed either through the make or the break of the stimulus contacts.

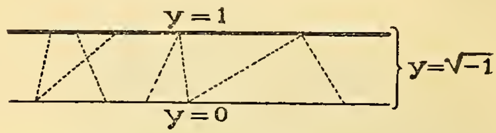
C. E. Seashore

The University of Iowa

A VECTOR DIAGRAM

Apropos of Carl Barus's interesting note in Science of August 2, p. 149, it may not be amiss to call attention to a representation that I used in a communication to the March meeting of the Chicago Section of the American Mathematical Society.[1]

I represent a real point (x', y') in the plane by a dot and call it a black point, while an imaginary point $(x'+ix'', y'+iy'')$ is represented by a blue point coincident with the real point $(x'+x'', y'+y'')$ and joined to (x', y') by a real vector. Where no confusion



is caused the real vector is drawn straight, but otherwise it may be curved, it being understood that the direction is determined by the end points. Furthermore, if the vector moves its end points describe a black curve and a blue curve. Thus the line

$$y=\sqrt{-1}$$

is represented by joining every point in the black line

$$y=0$$

to every point in the blue line

$$y=1.$$

In the accompanying diagram the "blue line" is drawn heavy, the "red lines" broken.

Ellery W. Davis

QUOTATIONS

LIVING ON OUR CAPITAL

The passion to beat our records in material advancement tends to blind the thought to the fact that we are rapidly consuming the very fundamental resources on which the prosperity of the country rests. Without doubt the timber supply of the United States is disappearing far more rapidly than any increment of growth. The treatment of the soil in much

[1] *Bulletin of the American Mathematical Society*, June, 1907, p. 436.

of the best agricultural lands is still of the kind that exhausts fertility and makes crop failures inevitable.

In the use of the iron ore deposits there is not even the possibility of duplication in preventing the exhaustion of supply. The rate of utilization has for several years been going on at from 25,000,000 to 30,000,000 tons a year. The country has been taking out, say 400,000 tons of copper a year and the coal mines of the country yield 475,000,000 tons. The annual lumber and timber products, including fire and pulp wood, are probably valued at no less than $1,000,000,000. Excepting agriculture and lumbering, there is no possible way of replenishing supplies once exhausted, except by the discovery of new sources of production.

The forests, the coal beds, the iron ore and the copper, along with the fertility of the soil, are essential parts of the capital of the nation. The annual output from them is not simply income; it is to a large extent a spending of capital. Expenditure of capital resources always points to a time when the community will be put to the necessity of finding substitutes for any one or more of these fundamental elements of national strength. Without attempting to forecast the time of such exhaustion the policy of the present requires that efforts be made in two directions to put off as far as possible the day of reckoning. For the nation that has lost its elements of might in material resources cannot hope to maintain its ascendency among its more powerful and farseeing competitors.

The two things which a nation can do are to economize consumption and to discover substitutes. The natural effect of rapid consumption is productive of higher prices, which in themselves supply an automatic check. But before the check of advancing prices sets in there are always wasteful methods at work which are themselves to no small extent the cause of advancing prices. Only after billions of dollars have been lost in the treatment of the soil, of the forests and the mines, does the policy of more economical management force itself upon those in control. The natural law of supply and demand compels man in his treatment of nature to become a better husbandman. Yet this is too much like locking the stable after the theft of the horse fully to meet the case.

The real remedy for rapid and wasteful exhaustion of natural resources is to be found in technical and scientific research. The endowment of such research is one of the greatest financial problems of American industry. The state and federal governments have already provided for agriculture and applied foresight to the use of the public forests. The consolidation of iron ore properties under the control of a smaller number of large corporations is in itself a promise of a more economical method of handling them. But the real gain must come from the laboratory, whether in the iron and steel plant or in the experimental rooms of our universities and technical schools. The single item of applying electricity economically to the smelting of ores would in itself, for instance, be worth thousands of times the cost of experimentation and research in a single year's output.—*Wall Street Journal.*

ABSTRACTS FOR EVOLUTIONISTS

Madreporarian Corals.—In a magnificent work on the Madreporaria of the Hawaiian Islands and Laysan,[1] Dr. T. W. Vaughan takes up the difficult questions relating to the species and varieties of these animals, and while leaving them unsettled, gives a most interesting and suggestive discussion, with an abundance of facts, and very good illustrations, the latter occupying no less than ninety-six large plates. The following quotations will be of general interest:

> Variation in corals is, we know, great and complex. If we knew its limits, we should know the limits of the different species. Bernard, in cataloguing the Perforate Corals of the British Museum (Natural History), experienced so much difficulty in defining them from the collections at his disposal that he decided to abandon the Linnæan system of nomenclature, and to use in his catalogues a geographical number system (p. 4).

> Studies of variations, such as those contained in this paper, may appear elaborate to persons who have not gone deeply into the subject, but in reality they are of only a preliminary nature, for

[1] Bulletin 59, U. S. National Museum, 1907.

as stated in the introductory remarks, "there is on every side an insufficiency of data," and consequently it is not possible to solve many of the fundamental problems pertaining to the group. The study of variation is inseparable from experimental physiological investigations, for these are a necessary foundation for the understanding of variation (p. 6).

The author then goes on to distinguish between *gametic* and *vegetative* variation, and to outline the methods whereby these might be studied experimentally. He expresses the hope that the necessary investigations may be undertaken by the marine biological stations. Under *Porites compressa* (pp. 174–193) there is given a full account of twenty types of variation, called forms and subforms.

The variation appears to be continuous, but with a number of definite secondary modes, should they be plotted into a specific curve. . . . We have no facts by which it could be ascertained whether the differences are of gametic or vegetative origin.

Antarctic Pteropod Mollusca.—In the report of the British National Antarctic Expedition (1907), Sir Charles Eliot discusses the Pteropods of the southern seas, and calls attention to the fact that "in both the Arctic and Antarctic seas the predominant, and as we approach the Poles probably the only Pteropods are closely allied, or even identical species of *Limacina* and *Clione.*" The distribution of these forms is interrupted by a wide zone in which they do not occur, none having been recorded from within thirty degrees either north or south of the equator. Sir Chas. Eliot remarks:

I confess that I have seen no explanation of these facts which appears to me satisfactory. Our knowledge of the direction in past ages of ocean currents which must have largely determined the distribution of pelagic forms is slight, and our record of fossil Pteropods is very imperfect (p. 3).

The Lizard-genus Leiolopisma.—Dr. L. Stejneger, in his recent admirable revision of the Reptiles and Amphibians of Japan,[2] gives an account of *Leiolopisma laterale* (Say), a lizard which in North America inhabits the lower Austral zone east of the Rocky Mountains, but is not found at all in the west. It reappears in Asia, occurring over a large area in China, and exists also in the Riu Kiu islands. The Chinese animal has been separated as *L. reevesii* (Gray), but Boulenger failed to find any distinctive characters to separate it, and Dr. Stejneger "upon the most searching comparison" has also utterly failed to discover any difference. The remaining species of the genus belong to the Old World. In speaking of the Scincidæ in general, Dr. Stejneger says: "Many species have an enormous geographic range, owing to the ease with which they may be accidentally transported," but there is no reason to suppose that the distribution of *L. laterale* should be explained in that way. Probably many genera of lizards are of great antiquity. When recently at the Museum of Comparative Zoology I was shown by Mr. Samuel Henshaw a small lizard perfectly preserved in amber. Instead of being some strange extinct form, as one might have expected, it had all the appearance of a modern *Gekko,* and presumably belongs to that genus. It is scarcely necessary, of course, to refer to the fact that the case of *Leiolopisma* parallels several others known among plants, the molluscan *Philomycus,* etc., though the absolute *specific* identity is very remarkable, especially in a vertebrate.

A Mollusc New to Ireland.—Mr. J. W. Taylor[3] has published a very interesting account of the discovery of *Vitrina elongata* (Draparnaud) in Ireland. It is a species which occurs commonly in the mountain regions of Central Europe, and also in Spain, and Mr. Taylor thinks it formerly had a much wider distribution, but has been driven out of many regions by stronger or more dominant species. Its survival in Ireland he attributes to the easier conditions (from the standpoint of the *Vitrina*) existing there.

A Grass Common to Ecuador and Guatemala.—In a recent account of some Guatemalan plants,[4] Dr. B. L. Robinson and Mr. H. H. Bartlett call attention to the discovery of the anomalous genus of South American

[2] Bulletin 58, U. S. National Museum, 1907.

[3] *Irish Naturalist,* August, 1907.

[4] *Proc. Amer. Acad.,* June, 1907.

grasses,' *Streptochœta*, in Guatemala. The species proves to be *S. sodiroana* Hack, described from Ecuador, the determination having been confirmed by Professor Hackel himself:

This is by no means an isolated case of the occurrence of identical species in Ecuador and Guatemala, but it has peculiar interest from the marked character and rarity of the plant concerned (p. 50).

T. D. A. Cockerell

University of Colorado

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

MONTHLY WEATHER REVIEW

Nos. 5 and 6, *Monthly Weather Review*, 1907, contain the following articles of the most general interest:

"Guilbert's Rules for Weather Prediction," by Dr. Oliver L. Fassig. Guilbert prepared a paper for the competition organized by the Belgian Astronomical Society, "in order to bring out the present state of the art of predicting the weather."

"Principles of Forecasting the Weather," by Gabriel Guilbert, of Caen. This sets forth the method followed by the writer, which is based on the principle of the *normal wind*. Those who are interested in weather forecasting, either practically or theoretically, will find this discussion worthy of serious attention.

"The Relation of the Movements of the High Clouds to Cyclones in the West Indies," by J. T. Quin; a further contribution to the discussion by the late Father Benito Viñes, prepared for the Chicago Meteorological Congress of 1893.

"Memorandum on the Gulf Stream and the Weather," by Professor Abbe; a sane statement of the extent to which the Gulf Stream does *not* affect our weather.

"The Cold Spring of 1907," by Professor A. J. Henry; a review of the weather map features which produced the cold weather of last spring, coupled with the following: "The underlying causes of the recent cold weather are probably obscure and deep seated."

"Value of Weather Forecasts to Natural Gas Companies," in which the importance of forecasts of colder weather, with increased need of gas, is emphasized.

"Tornado at Wills Point, Texas, May 25, 1907," illustrated by two snap-shot photographs. Such photographs, although still rare, are fortunately becoming more numerous.

"Relations of the U. S. Weather Bureau to the Railroad Man," an address delivered by H. W. Richardson, local forecaster at Duluth, Minn., before the Northern Railway Club; contains notes on many interesting phases of the relation between weather and railroading.

"Legal Decisions as to Cyclones," being the opinion in full, of Judge Philips, of the United States Circuit Court of Appeals, Eighth Circuit, Minnesota.

"Hythers and the Comparison of Climates," by W. F. Tyler; a discussion of the question of sensible temperatures.

"Foehn in New South Wales," an extract from an account published in 1837.

"The St. Swithin's Day Fallacy," by J. H. Morrison. "It would seem to be almost useless to say anything further regarding the absurdity of the old superstition, with such an array of tell-tale figures all set against the legend."

"The Santa Ana of California," quotation from Professor Geo. E. Hale (*An. Vol. Carnegie Inst.*, 1906).

"Equinoctial Storms," by Professor E. B. Garriott. "There is no one special storm to which the term '*the* equinoctial' should be applied."

FORESTS AND RAINFALL

Dr. J. Schubert, director of the meteorological section of the Prussian Forestry School at Eberswalde, has recently published the results of his continued studies on forest influences in two papers. In one of these ("Der Niederschlag in der Setzlinger Heide," 1901–5; *Zeitschr. f. Forst und Jagdwesen*, 1907, No. 8) it is pointed out that of seventeen stations in forest, on the forest edge and in the open, the forest stations show a greater precipitation (1901–5), and the stations in the open show the least. Corrections for snowfall and for difference in the exposure of the gauges as regards wind, amount to 5.5 per cent.; the observed difference in catch being 5.2 per cent. It thus appears that, as has previously been the case when the conditions of forest rainfall have been critically examined, the probability of error is about equal to the apparent difference in the amount of precipitation.

The second paper ("Wald und Niederschlag in Westpreussen und Posen und die Beeinflussung der Regen und Schneemessung durch den Wind," ibid., 1906, No. 11) is a critical study of the effect of wind on the catch of precipitation, especially snow, in gauges.

INFLUENCE OF FORESTS UPON WIND VELOCITY

M. I. St. Murat, the new director of the Meteorological Institute of Roumania, has made a study of the retarding effect of forests upon wind velocity (Bucharest, 1907, 4to, pp. 33, pls. 3), which appears in the *Annales* of the Roumanian Academy, Bucharest. The subject is one which has hitherto received practically no attention, at least so far as quantitative measurements are concerned. The results are as follows: The greatest effect which a forest can have upon the wind consists in diminishing the wind velocity to leeward of the forest. At 50 meters (164 feet) this decrease in velocity may amount to 3 to 12 kilometers (4–7½ miles) an hour, which means a reduction of the force of the wind by one degree on the Beaufort scale. This decrease is felt within 100 meters (330 feet) of the forest. After that the velocity increases again with increasing distance, and at about 500 meters (1,640 feet) reaches the force noted before the forest was encountered.

THUNDERSTORMS AND "FALSE CIRRUS"

Dr. C. Kassner has investigated the question of the "false cirrus" and of solar haloes ("Gewitterschirm und Sonnenringe," *Met. Zeitschr.*, July, 1907), with the following result:

1. Solar haloes before and after thunderstorms show that the cirrus veil is an ice cloud.

2. It is therefore wrong and misleading to call these cirrus clouds "false cirrus."

3. The cirrus cloud veil precedes the thunderstorm on the average by as much as four hours, and follows it by about one hour. Hence the average extent is measured by five hours, or, with an average hourly velocity of progression of 25 miles, the distance covered is 125 miles.

CLIMATOLOGY OF SOUTH AFRICA

J. R. Sutton, meteorologist of the De Beers Consolidated Mines, Kimberley, has published three more papers dealing with the climate of his district. These are (1) "A Contribution to the Study of Evaporation from Water-surfaces" (*Sci. Proc. Roy. Dub. Soc.*, XI., N. S., No. 13, 1907, 137–178); (2) "Variability of Temperature in South Africa," and (3) "The Diurnal Variation of Barometric Pressure" (*Rept. So. Afr. A. A. S.*, 1906, 13–48; 135–142). These papers are all worthy of attention on the part of those interested in the general subjects treated, or in the climatology of South Africa in particular.

THE WEATHER BUREAU

An account of the various activities of the Weather Bureau in saving life and property is given in an article by Gilbert H. Grosvenor, entitled "Our Heralds of Storm and Flood," published in the *National Geographic Magazine* for September, 1907. This article, which is fully illustrated, originally appeared in the *Century*.

SALT OF MARINE ORIGIN IN THE ATMOSPHERE

A paper entitled "Quelle est l'Importance du Transport atmosphérique de Sel marin?" by E. Dubois, published in *Ciel et Terre*, July 16, 1907, is worth noting chiefly because of the bibliographical notes which accompany it.

R. DeC. Ward

Harvard University

THE DISTRIBUTION OF RADIUM IN THE ROCKS OF THE SIMPLON TUNNEL[1]

The principal classes of material which enter into the composition of the massif of the

[1] Read before Section C, British Association for the Advancement of Science, Leicester, 1907.

Simplon are: (*a*) The Jura-Trias sediments, lithologically often much alike and much interfolded; (*b*) the Paleozoic crystalline schists; and (*c*) the gneiss of Monte Leone and the Antigorio gneiss, both stated to be of Archæan age. These rocks throughout contain radium, and for the most part in quantities much above what hitherto has been ascribed to sedimentary or igneous rocks.

Some thirty-six typical samples, taken from various points in the tunnel, have been examined. The poorest in radium are certain anhydrite rocks. Certain amphibolite schists go very high. The Antigorio gneiss rises from 10.5×10^{-12} and 8.0×10^{-12} grams radium per gram of rock at the Italian entrance to 23.7×10^{-12} at 4,000 meters inwards. Some of the Archæan gneisses yielded very high results.

Such quantities of radium if generally distributed throughout the rocks of the massif would be sufficient to disturb any forecast of the temperature which under normal conditions would be encountered at the level of the tunnel. It is suggested that the radium was in fact the source of the discrepancy between the predicted and the observed rock temperatures.

As it is improbable that these results are unique and apply only to this particular sedimentary accumulation and locality, they appear to point to hitherto unsuspected quantities of radium (and its parent elements) in the immediate surface materials of the earth. It seems impossible to avoid the conclusion that these elements were precipitated along with the sediments entering into the composition of the massif. The question then arises whether the accumulation of such quantities or radioactive elements may not enter as a factor in the events attending mountain-building. It can be shown that an area of sedimentation whereon has been accumulated some 10,000 meters of sediments, having a richness in radium comparable with the Simplon rocks, must necessarily become an area of greatly lessened crust-rigidity, and would hence become the probable site of crust-flexure under tangential compressive stress.

Further investigation will be required before such views can be generalized and the importance of radium as a source of instability of the earth's crust be determined. Apart from any speculations as to the influence of radium as the cause of an energetic substratum, the shifting of radium and its parent elements by denudation must be regarded as a convection of thermal energy, and this convection, if the quantities involved are sufficient, must, under the conditions referred to above and the unceasing action of denudation, become rhythmic in operation, and at the same time must result in shifting the areas of high temperature and crust-weakness from age to age as the site of sedimentary accumulation changes.

J. Joly

THE ARC OF PERU

The Committee of the French Academy of Sciences having scientific control of the French Geodetic operations on the equator has reported the completion of the remeasurement of the historic arc of Peru.[1]

This arc was measured by the French (1736–1743) and used in connection with a similar arc in the Arctic regions, also measured by the French, to decide a question in regard to the form of the earth which had arisen as the result of Cassini's surveys in France.

A discussion of the measurement of the arc can be found in the report of the Superintendent of the Coast and Geodetic Survey for 1889, appendix 7.

In 1889, the question of remeasuring this arc was brought before the International Geodetic Association by the Delegate of the United States, Professor George Davidson, who suggested that France should have the prior right to execute the work.

Circumstances prevented any active work until 1898, when the discussion of the subject was renewed in the same association as the result of a motion offered by the Delegate of the United States, Mr. E. D. Preston. The association voted in favor of the proposition to remeasure the arc and the French delegates undertook to have the work done.

[1] *Comptes Rendus Hebdomadaires des Séances de L'Académie des Sciences*, No. 6, 5 Août, 1907.

Officers of the Geographic Service of the French Army left Paris for Ecuador in May, 1899, and the work was continued until completed.

The arc extends from Tulcan, Ecuador, Lat. + 0° 48′ 25″.6 to Payta, Peru, Lat. — 5° 05′ 08″.6 and the work accomplished in the remeasurement may be summarized as follows; viz.:

Seventy-four geodetic stations.

Three base lines measured.

Eight differences of longitude determined between stations at Tulcan, Piular, Quito, Latacunga, Riobamba, Cuenca, Machala, and Payta. The first five of these stations are distributed along the northern section of the arc, the sixth at the middle of the southern section, the seventh on the coast at the same latitude as the sixth, and the last at the end of the southern section, on the coast.

The comparison of the differences of longitude, geodetic and astronomic, between the stations at Machala and Payta and the station at Cuenca will throw light on the form of the geoid, as the first two stations are on the coast and the third is in the inter-andine region.

Six azimuths determined: at Tulcan, Piular, Quito, Riobamba, Cuenca, and Payta.

Sixty-four determinations of latitude.

Forty-eight magnetic stations: distributed all along the arc.

Six pendulum stations. One of these is at Machala, on the coast, at the point where observations for longitude were made; one at the foot of the western Cordillera, near Chimborazo; one, at an elevation of 4,150 meters in the western Cordillera; two, in the inter-andine region at Riobamba and Quito; and one at an altitude of 1,800 meters in the plain of the Amazon on the eastern slope of the eastern Cordillera.

Two lines of levels of precision: one from the Riobamba base line to Guayaquil and to the tide gauge at Salinas on the Pacific Coast and the other from the southern base line to the tide gauge at Payta, the two lines covering a distance of 410 kilometers.

A study was made of the natural history of the country and important collections were made, which will add to the knowledge of botany, zoology, anthropology and ethnology.

The preliminary computations are far enough advanced to assure the value of the observations. The closure of the triangles and the agreement of the computed and the measured lengths of the base lines compare well with the results obtained in the revision of the meridian of France.

The publication of the results of the work will be regarded as an important event by geodesists throughout the world.

The work reflects great credit on the French government for its liberality in providing the necessary funds, upon the French savants who directed the work and upon the gallant officers who made the scientific observations under most trying and unusual conditions.

Isaac Winston

REPORT OF THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE[1]

The International Commission on Zoological Nomenclature has the honor to submit the following report to the Seventh International Zoological Congress:

The Sixth International Congress referred to the Commission for consideration and report a paper (presented to that congress) urging that "absolute priority" be adopted in the law of priority, instead of taking 1758 as a starting point for zoological nomenclature.

While appreciating the sentiments which gave rise to the proposition in question, your commission is unanimously of the opinion that both practical and theoretical considerations contravene the adoption of "absolute priority" in preference to the date 1758. Accordingly, it is herewith recommended that article 26 of the code be not changed in respect to the point at issue.

During the past three years, several zoologists have submitted to the commission propo-

[1] Presented to the Seventh International Zoological Congress, Boston, Mass., August 19–23, 1907, and unanimously adopted after two public readings.

sitions for amendments or additions to the code. In accordance with the rule established by the Cambridge Congress, a number of these propositions could not be considered formally, because they did not reach the commission at least one year prior to the meeting of the present congress.

In its deliberations, the commission decided to report to the congress only those propositions upon which the vote in commission, as assembled here, was unanimous. The following propositions are unanimously recommended for adoption:

Add to Art. 8 the following:

Recommendation.—Certain biological groups which have been proposed distinctly as collective groups, not as systematic units, may be treated for convenience as if they were genera, but they require no type species. Examples: *Agamodistomum, Amphistomulum, Agamofilaria, Agamomermis, Sparganum.*

Add to Art. 14 the following:

Recommendation.—It is well to avoid the introduction of the names *typicus* and *typus* as new names for species or subspecies, since these names are always liable to result in later confusion.

Add to Art. 20 the following:

Recommendation.—In proposing new names based upon personal names which are written sometimes with ä, ö or ü, at other times with æ, œ and ue, it is recommended that authors adopt æ, œ and ue. Example: *muelleri* in preference to *mülleri.*

Add to Art. 29:

Recommendation.—To facilitate reference, it is recommended that when an older species is taken as type of a new genus, its name should be actually combined with the new generic name, in addition to citing it with the old generic name. Example: *Gilbertella* Eigenmann, 1903, Smithsonian Misc. Coll., v. 45, p. 147, type *Gilbertella alata* (Steindachner) = *Anacyrtus alatus* Steindachner.

Strike out the entire Art. 30 (dealing with the designation of type species of genera) and substitute therefor the following:

Art. 30.—The designation of type species of genera shall be governed by the following rules (*a–g*), applied in the following order of precedence:

I. Cases in which the generic type is accepted *solely* upon the basis of the original publication—

(*a*) When in the original publication of a genus, one of the species is definitely designated as type, this species shall be accepted as type regardless of any other considerations. (Type by original designation.)

(*b*) If, in the original publication of a genus, *typicus* or *typus* is used as a *new* specific name for one of the species, such use shall be construed as "type by original designation."

(*c*) A genus proposed with a single original species takes that species as its type. (Monotypical genera.)

(*d*) If a genus, without originally designated (see *a*) or indicated (see *b*) type, contains among its original species one possessing the generic name as its specific or subspecific name, either as valid name or synonym, that species or subspecies becomes *ipso facto* type of the genus. (Type by absolute tautonomy.)

II. Cases in which the generic type is not accepted *solely* upon basis of the original publication—

(*e*) The following species are excluded from consideration in selecting the types of genera:

(α) Species which were not included under the generic name at the time of its original publication.

(β) Species which were *species inquirendæ* from the standpoint of the author of the generic name at the time of its publication.

(γ) Species which the author of the genus doubtfully referred to it.

(*f*) In case a generic name without originally designated type is proposed as a substitute for another generic name, with or without type, the type of either, when established, becomes *ipso facto* type of the other.

(*g*) If an author, in publishing a genus with more than one valid species, fails to designate (see *a*) or to indicate (see *b*, *d*) its type, any subsequent author may select the type, and such designation is not subject to change. (Type by subsequent designation.)

The meaning of the expression "select a type" is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type.

III. Recommendations.—In selecting types by subsequent designation, authors will do well to govern themselves by the following recommendations:

(*h*) In case of Linnæan genera, select as type the most common or the medicinal species. (Linnæan rule,[2] 1751.)

(*i*) If a genus, without designated type, contains among its original species one possessing as a specific or subspecific name, either as valid name or synonym, a name which is virtually the same as the generic name, or of the same origin or same meaning, preference should be shown to that species in designating the type, unless such preference is strongly contraindicated by other factors. (Type by virtual tautonomy.) Examples: *Bos taurus, Equus caballus, Ovis aries, Scomber scombrus, Sphærostoma globiporum;* contraindicated in *Dipetalonema* (compare species *Filaria dipetala*, of which only one sex was described, based upon one specimen and not studied in detail).

(*j*) If the genus contains both exotic and non-exotic species from the standpoint of the original author, the type should be selected from the non-exotic species.

(*k*) If some of the original species have later been classified in other genera, preference should be shown to the species still remaining in the original genus. (Type by elimination.)

(*l*) Species based upon sexually mature specimens should take precedence over species based upon larval or immature forms.

(*m*) Show preference to species bearing the name *communis, vulgaris, medicinalis* or *officinalis.*

(*n*) Show preference to the best described, best figured, best known, or most easily obtainable species, or to one of which a type specimen can be obtained.

(*o*) Show preference to a species which belongs to a group containing as large a number of the species as possible. (De Candolle's rule.)

(*p*) In parasitic genera, select, if possible, a species which occurs in man or some food animal, or in some very common and wide-spread host-species.

(*q*) All other things being equal, show preference to a species which the author of the genus actually studied at or before the time he proposed the genus.

(*r*) In case of writers who habitually place a certain leading or typical species first as "chef de file," the others being described by comparative reference to this, this fact should be considered in the choice of the type species.

(*s*) In case of those authors who have adopted the "first species rule" in fixing generic types, the first species named by them should be taken as types of their genera.

(*t*) All other things being equal, page precedence should obtain in selecting a type.

Opinions Rendered by the Commission.—In response to certain questions, especially in reference to the Law of Priority (Art. 25) and its application (Art. 26), submitted for consideration, the Commission herewith unanimously renders the following opinions:

The meaning of the word "indication" *in Art.* 25a.—The word *"indication"* in Art. 25a is to be construed as follows:

(*A*) with regard to *specific* names, an *"indication"* is (1) a bibliographic reference, or (2) a published figure (illustration), or (3) a definite citation of an earlier name for which a new name is proposed.

(*B*) with regard to *generic* names, (1) a bibliographic reference, or (2) a definite citation of an earlier name for which a new name is proposed, or (3) the citation or designation of a type species.

In no case is the word *"indication"* to be construed as including museum labels, museum specimens or vernacular names.

The Nature of a Systematic Name.—The Commission is unanimously of the opinion that a *name,* in the sense of the Code, refers to the designation by which the actual objects are known. In other words, we name the objects themselves, not our conception of said objects. Names based upon hypothetical forms have, therefore, no status in nomenclature and are not in any way entitled to consideration under the law of priority. Examples: *Pithecanthropus* Haeckel, 1866, being the name of an hypothetical genus, has no status under the Code and does not therefore invalidate *Pithecanthropus* Dubois, 1894; *Gigantopora minuta* Looss, 1907, *n. g., n. sp.,* has no status under the code, since it is admittedly the name of a fantastic unit, not based upon any actual objects.

The Status of Publications Dated 1758.—The tenth edition of Linné's "Systema

[2] Si genus receptum, secundum jus naturæ et artis, in plura dirimi debet, tum nomen antea commune manebit vulgatissimæ et officinali plantæ.

Naturæ" was issued very early in the year 1758. For practical reasons, this date may be assumed to be January 1, 1758, and any other zoological publication bearing the date 1758 may be construed as having appeared subsequent to January 1. In so far as the date is concerned, all such publications may therefore be construed as entitled to consideration under the law of priority.

Status of Certain Names Published as Manuscript Names.—Manuscript names acquire standing in nomenclature when printed in connection with the provisions of Art. 25, and the question as to their validity is not influenced by the fact whether such names are accepted or rejected by the author responsible for their publication.

Status of Certain Pre-Linnæan Names Reprinted Subsequent to 1757.—A pre-Linnæan name, ineligible because of its publication prior to 1758, does not become eligible simply by being cited or reprinted with its original diagnosis after 1757. To become eligible under the code, such names must be reinforced by adoption or acceptance by the author publishing the reprint. Examples: The citation, subsequent to 1757, of a bibliographic reference to a paper published prior to 1758 does not establish technical names which may appear in said reference; synonymic citation of pre-Linnæan names, as in the tenth edition of Linné's "Systema Naturæ," does not establish such names under the code.

Ch. Wardell Stiles,
Secretary

WILBUR OLIN ATWATER

As the outcome of an illness lasting nearly three years, Professor Wilbur Olin Atwater died at his home in Middletown, Conn., on the evening of September 22, 1907. Professor Atwater was born in Johnsburgh, N. Y., on May 3, 1844. After three years of undergraduate life as a student in the University of Vermont, he spent his senior year at Wesleyan University, graduating in 1865. Several years were spent in teaching in high schools and he then devoted some time to the study of chemistry at the Sheffield Scientific School, receiving the degree of Doctor of Philosophy from Yale University in 1869. His thesis dealt with the composition of several varieties of American maize, thus early showing his tendencies to agricultural science—tendencies that were stimulated by further study at foreign universities in Leipsic and Berlin.

On return from foreign study, he was successively called to professorships in the East Tennessee University, Maine State College, and Wesleyan University. Taking up his work at this latter institution in the then new Orange Judd Hall of Natural Sciences, he began to prosecute researches particularly in the field of agricultural chemistry, enlisting the cooperation of the farmers and awakening interest in the rapidly developing chemistry of fertilizers. This active interest in agricultural chemistry he retained until his death. Recognizing the great service to agricultural science resulting from the experiment stations in Germany, he founded at Wesleyan University the first American agricultural experiment station in 1875. This station was subsequently removed to New Haven and is there continued as the Connecticut Agricultural Experiment Station. In 1888, the Storrs (Conn.) Agricultural Experiment Station was organized and Professor Atwater was appointed its director, a position he held until 1902.

The rapid development of the experiment station movement soon showed that some central clearing house was necessary to give the results of the various stations proper publicity, to promote cooperation among the various experiment station workers and to prevent as far as possible unnecessary duplication of work. To this end, the Office of Experiment Stations of the U. S. Department of Agriculture was created and Professor Atwater was appointed its first director.

It was a natural transition from the study of animal feeding to that of the feeding of man and soon Professor Atwater was directing his energies to chemical and statistical researches on the food and nutrition of man. His early experience as special agent of the U. S. Department of Labor developed in his mind to a high degree the importance of the social and economic study of the relations of food and diet to the labor power, health and moral tone of communities and the scientific studies of dietaries begun in a small way developed into a large investigation of the dietetic conditions obtaining in various parts of the United States. Special appropriations were secured from Congress to study the nutrition of man and the whole enterprise soon partook of the nature of an extensive cooperative study of food and diet. These studies were carried out with the active assistance of various investigators in numerous universities and colleges and they extended literally from Maine to California.

In company with his colleague, Dr. E. B. Rosa, he developed at Wesleyan University a respiration calorimeter for experiments with man, in which many researches into the fundamental laws of metabolism have been made. Perhaps the investigation of greatest theoretical interest is the series of experiments made with this apparatus demonstrating that the law of the conservation of energy obtained in the physiological transformations of the living body.

An investigation into the nutritive value of alcohol made with this apparatus by the aid of grants from the Committee of Fifty for the Investigation of Alcohol attracted much notice, both in America and in Europe, and Professor Atwater soon began an active campaign in the interest of rational temperance reform.

Professor Atwater was a member of a large number of scientific societies and kindred institutions. He was a foreign member of the Swedish Royal Academy of Agriculture and a corresponding member of the Russian Imperial Military Academy. His chemical, agricultural and economic writings have been translated into several foreign languages and few American scientists were better known abroad than was he. His writings number somewhat over 100 papers and cover a large field.

It was perhaps as an administrative officer and organizer that Professor Atwater rendered the greatest service to American science, and he will always be noted for the establishment of the experiment station movement. As the first director of the Office of Experiment Stations, he chose as his assistants Dr. A. W. Harris, now president of Northwestern University, who became his immediate successor, and Dr. A. C. True, now director of the Office of Experiment Stations. Thus, in large measure, the policy which he inaugurated has been continued from the creation of this office.

Of remarkable activity and energy, Professor Atwater attracted many young men to his laboratory and his loss will be especially felt by all those who have had the good fortune to have come under his influence during his active career as a director of research for more than thirty years.

F. G. B.

SCIENTIFIC NOTES AND NEWS

The memorial statue of Joseph Leidy, the eminent anatomist and zoologist, erected on the west side of the City Hall Plaza, Philadelphia, will be unveiled at 3 P.M. on Wednesday, October 30. Addresses will be made by Mr. Joseph Wharton and Professor Henry C. Chapman, M.D.

Dr. G. Hellmann has been appointed professor of meteorology in the University of Berlin and director of the Prussian Meteorological Service, in succession to the late Professor von Bezold.

On the occasion of the recent celebration of the centenary of the Geological Society of London, the gold medal of the Institution of Mining and Metallurgy was presented to Sir Archibald Geikie, the president of the society.

President Hadley, of Yale University, has sailed for Germany, to spend six months as Roosevelt professor of American history and institutions in the University of Berlin, on the Columbia University foundation.

Dr. Robert F. Weir and Dr. Charles McBurney, professors of clinical surgery, have been made emeritus professors of surgery at the College of Physicians and Surgeons, Columbia University.

Dr. G. N. Stewart, professor of physiology at Western Reserve University, has leave of absence during the present academic year, which he will spend in research in Vienna.

Professor George F. Fullerton, professor of philosophy in Columbia University, has been given leave of absence and is spending the present year at Munich. His courses are given by Professor Arthur O. Lovejoy, of Washington University.

Professor William A. Hammond, of Cornell University, will lecture throughout the year at the University of Pennsylvania on ancient and medieval philosophy.

Mr. C. C. Robertson, of the Yale Forestry School, after a tour of the European forests, will engage in government forestry work in Orange River Colony, South Africa.

Professor Austin Cary, of Harvard University, has been engaged by the Maine State Forestry Commission for a series of lectures covering several weeks, during which time he will speak before granges, schools and other audiences in cities and towns in all parts of the state. Professor Cary will commence his tour during the first week of November.

Dr. A. A. Macdonell, Boden professor of Sanskrit at Oxford, has left England on leave of absence for India and Ceylon in furtherance of Sanskrit research. All the most important Sanskrit libraries, archeological sites and museums, and university colleges in India and Ceylon will be visited, and conferences will be held with native scholars. One of the objects of the tour is to acquire old Sanskrit manuscripts where opportunity offers, and another to collect material for a Dictionary of Indian Religion and Mythology, illustrated and treated historically.

Dr. George Byron Gordon, curator of the section of American archeology at the Museum of Arts and Sciences of the University of Pennsylvania, has been making explorations among the Indian tribes of Alaska, and has secured many valuable specimens.

Dr. William H. Nichols, chairman of the board of directors of the General Chemical Company, gave the address at the Founder's Day celebration at Lehigh University on October 10.

Dr. Joseph W. Richards, of Lehigh University, lectured before the Franklin Insititute of Philadelphia, on October 10, on the "Thermo-electric Production of Iron and Steel."

Birmingham University has arranged a course of lectures during the coming session, especially in the interests of the industrial classes, on the lines followed in an experimental series last winter. The principal, Sir Oliver Lodge, will deal in five divisions with "Pioneers of Science," and other lectures will be delivered by Professor J. H. Poynting, Professor C. Lapworth and Professor T. Turner. Some of the subjects included in the lectures have special reference to local industries.

A course in experimental physiology, under the direction of Professor Graham Lusk, is offered to teachers on Fridays at three o'clock, at University and Bellevue Hospital Medical College, 338 East 26th street, New York City.

The program of the Harvey Society course of lectures for the coming year is as follows:

October 26—Professor E. O. Jordan, University of Chicago: "The Problems of Sanitation."

November 16—Professor James Ewing, Cornell University: "Etiology of Tumors."

November 30—Professor D. L. Edsall, University of Pennsylvania: "The Bearing of Metabolism Studies on Clinical Medicine."

January 11—Professor Ernest H. Starling, University of London: "The Chemical Control of the Body."

January 25—Professor George W. Crile, Western Reserve University: "Shock."

February 8—Professor Joseph Jastrow, University of Wisconsin: "Subconsciousness."

February 22—Professor Otto Folin, Harvard University: "Problems of Chemistry in Hospital Practise."

March 7—Professor Ross G. Harrison, Yale University: "Embryonic Transplantation and the Development of the Nervous System."

April 11—Professor E. A. Schäfer, University of Edinburgh: "Artificial Respiration in Man."

The lectures are given under the patronage of the New York Academy of Medicine and are held at the Academy Building, 17 West 43d street, on Saturday evenings at 8:30

o'clock. All interested are cordially invited to attend them.

The committee on the Mary Putnam Jacobi fellowship announces that $8,000 of the $25,000 required has been raised. The fund is expected to provide an income of $1,000, whereby efficient aid may be rendered to post-graduate women students in medicine. The Women's Medical Association of New York City invites the cooperation of all who desire to further the higher medical education of women in medicine. The treasurer of the association is Dr. Eleanor Tomes, 136 East Thirtieth street.

Professor Charles Stewart, F.R.S., for the past twenty-three years conservator of the museum of the Royal College of Surgeons of England, died on September 27. He was also for a long time Hunterian professor of human and comparative anatomy at the college, and had been Fullerian professor of physiology at the Royal Institution.

The Berlin Cancer Institute, which is under the direction of Professor von Leyden, is to be considerably enlarged. New laboratories for the investigation of cancer will, it is announced, be built in a house in the neighborhood of the Charité Hospital.

The New England Federation of Natural History Societies met in Portland, Me., on Friday and Saturday, October 4 and 5. The federation was the guest of the Portland Society of Natural History, an old association of which Stimpson, Mighels, Fuller and Morse were earlier members. About twenty delegates were present, representing as many of the affiliated associations. Exhibits were shown by the Appalachian Mountain Club of Mount Washington flora; Dr. D. W. Fellows, ferns and grasses of Maine; Mrs. J. H. Lewis, moths of Maine; Fairbanks Museum, St. Johnsbury, Vt., alpine plants; J. H. Emerton, Boston, spiders; Miss Cherrington and Miss Clapp, of Boston, mosses of New England, and others. The meeting of Friday evening was by the Portland society, with President Leslie A. Lee, of Brunswick, in the chair, Major J. W. Boyd (archeology) and J. H. Emerton (spiders) being the speakers. On Saturday evening the meeting was of the federation, with Miss Delia I. Griffin, of St. Johnsbury, on the relations between the small museum and the school children, and Miss M. Edna Cherrington on mosses. On Saturday afternoon a joint outing of the society and the federation made a trip to the shore, where more than a score of unusual species were found in the tide-pools. On Sunday, on invitation of Professor Lee, the delegates visited the museums and laboratories of Bowdoin College. The president of the federation is John Ritchie, Jr., and the secretary, J. H. Emerton, both of Boston. The annual meeting of the federation is set for April, in Boston, and a special meeting will be convened the first week in July on the summit of Mount Washington, where an unusual opportunity will be afforded to study the fauna, flora, topography and geology of the presidential range.

The seventh Annual Conference of the Sanitary Officers of the State of New York, under the auspices of the New York State Department of Health, will be held at Buffalo from October 16 to 18. There will be an opening address by Dr. Eugene H. Porter, commissioner of health, and by Governor Hughes. A number of papers of scientific importance will be presented during the six following sessions of the congress.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. John D. Rockefeller has undertaken to triple gifts made for the memorial library to be erected at the University of Chicago in honor of William Rainey Harper. The sum of $110,000 has been subscribed for the memorial from various sources, and Mr. Rockefeller has given $330,000. He will triple further gifts, not exceeding $90,000, thus making his total contribution $600,000.

Professor John Hayes Hammond has given an additional $5,000 for the further equipment of the Hammond Metallurgical Laboratory of the Sheffield Scientific School of Yale University. This makes Professor Hammond's gift to the laboratory $127,000. The Sheffield Scientific School has also received a gift of $1,000 a year, for ten years, from an anonymous donor, a member of the class of '95 S., to be used for the course in commercial geography.

The Johns Hopkins University has received $20,000 by the will of the late Miss Frances Wilson, of New York.

Mrs. George E. Wheelock has given $5,000 to Columbia University as a fund in memory of her late husband, the income to be applied to the benefit of the Department of Physiology. Columbia University has also received $5,000 from Mr. Bernard M. Baruch for the Vanderbilt Clinic.

Mr. Andrew Carnegie has given £10,000 towards the establishment of a technical college at Aberdeen.

The board of regents of the University of Kansas have recently let the contract for the first of a group of five new buildings for the School of Engineering. Two more buildings of the group will be started next year, when the money appropriated by the legislature becomes available. The Robinson Gymnasium, erected at a cost of $100,000, was opened for use on October 10.

The new laboratories of the scientific departments of the College of Liberal Arts of Boston University have been opened in the building formerly occupied by the Harvard Medical School and adjoining the Public Library. The top floor is occupied by the departments of astronomy, physics and mathematics, and comprises large and small lecture rooms, laboratories and offices; a large part of the basement is also given over to physics. The chemical and the biological departments occupy the second floor, and consist of large, admirably-lighted class laboratories, private laboratories and store rooms, professors' rooms and an amphitheater for the larger classes. The two domes for the telescopes of the astronomical department are situated on the roof and are not quite completed. The equipment of all the laboratories is new and was purchased in part by special funds donated to the university for that purpose. A large passenger elevator makes all the floors of the building readily accessible. The scientific departments are under the same directors as last year: Professor J. B. Coit in astronomy and mathematics; Professor N. A. Kent in physics; Professor L. C. Newell in chemistry, and Professor A. W. Weysse in biology.

Western Reserve University is one of the three institutions in the United States requiring for entrance to its medical department the equivalent of three years in a standard college of arts or science. The four years' course includes required, systematic work in the laboratories of anatomy and histology, pathology, physiology, bacteriology, pharmacology and clinical microscopy. Since instituting the high college requirement for admission, only laboratory work in advanced and physiological chemistry under the charge of the departments of physiology and biochemistry has been given in this school. The five-story building now being erected will provide laboratories for the new department of experimental medicine established by the Payne-Hanna gift of $200,000. Alterations and improvements have been completed at Lakeside Hospital, one of the hospitals affiliated with Western Reserve University.

The plan of reorganization of the School of Agriculture of the Pennsylvania State College provided for the separation of the collegiate instruction in agricultural chemistry and the work of investigation in that field of science, the two departments thus formed being designated respectively as the department of agricultural chemistry and the department of experimental agricultural chemistry. It has already been announced that the latter portion of the work has been retained by Professor Frear, who, it is expected, will also offer some post-graduate courses of instruction. It is now announced that the professorship of agricultural chemistry has been filled by the election of Professor Charles Lyndall Penny, A.M., lecturer in agricultural chemistry to the Delaware Agricultural College, and for many years chemist to the Delaware Experiment Station. Margaret B. MacDonald, Ph.D., (Bryn Mawr) has been appointed to the position of instructor in agricultural chemistry.

The chair of assaying in the Massachusetts Institute of Technology, vacant by the resignation of Professor Richard W. Lodge to become a consulting engineer, has been filled by the appointment of Professor Edward E. Bugbee, who graduated from the institute in 1900, and has since been teaching in the University of Iowa and the University of Washington.

The chair of mathematics at the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., has been filled by the appointment of Samuel G. Barton, Ph.D. (Pennsylvania), Harrison fellow at the University of Pennsylvania, 1905–1906, and research fellow in astronomy, 1906–1908.

Dr. Leon J. Cole, chief of the division of animal breeding and pathology of the Rhode Island Experiment Station, has been appointed instructor in zoology in Yale University. Lorande Loss Woodruff, Ph.D. (Columbia), instructor in Williams College, has been appointed instructor in biology at the same institution. Mr. Henry J. Spencer, of Syracuse University, succeeds Dr. Woodruff as instructor in biology at Williams.

Dr. Frank Pierpont Graves, of the University of Missouri, has been appointed professor of the history and principles of education at the Ohio State University. Dr. Guy Montrose Whipple, assistant professor of education at Cornell University, has been appointed acting professor of education at Missouri.

The following new appointments have been made at the University of Kansas: F. H. Billings, associate professor of botany; Adolf Zeifle, assistant professor of pharmacy; J. E. Todd, assistant professor of geology; H. L. Jackson, assistant professor of chemistry; P. A. Glenn, assistant professor of entomology; Charles Oshwald, instructor in mechanical engineering; J. B. Carter, instructor in physiology; Burton McCullum, instructor in physics; Frank Rupert, assistant instructor in chemistry; Thomas Haslam and Florence Hazen, assistants in chemistry; W. A. Starin, instructor in botany; W. B. R. Robinson, assistant instructor in zoology. Associate Professor M. E. Rice has been made acting head of the department of physics; the chair of physics is vacant and will probably be filled some time during the year.

At Washington and Lee University, the Rev. J. Howerton, D.D., has been made professor of philosophy in the place of Dr. A. Quarles, who died in April; and Dr. Thomas K. Urdahl, Ph.D. (Wisconsin, '97), professor of political and social science in Colorado College, has been elected to the chair of political economics and political science, vacant by the removal of Dr. H. T. Willis to the George Washington University. The other changes in the teaching corps are among the assistants, most of whom are changed annually. In physics, Frederic Bartenstein becomes head assistant, with E. K. Paxton and R. W. Dickey as junior assistants. In chemistry, Wm. H. Marquess is head assistant, with A. P. Lee, E. H. Deets and A. W. Lybrand as junior assistants. In biology, W. P. Hooper is assistant. In engineering, E. A. Hoge is assistant. In mathematics, R. Ragland and J. W. Addison are assistants. Of this list Messrs. Bartenstein, Marquess and Lee are reappointments.

The following changes occur in the Scientific Department of the University of Maine this year: W. D. Hurd promoted from acting dean to dean of the College of Agriculture: L. H. Merrill, professor of biological and agricultural chemistry; C. P. Weston promoted to professor of mechanics and drawing; Dr. M. A. Chrysler, associate professor of botany; C. B. Brown, promoted to assistant professor of civil engineering; Herman Beckenstrater, assistant professor of horticulture; J. E. McClintock, in charge of the agricultural extension work; W. M. Curtis, assistant professor of mechanical engineering; H. R. Willard, promoted to an assistant professorship of mathematics; D. J. Edwards, promoted to an instructorship in botany; P. L. Bean, L. I. Johnstone, and A. R. Lord, instructors in civil engineering; R. E. Clayton, J. Seymour and W. F. Washburn, instructors in chemistry; H. W. Bearce promoted to an instructorship in physics; C. C. Murdock, tutor in physics; and C. S. Winch, taxidermist in the museum.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, OCTOBER 25, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ADDRESS OF THE PRESIDENT OF THE MATHEMATICAL AND PHYSICAL SECTION OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

I PROPOSE to use the opportunity afforded by this address to explain a dynamical theory of the shape of the earth, or, in other words, of the origin of continents and oceans.

The theory which has for more than a century been associated with the phrase "the figure of the earth" is the theory of the shape of the surface of the ocean. Apart from waves and currents, this surface is determined by the condition that there is no up and down upon it. This condition does not mean that the surface is everywhere at the same distance from the center of the earth, or even that it is everywhere convex, but that a body moving upon it neither rises against, nor falls in the direction of, gravity (modified by the rotation). A surface which has this character is called an equipotential surface, and the surface of the ocean coincides with part of an equipotential surface under gravity modified by the rotation. This particular equipotential surface runs underground beneath the continents. It is named the "geoid." The height of a place above sea-level means its height above the geoid. If we knew the distribution of density of the matter within the earth it would be a mathematical problem to determine the form of the geoid. As we do not know this distri-

[1] Leicester, 1907.

bution we have recourse to an indirect means of investigation, and the chief instrument of research is the pendulum. The time of vibration of a pendulum varies with the place where it is swung, and from the observed times we deduce the values of gravity at the various places, and it was shown many years ago by Stokes that the shape of the geoid can be inferred from the variation of gravity over the surface.

The question to which I wish to invite your attention is a different one. If the ocean could be dried up, the earth would still have a shape. What shape would it be? Why should the earth have that shape rather than some other? In order to describe the shape we may imagine that we try to make a model of it. If we could begin with a model of the geoid we should have to attach additional material over the parts representing land and to remove some material over the parts representing sea. Our model would have to be as big as a battleship if the elevations and depressions were to be as much as three or four inches. In thinking out the construction of such a model we could not fail to be impressed by certain general features of the distribution of continent and ocean, and we may examine a map to discover such features.

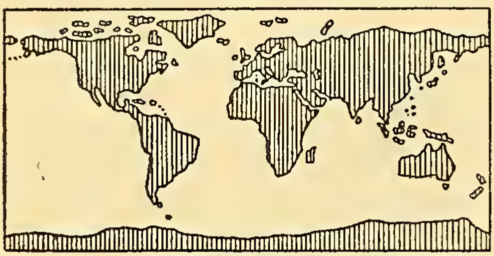


Fig. I.

Fig. 1 is a rough map of the world drawn in such a way that to every degree of latitude or of longitude there corresponds the same distance on the map. Certain very prominent features have often been remarked: the tapering of America and Africa towards the south, the disproportion between the land areas of the northern and southern hemispheres, the excess of the oceanic area above the continental area, which occupies but litttle more than one quarter of the surface; the wide extent of the Pacific Ocean, which with the adjoining parts of the Southern Ocean covers nearly two fifths of the surface. Another prominent feature is the antipodal position of continent and ocean. South America south of an irregular line which runs from a point near Lake Titicaca to Buenos Ayres is antipodal to a portion of Asia which lies in an irregular triangle with corners near Bangkok, Kiaochau and Lake Baikal; but no other considerable parts of the continental system have continental antipodes. The Antarctic continent is antipodal to the Arctic Ocean, Australia is antipodal to the central Atlantic, and so on. Another notable feature is the skew position of South America to the east of North America; South America lies to the east of the meridian 85° west of Greenwich; most of North America lies to the west of it. But, although we may observe prominent general features of the distribution, we should find it far from easy to attribute to the form of our imaginary model anything that could be called a regular geometrical figure. When we begin to think about the removal of material from the parts of the model which are to represent oceans and seas, we require a map which gives information about the depth of the sea in different places. Around all the coasts there is a margin of not very deep water. If some part of the sea could be dried up, so that more land was exposed around all the coasts, the area of the surface of the sea would be diminished; and it is known that the depth of water that would have to be removed in order to make the area of the sea just half the total area, is about 1,400 fathoms. The contour-line at this depth would divide the surface into two regions of approximately equal area—the continental region and the oceanic region. Fig. 2 represents the con-

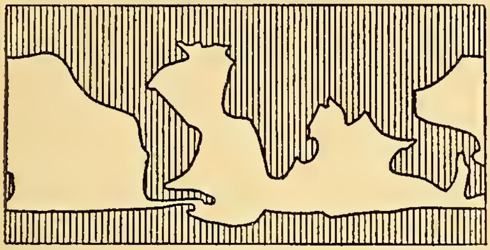


Fig. 2.

tour-line at 1,400 fathoms, or the line of separation of the continental and oceanic regions. The continental region is shaded. In drawing this map I have omitted a number of small islands, and I have also omitted a few enclosed patches of deep water. Two of these are in the Mediterranean, one in the Arctic Ocean, and others are in the Gulf of Mexico and the Caribbean Sea. The Red Sea, the Mediterranean, and the Arctic Ocean belong to the continental region, and so do the Gulf of Mexico and the Caribbean Sea. At this depth Asia and North America are joined across Behring's Strait, and Europe is joined to North America across the British Isles, Iceland, and Greenland; Australia is joined to Asia through Borneo and New Guinea, and the Australasian continental region nearly reaches the Antarctic region by way of New Zealand. At this depth also South America does not taper to the south, but spreads out, and is separated from the Antarctic region by a very narrow channel. By going down to great depths our problem is very much simplified. We find that the surface of the earth can be divided into continental and oceanic regions of approximately equal area by a curve which approaches a regular geometrical shape. By smoothing away the irregularities we obtain the curve shown in Fig. 3, which exhibits the surface as divided up into a continuous continental region and two oceanic regions—the basin

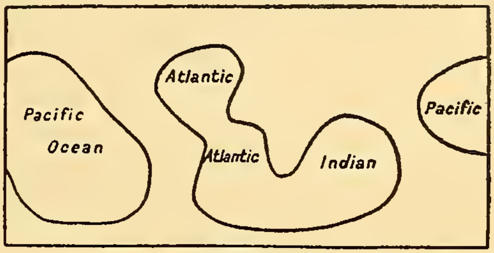


Fig. 3.

of the Pacific Ocean and the basin of the Atlantic and Indian Oceans. We may take our problem to be this: to account on dynamical grounds for the separation of the surface into a continental region and two oceanic regions which are approximately of this shape.

The key of the problem was put into our hands four years ago by Jeans in his theory of gravitational instability. If there are any differences of density in different parts of a gravitating body, the denser parts attract with a greater force than the rarer parts, and thus more and more of the mass tends to be drawn towards the parts where the density is in excess, and away from the parts where it is in defect. In every gravitating system there is a tendency to instability. In a body of planetary dimensions this tendency, if it were not checked, would result in a concentration of the mass either towards the center or towards some other part. But concentration of the mass means compression of the material, and it can not proceed very far without being checked by the resistance which the material offers to compression. There ensues a sort of competition between two agencies: gravitation, making for instability, and the elastic resistance to compression, making for stability. Such competing agencies are familiar in other questions concerning the stability of deformable bodies. A long thin bar set up on end tends to bend under its own weight. A steel knitting-needle a foot long can stand up; a piece of thin paper of the same length would bend over. In order that a body may be stable in an assigned configuration there must be some relation between the forces which make for instability, the size of the body, and the resistance which it offers to changes of size and shape. In the case of a gravitating planet we may inquire how small its resistance to compression must be in order that it may be unstable, and, further, in respect of what types of displacement the instability would manifest itself. If we assign the constitution of the planet, the inquiry becomes a definite mathematical problem. The greatest difficulty in the problem arises from the enormous stresses which are developed within such a body as the earth by the mutual gravitation of its parts. The earth is in a state which is described technically as a state of "initial stress." In the ordinary theory of the mechanics of deformable bodies a body is taken to be strained or deformed when there is any stress in it, and the strain is taken to be proportional to the stress. This method amounts to measuring the strain or deformation from an ideal state of zero stress. If the ideal state is unattainable without rupture or permanent set or overstrain, the body is in a state of initial stress. The commonest example is a golf-ball made of india rubber tightly wound at a high tension. Now the problem of gravitational instability can be solved for a planet of the size of the earth on the suppositions that the density is uniform and the initial stress is hydrostatic pressure. If the resistance to compression is sufficiently small the body is unstable, both as regards concentration of mass towards the center and as regards displacements by which the density is increased in one hemisphere and diminished in the other. A planetary body of sufficiently small resistance to compression could not exist in the form of a homogeneous sphere. It could exist in a state in which the surface is very nearly spherical, and the mass is arranged in a continuous series of nearly spherical thin sheets, each of constant density; but these sheets would not be concentric. They would be crowded together towards one side and spaced out on the opposite side somewhat in the manner shown in Fig. 4. The effect would be a displacement of the center of gravity away from the center of figure towards the side where the sheets are crowded together. How small must the resistance to compression be in order that this state may be assumed by the body instead of a homogeneous state? The answer is that, if the body has the same size and mass as the earth, the material must be as compressible as granite. Granite, as we know it at the earth's surface, is not a typically compressible material. A cube of granite 10 feet every way could be compressed from its volume of 1,000 cubic feet to a volume of 999 cubic feet by pressure applied to every part of its surface; but according to the recent measurements of Adams and Coker the pressure would have to be rather more than two tons per square inch. A homogeneous sphere of the same size and

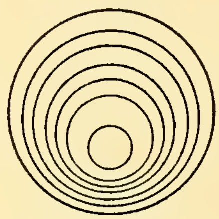


Fig. 4.

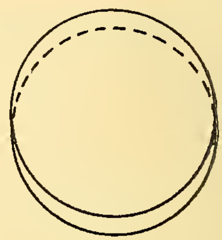


Fig. 5.

mass as the earth, made of a material as nearly incompressible as granite, could not exist; it would be gravitationally unstable. The body would take up some such state of aggregation as that illustrated in Fig. 4, and its center of gravity would have an eccentric position.

Now how would an ocean rest on a gravitating sphere of which the center of gravity does not coincide with the center of figure? Its surface would be a sphere with its center at the center of gravity (Fig. 5). The oceanic region would be on one side of the sphere and the continental region on the other side. It was pointed out many years ago by Pratt that the existence of the Pacific Ocean shows that the center of gravity of the earth does not coincide with the center of figure. There is no necessity to invoke some great catastrophe to account for the existence of the Pacific Ocean, or to think of it as a kind of pit or scar on the surface of the earth. The Pacific Ocean resembles nothing so much as a drop of water adhering to a greasy shot. The force that keeps the drop in position is surface tension. The force that keeps the Pacific Ocean on one side of the earth is gravity, directed more towards the center of gravity than the center of figure. An adequate cause for the eccentric position of the center of gravity is found in the necessary state of aggregation which the earth must have had if at one time it was as compressible as granite. The theory of gravitational instability accounts for the existence of the Pacific Ocean.

But we can go much farther than this in the direction of accounting for the continental and oceanic regions. We keep in mind the eccentric position of the center of gravity, and try to discover the effect of rotation upon a planet of which the center of gravity does not coincide with the center of figure. The shape of a rotating planet must be nearly an oblate spheroid; but the figure of the ocean would, owing to its greater mobility, be rather more protuberant at the equator than the figure of the planet on which it rests. The primary effect of the rotation of the earth upon the distribution of continent and ocean is to draw the ocean towards the equator, so as to tend to expose the arctic and antarctic regions. We have seen that both arctic and antarctic are parts of the continental region. But there is an important secondary effect. Under the influence of the rotation the parts of greater density tend to recede further from the axis than the parts of less density. If the density is greater in one hemispheroid than in the other, so that the position of the center of gravity is eccentric, the effect must be to produce a sort of furrowed surface; and the amount of elevation and depression so produced can be described by an exact mathematical formula. It has been proved that this formula is the sort of expression which mathematicians name a spherical harmonic of the third degree.

The shape of the earth is also influenced by another circumstance. We know that at one time the moon was much nearer to the earth than it is now, and that the two bodies once rotated about their common center of gravity almost as a single rigid system. The month was nearly as short as the day, and the moon was nearly fixed in the sky. The earth must then have been drawn out towards the moon, so that its surface was more nearly an ellipsoid with three unequal axes than it is now. The primary effect of the ellipsoidal condition upon the distribution of continent and ocean would be to raise the surface above the ocean near the opposite extremities of the greatest diameter of the equator. But, again, owing to the eccentric position of the center of gravity, there would be an important secondary effect. The gravitational attraction of an ellipsoid differs from that of a sphere, and it may be represented as the attraction of a sphere together with an additional attraction. If the density was greater in one hemi-ellipsoid than in the other, the additional attraction would produce a greater effect in the parts where the density was in excess, and the result, just as in the case of rotation, would be a furrowing of the surface. It has been proved that the formula for this furrowing also is expressed by a spherical harmonic of the third degree.

We are brought to the theory of spherical harmonics and the spherical harmonic analysis. Spherical harmonics are certain quantities which vary in a regular fashion over the surface of a sphere, becoming positive in some parts and negative in others. I spoke just now of making a model of a nearly spherical surface by removing material from some parts and heaping it up on others. Spherical harmonics specify standard patterns of deformation of spheres. For instance, we might remove material over one hemisphere down to the surface of an equal but not concentric sphere (*cf.* Fig. 5) and heap up the material over the other hemisphere. We should produce a sphere equal to the original but in a new position. The formula for the thickness of the material removed or added is a spherical harmonic of the first degree. It specifies the simplest standard pattern of deformation. Again, we might remove material from some parts of our model and heap it up on other parts so as to convert the sphere into an ellipsoid. The formula for the thickness of that which is removed or added is a spherical harmonic of the second degree. Deformation of a sphere into an ellipsoid is the second standard pattern of deformation. The mathematical method of determining the appropriate series of standard patterns is the theory of spherical harmonics. Its importance arises from the result that any pattern whatever can be reached by first making the deformation according to the first pattern, then going on to make the deformation according to the second pattern, and so on. If we begin with a pattern, for instance the shape of the earth, which is not a standard pattern, we can find out how great a deformation of each standard pattern must be made in order to reproduce the prescribed pattern. The method of doing this is the method of spherical harmonic analysis. Except in very simple cases the application of it involves rather tedious computations. With much kind assistance and encouragement from Professor Turner, I made a rough spherical harmonic analysis of the earth's surface. I divided the surface into 2,592 small areas, rather smaller on the average than Great Britain, gave them the value $+1$, or one unit of elevation, if they are above the sea, and the value -1, or one unit of depression, if they are below the 1,400-fathom line. To the intermediate areas I gave the value 0. The distribution of the numbers over the surface was analyzed for spherical harmonics of the first, second, and third degrees.

Any spherical harmonic of the first degree gives us a division of the surface into two hemispheres—one elevated, the other depressed. The spherical harmonic analysis informs us as to the position of the great circle which separates the two hemispheres, and also as to the ratio of the maximum elevation of this pattern to the maximum elevation of any other pattern. The central region of greatest elevation of this pattern is found to be in the neighborhood of the Crimea, and the region of elevation contains the Arctic Ocean and the northern and central parts of the Atlantic, Europe, Africa, Asia, most of North America, and a small part of South America. When the surface is mapped on a rectangle in the same way as before, the chart of the harmonic is that shown in Fig. 6.[2] The actual disproportion between the amounts of continental area in the northern and southern hemispheres is associated with the result that the central

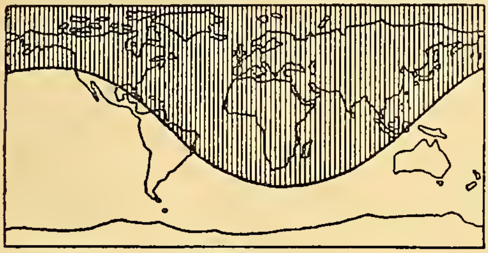


Fig.6.

region of elevation, as given by the analysis, is about 45° north of the equator; and the extension of the Pacific Ocean and adjoining Southern Ocean to much higher southern than northern latitudes is associated with the corresponding position of the central region of greatest depression about 45° south of the equator. In regard to harmonics of the second degree, the spherical harmonic analysis informs us as to the ellipticity of the equator and the obliquity of the principal planes of that ellipsoid which most nearly represents the elevation of the surface above or its depression below the surface of the ocean, or the geoid. The result is an equatorial region of depression, which spreads north and south unequally in different parts and forms a sort of immense Mediterranean, containing two great basins, and separating a northern region of elevation from a southern. The northern region of elevation occupies the northern part of the Atlantic Ocean and runs down to and across the equator in the neighborhood of Borneo. The southern region of elevation occupies the southern part of the Pacific Ocean, and it runs up to and across the equator in the

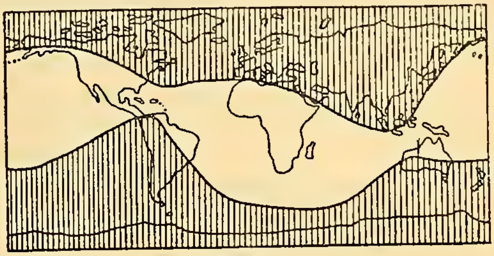


Fig.7.

neighborhood of Peru. The chart of the harmonic is shown in Fig. 7. The equatorial regions of elevation given by the analysis are near the ends of a diameter, as we should expect.

It has not been necessary to enter into a minute description of the harmonics of the first and second degrees, because they represent very simple things—a shifting of the surface to one side and a distortion of it into an ellipsoid. The harmonics of the third degree are not so familiar. There are essentially four of them, each specifying a standard pattern of deformation. The first of these, the zonal harmonic, gives us a division of the surface into two polar caps and two zones by means of the equator and the parallels of latitude about 51° north and 51° south. Alternate zones are depressed and elevated, as shown in Fig. 8.

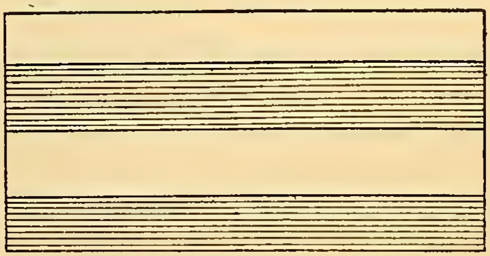


Fig.8

[2] In this figure, and in the following figures, regions of elevation are shaded, and regions of depression are left blank.

The existence of an Antarctic continent and an Arctic Ocean is specially associated with the presence of this harmonic, and the disproportion of the continental areas in the northern and southern hemispheres is also connected with it. The second of the harmonics of the third degree, the tesseral harmonic of rank 1, gives us a division of the surface into six half-zones by means of

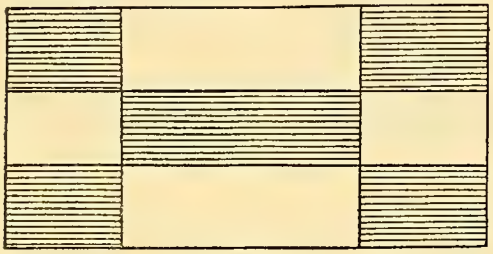


Fig. 9.

a complete meridian circle and the parallels of latitude about 27° north and 27° south. Alternate half-zones are depressed and elevated as shown in Fig. 9. The combined effect represented by the zonal harmonic and the tesseral harmonic of rank 1 is a furrowed surface with an Arctic region of depression extending southwards in the direction of the Atlantic, a zone of elevation which runs across the Atlantic, South America and Africa, and then turns

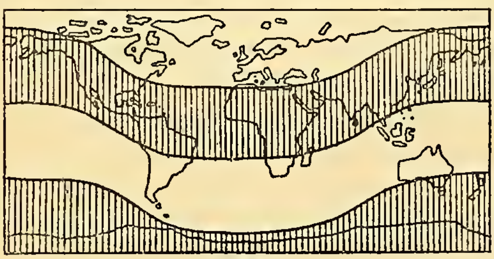


Fig. 10.

northwards at either end, a zone of depression with the same kind of contour, and an Antarctic region of elevation which extends northwards in the direction of Australasia. These regions are shown in Fig. 10. I have recorded the result of combining these two harmonics because they represent the particular effects that would be produced by the interaction of two causes—the rotation, and the eccentric position of the center of gravity. The third type of harmonics of the third degree, the tesseral harmonic of rank 2, gives us a division of the surface into octants by

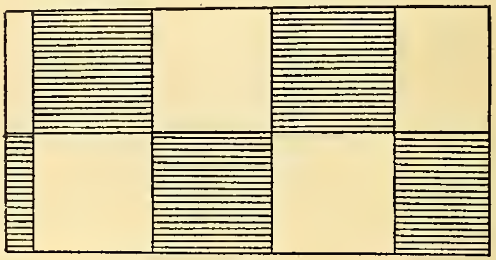


Fig. 11.

means of the equator and two complete meridian circles. Alternate octants are elevated and depressed as shown in Fig. 11. We can name the octants where there is elevation: Asia, Australasia, North America, South America. The harmonic of this type is certainly prominent. It is specially associated with the skew position of South America to the east of North America. The fourth type of harmonics of the third degree, the sectorial harmonic, gives us a

Fig. 12.

division of the surface into six sectors by means of three complete meridian circles. Alternate sectors are depressed and elevated as shown in Fig. 12. The southward tapering of Africa is specially associated with the harmonic of this type. The combined effect of all the harmonics of the third degree is shown in Fig. 13. It represents the sphere deformed into a sort of

Fig. 13.

irregular pear-shaped surface. The stalk of the pear is in the southern part of Australia and contains Australasia and the Antarctic continent. This is surrounded on all sides but one (towards South America) by a zone of depression, the waist of the pear. This, again, is surrounded on all sides but one (towards Japan) by a zone of elevation, the protuberant part of the pear; and finally we find the nose of the pear in the central Atlantic between the Madeiras and the Bermudas. I do not, however, wish to emphasize the resemblance of the surface to a pear or any other fruit, but prefer to describe it as an harmonic spheroid of the third degree. Another way of regarding it would be as a surface with ridges and furrows. From a place in the South Atlantic there run three ridges: one northwestwards across America, a second northeastwards across Africa and Asia, and the third southwards over the Antarctic continent, continuing northwards across Australia nearly to Japan. From the Sea of Okhotsk there run three furrows: one southwestwards across Japan, the Malay Peninsula, and the Indian Ocean; a second southeastwards across the Pacific; and the third northwards over the Arctic Ocean, continuing southwards by way of the Atlantic. Harmonics of the first and third degrees have in common the character of giving depression at the antipodes of elevation; the harmonics of the second degree give depression at the antipodes of depression and elevation at the antipodes of elevation. The maxima of the harmonics of the first and third degrees are found to be rather greater than the maximum of the harmonic of the second degree. Of three quantities to be added together the two larger ones agree in giving depression at the antipodes of elevation; a result which is in accordance with the fact that most continents have oceanic antipodes.

When we superpose the effects represented by all the various harmonics of the first, second and third degrees, so as to make, as it were, a composite photograph of all the various elevations and depressions represented by them severally, each in its appropriate amount as determined by the harmonic analysis, we find the curve

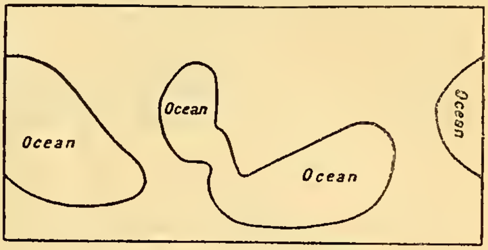


Fig. 14.

shown in Fig. 14 as the theoretical curve of separation between regions of elevation and depression which are approximately equal in area. I showed before a smoothed curve (Fig. 3) which I proposed to take as representing the facts to be accounted for. The resemblance of the two curves seems to be striking. Incidentally it has been noticed how the prominent features of the distribution of continent and ocean are associated with the presence of various harmonics. As regards the contour of the great ocean basins, we seem to be justified in saying that the earth is approximately an oblate spheroid, but more nearly an ellipsoid with three unequal axes, having its surface furrowed according to the formula for a certain spherical harmonic of the third degree, and displaced relatively to the geoid towards the direction of the Crimea.

As regards the amount of elevation and depression in different parts, the agreement of the theory with the facts is not so good. The computed elevation is too small in southern Africa, Brazil and the southern part of South America, too great in the Arctic regions, to the south of Australasia, and in the Mediterranean region. There are many reasons why we could not expect the agreement to be very good. One is the roughness of the method of harmonic analysis that was used. But there is also the fact that many causes must have contributed to the shaping of our actual continents and oceans besides those which have been taken into account in the theory. It appears, however, that the broad general features of the distribution of continent and ocean can be regarded as the consequences of simple causes of a dynamical character: eccentric position of the center of gravity, arising from a past state of inadequate resistance to compression, an inherited tendency, so to speak, to an ellipsoidal figure, associated with the attraction of the moon in a bygone age, the rotation, and the interactions of these various causes.

In attempting to estimate the bearing of the theory on geological history we must be guided by two considerations. The first is that the earth is not now gravitationally unstable. From observations of the propagation of earthquake shocks to great distances, we can determine the average resistance to compression, and we find that this resistance is now sufficiently great to keep in check any tendency to gravitational instability. The eccentric position of the center of gravity must be regarded as a survival from a past state in which the resistance to compression was not nearly so great as it is now. The second guiding consideration is that, according to the theory, the inequalities which are expressed by spherical harmonics of the third degree are secondary effects due to the interaction of the causes which give rise to inequalities expressed by harmonics of the first and second degrees. We should expect, therefore, that the inequalities of the third degree would be much smaller than those of the first and second degrees; but the harmonic analysis shows that the three inequalities are entirely comparable. We must conclude that the harmonics of the first and second degrees which we can now discover by the analysis are survivals from a past state, in which such inequalities were relatively more important than they are now. Both these considerations point in the same direction, and they lead us to infer that certain secular changes may have taken place in the past, and may still be going on. Sixty-nine years ago Charles Darwin wrote: "The form of the fluid surface of the nucleus of the earth is subject to some change the cause of which is entirely unknown, and the effect of which is slow, intermittent, but irresistible." Forty-two years later Sir George Darwin showed that any ellipsoidal inequality in the figure must be gradually destroyed by an irreversible action of the same nature as internal friction or viscosity. The same may be said of a state in which the center of gravity does not coincide with the center of figure when the resistance to compression is great enough to keep in check the tendency to gravitational instability. The state would be changed gradually in such a way as to bring the center of gravity nearer to the center of figure. A symptom of such changes might be the occurrence of great subsidences in the neighborhood of the Crimea, where we found the maximum of the first harmonic. Such subsidences are supposed by geologists to have taken place in rather recent times. Symptoms of the diminution of the inequalities expressed by harmonics of the second degree would be found in the gradual disappearance of seas forming part of the great depression which was described above as a sort of immense Mediterranean (*cf.* Fig. 7) in the destruction and inundation of a continent in the northern Atlantic and in a gradual increase of depth of the southern Pacific. The disappearance of seas from a vast region surrounding the present Mediterranean basin, and containing the Sahara and southern Asia as far east as the Himalayas, is one of the best ascertained facts in geological history; and the belief in the destruction of a north Atlantic continent is confidently entertained. In parts of the southern Pacific a depression represented by harmonics of the third degree is superposed upon an elevation represented by harmonics of the second degree, and we should therefore expect to find the depth of the ocean to be increasing gradually in this region. The region in question is that of the coral reefs and coral islands, such as Funafuti, and the result is in accord with Darwin's theory of the formation of coral reefs. So far as the general distribution of the mass within the earth is concerned, the reduction of the inequalities of the first and second degrees would seem to have already proceeded very far; for we are assured by geodesists that harmonics of the first degree, and those of the second degree which do not represent the effect of the rotation, are far from prominent in the figure of the geoid—much less prominent than we found them to be in the distribution of continent and ocean. We infer that the inequalities of the first and second degrees must have been progressively diminished in comparison with those of the third degree. The general result of such changes would be a gradual diminution of the depths and extents of the oceans which correspond with the harmonics of the first and second degrees, and a compensating increase in the depths and extents of the oceans which correspond with the harmonic of the third degree. To see the character of the changes which would thus be brought about, we may examine a figure which shows the composite elevations and depressions that are represented by harmonics of the first and second degrees, and, separately, those which are represented by harmonics of the third degree. In Fig. 15

Fig. 15.

the composite elevations of the first and second degrees are shaded vertically, and the elevations of the third degree are shaded horizontally. The deep parts of the Atlantic that border the coasts everywhere from Brazil to Ashanti are regions in which a depression represented by the third harmonic is superposed upon an elevation represented by the other two harmonics, and the same is true of the deep parts of the Indian Ocean which border the shores of Africa and Asia from Madagascar to Burmah. The deep parts of the Pacific that border the western coast of America from Alaska to Chile are regions in which an elevation represented by the third harmonic is superposed upon a depression represented by the other harmonics. These observations suggest that in the greater part of the Atlantic and the northern and western parts of the Indian Ocean the direction of secular change may have been that of an advance of the ocean to encroach upon the continental region, while in the Pacific Ocean on the American side the direction of secular change may have been that of a retreat of the ocean, permitting an extension of the continental region. This difference would lead us to expect different types of coast in the two regions, and such a difference has been observed. Whereas in the Atlantic region, with few exceptions, the coast cuts across the directions of the mountain chains, in the Pacific region on the American side the coast generally corresponds in direction with the neighboring mountain chains of the continent. The deep parts of the Pacific which are nearest to the Asiatic coast from Kamchatka to Siam, are regions where a moderate depression represented by the third harmonic is superposed upon a moderate elevation represented by the other harmonics. These shores of the Pacific are distinguished by the wide margin which separates the deep ocean from the coast of the continent. It might perhaps be desirable to recognize in this region a type of coast differing from the two main types associated with the Atlantic and the American side of the Pacific. The analysis does not represent South Africa or the southern parts of South America sufficiently well to warrant us in expecting these regions to exhibit one type rather than the other; but the way in which Australia is represented, as an elevation of the third degree superposed upon a depression of the first, suggests that the coasts of Australia, and especially the eastern coast where the elevation in question is greater, should be of the same type as the American shores of the Pacific; and it is the fact that the mountain chains of Queensland and New South Wales run parallel to the neighboring coasts. There seems therefore to be much evidence to support the view that the direction of secular change has been that of diminishing the prominence of the inequalities of the first and second degrees in comparison with those of the third degree. The process by which such changes would be brought about would be of the nature of relief of strain, expressing itself in occasional fractures of no very great magnitude; and such fractures would be manifested at the surface as earthquakes. Seismic and volcanic activities constitute the mechanism of the process of change. These activities are spasmodic and irregular, but the effect of them is cumulative. For this reason they tend in the course of ages to transform the shape of the earth from one definite type to another. The diminishing speed of the earth's rotation is another cause of change which appears to produce an alternating rather than a cumulative effect. On the one hand it tends to diminish that tendency, which we noted above, to draw the waters of the ocean towards equatorial regions; on the other hand it must result in an actual reduction of the equatorial protuberance of the earth's figure. This reduction can only be effected by seismic activity expressed by subsidences in equatorial regions. The effect which would in this way be produced in the distribution of continent and ocean would appear to be that there would be long periods in which the ocean would tend to advance towards the Arctic and Antarctic regions, interrupted by shorter periods in which it would tend to retreat towards the neighborhood of the equator.

The theory which I have tried to explain is a tentative one, and further investigation may prove it to be untenable; but it is to its credit that, besides tracing to dynamical causes the existing distribution of continent and ocean, it offers an explanation of the difference between the Atlantic and Pacific types of coast, it gives indications of a possible account of those alternations of sea and land which first led to the study of geology, and it suggests an origin for Charles Darwin's unknown force, the operation of which is slow and intermittent, but irresistible.

A. E. H. Love

PLANT PATHOLOGY[1]

Your secretary has asked me to review as far as possible in ten or fifteen minutes our actual knowledge of plant diseases, the best methods of combating them, the progress that has been made, together with a suggestion or two as to some improvements that may be expected in the future. I have accepted the invitation, knowing fully that I could not in so short a time begin to cover so much ground with a sufficient degree of thoroughness to give an adequate idea even of the most important bearings of pathology on horticulture, but I concluded that the committee must have had in mind that I would use their request as an illustration of the greatest failing, not only in pathological investigation, but in the application of methods recommended for the control of diseases, namely, *too much haste and lack of thoroughness.* These are failings incident to work in a new country under great pressure, where the field is large and the workers few. There has been a good measure of economic justification for the mistakes of the past, and they are teaching us valuable lessons for our guidance in the future. What we need now is to study carefully these successes and failures and determine as accurately as may be possible their causes as a basis for improved practise.

[1] Paper read at the meeting of the National Council of Horticulture, Jamestown, Va., September 23, 1907.

The old conditions are rapidly changing. The new times require more careful and intensive methods.

One-crop farming, too short and unwise crop rotations, improper methods of fertilizing and culture, with destruction of humus and the life and fertility of the soil, careless methods of propagation and seed selection, the use of varieties not adapted to soil and climate, and other limiting conditions are responsible for loss from diseases in a larger degree than is realized. An orange, or plum, or peach, or apple, or any other tree or shrub, whose cambium responds to a few warm days in winter or early spring, is not a safe variety to plant in localities where such warm periods occur. Plants of northern range, accustomed to respond to lower initial heat stimulus, are thus subject to winter injury in more southern latitudes. On the other hand, plants of southern range planted north start later, are less subject to late frosts, but may be injured by early frosts. These cold injuries are often hardly noticeable, but they are sufficient to weaken the plant and open the way for trunk cankers and numerous other parasitic diseases which the trees could otherwise resist.

A soil slightly too acid or alkaline for a particular variety, though not enough to prevent growth, may nevertheless weaken the root system, or, in fact, the whole plant, making it subject to serious disease. So also the moisture or temperature fluctuations of the soil and its aeration may be unfavorable to a particular variety, making it less resistant to disease, if not actually causing a pathological condition in itself. Too little attention has been given to these factors by the farmers and horticulturists as well as by the pathologists.

An important duty in this new century will be to develop a better appreciation and more accurate understanding of the relation of these factors to health and disease. The cropping system of a farm or orchard, the planting of a nursery or a park to be satisfactory and successful in securing healthy growth must be undertaken only after a careful consideration of all these factors involved. Like the architect, the horticulturist and the farmer must have a carefully thought-out plan and as nearly as possible see the end from the beginning.

RESISTANCE AND IMMUNITY

Our ideal, of course, is to cultivate plants that can in the largest measure consistent with other requirements fight their own battles. Observation and experience have given us a large amount of information on adaptability to conditions and resistance to disease, which remains to be classified and digested in order to be made generally available. We often neglect to reap the benefits of a destructive drouth, a cold wave, an epidemic of disease, or the failure of a crop, *by neglecting to study and save what is left.* The few straggling plants left do not appeal to the average man. He plows them up or turns in the hogs. But the man familiar with nature's methods sees in these survivors resistant strains and saves the few straggling plants for seed, with the hope that the few survivors may have some peculiarity transmittable to progeny, making them resistant to the factor that caused the general destruction of the crop. In this way originated the wilt-resistant cotton, wilt-resistant cowpeas and flax, and cowpeas and tobacco resistant to nematode or root-knot. Strains of red-clover resistant to anthracnose (a disease which in many sections of the South makes it impossible to grow ordinary non-resistant clover) were also originated in this way. Strains of corn, oats, wheat, rye, clover, alfalfa, sugar beets and other grains, forage plants and vegetables resistant to cold, alkali and drouth have been developed from such selections—in some cases made purposely by subjecting the crop to these conditions, in others in simply taking advantage of what occurred naturally. In some of the older and more thickly populated parts of the world, necessity has forced the saving of the last straw. This is why we find the drouth-resistant durum wheats in the dry regions of Russia and Asia and around the Mediterranean, the alkali and drouth-resistant alfalfas and other forage crops in the same regions, a cold-resistant alfalfa in Siberia and Northern Manchuria, the cold-resistant winter-wheats of Russia, and other crops too numerous to mention. Hundreds of years of culture and selection, forced by poverty and necessity under forbidding conditions of cold and drouth and disease, have made those sections veritable storehouses of good things, but what nature and necessity have not produced for us we can in large measure do for ourselves. We can combine the cold-resisting quality of the trifoliate inedible orange with the fruit qualities of the tender, sweet orange; the disease-resistant quality of the citron with the fruit quality of the edible melons; the rust-resistant quality of the durum wheat with the berry of the blue stem; the cold-resistant quality of the wild crab with the fruit of our finer apples. The possibilities of such composite breeding have scarcely been touched or appreciated. In such work many factors must be taken into account and great care and foresight exercised.

PATHOLOGICAL INVESTIGATION

Coming now to the scientific study of plant diseases, there is almost unlimited room for improvement. Compared with what there is still to discover, our knowledge of most diseases is still meager and one-sided. The brain of the pathologist is his most important instrument in such investigations. It must be trained to work with precision in all of the various directions and fields involved in such study. This is not now generally the case, and our colleges must be awakened to their duty. To most successfully combat a disease, we should know the causes that contribute to it and as much about the causes as possible. We should understand the pathological reaction of the diseased plant. Only in this way shall we be able to remove the causes or protect the plant against them or assist it to recover.

SPRAYING

In the cases of disease due to attack of parasitic organisms, we are often able to protect our crops by spraying. Spraying, like a coat of mail, is a protection against entrance to the tissues by invading organisms. If there are any holes in the coat of mail or if it is made of poor material or is put on after the arrow has pierced the flesh, it may be of no avail. Much of our spraying has holes in it. The tissues are not properly coated during the periods of attack. Much of the new growth is left unprotected during the critical period. The parasite gets in through these places, and we find too late that hasty, careless spraying is of little value.

Improperly made mixtures, or mixtures made of poor materials, are often of no protection and may be as injurious as the disease. Even good Bordeaux mixture can not safely be used on some plants, like peaches, and in some seasons is slightly injurious to apples.

The apparatus for spraying is, as a rule, poorly constructed, clumsy and in great need of general improvement and adaptation to particular conditions. Demand good machinery and pay for it. It is essential to success. Those who know these things must teach, *by demonstration,* those who know imperfectly or do not know at all. Literature is valuable as an aid to demonstration teaching, but can never take the place of it. Too much dependence on literature is one of our great educational mistakes. Send out fewer bulletins and more men.

Briefly, then, we shall improve on the pathology of the last century if we take time to be careful and thorough; study the causes of failure and profit by the results; demand better-trained minds and improved apparatus, and depend in our teaching more upon men and less upon books.

A. F. Woods

Bureau of Plant Industry,
U. S. Department of Agriculture

SCIENTIFIC BOOKS

The Carboniferous of the Appalachian Basin. By John J. Stevenson, Professor of Geology in New York University. Pp. 595.

This is the title of a volume recently issued by Judd & Detweiler, of Washington, D. C. The volume consists of four papers previously published in the *Bulletin of the Geological Society of America* between 1903 and 1907.

The subjects treated in these several papers in order of publication are: "Lower Carboniferous," a paper of 82 pages, presented before the society, July 1, 1902, and published March 28, 1903; "The Pottsville" is next discussed in a paper of 174 pages, presented before the society, January 1, 1904, and published under date of May 28 of the same year; the "Allegheny" and "Conemaugh" formations were discussed in the third paper of 165 pages, presented before the society, December 29, 1905, and published May 28, 1906, while the concluding paper of 174 pages, including an elaborate index, presented before the society December 29, 1906, and published under date of April 19, 1907, deals with the "Monongahela" and "Dunkard" formations, ending with a chapter on "Geographical Changes during Pennsylvanian" time, and some "Paleontologic Notes" upon the fauna and flora of the Pennsylvanian.

The work as a whole is a concise summary with complete marginal references to practically all of the publications and conclusions of previous observers on the Carboniferous rocks of the Appalachian basin. It is by far the most elaborate and comprehensive study ever undertaken of the Appalachian Carboniferous, and it will long remain the chief book of reference for the stratigraphic relations of these great series of deposits, the most important economically on the continent.

Dr. Stevenson was peculiarly qualified for the great task he undertook, having himself spent about forty years of his life in the study of the Carboniferous rocks, and having personally seen more of the Appalachian basin than any other geologist. Then, too, in Dr. Stevenson's library, the most complete of any in publications dealing with the Appalachian Carboniferous, is to be found practically everything that other geologists had written. The study and digestion of this immense mass of data scattered through hundreds of publications was in itself a task of enormous proportions, and the writer has put all of his brother geologists of the present, as well as those of the future, under lasting obligations by the long and arduous "labor of love" involved in the publication of this great work which is destined to remain the chief monument of its distinguished author.

One of the principal causes for friction between the U. S. Geological Survey and the other geologists of the country, not connected with that organization, has been a failure of the United States geologists to recognize properly the work of previous observers in the same area, except occasionally when these observers had made some glaring mistakes. The absence of some such publication as Dr. Stevenson's may have been the principal reason for this apparent want of courtesy and fairness in the recognition of previous work, but hereafter there can remain no "extenuating circumstances" for such neglect so far as the Appalachian Carboniferous is concerned.

Regarding the conclusions of the author upon some mooted questions like the western limits of the Catskill, the identity of certain coal beds of wide extent, the equivalency of the Kanawha Black Flint, and other questions of like nature, there will evidently not be entire concurrence on the part of geologists. The reviewer also thinks that the great apparent thinning of both the Monongahela and Conemaugh formations along their northern and western margins is based upon mistaken identifications, that while there is much thinning of these formations shown toward the northwest, it is not really so great as indicated by the author. These are minor matters, however, and confined to regions where, owing to absence of accurate maps and careful measurements, there is much room for doubt as to identifications.

The author rightly gives proper credit to the monumental work of David White, whose skillful and untiring paleobotanical studies have assisted so much in the solution of the many intricate stratigraphic problems connected with the Pottsville and Kanawha formations, and their great southwestward thickening.

Geologists will look forward anxiously for the appearance of Dr. Stevenson's promised paper upon the origin of coal and his discussion of the many related problems for which the wide study and field work of this eminent teacher and geologist have given exceptional qualifications.

I. C. W.

A General Catalogue of Double Stars within 121° of the North Pole. By S. W. Burnham. Part I., The Catalogue, pp. lv + 274. Part II., Notes to the Catalogue, pp. viii + 828. Published by the Carnegie Institution of Washington. 1906.

We run little risk in saying that this is the most important astronomical publication of the year. Although devoted to a highly technical division of the science, it will surely command the attention of astronomers everywhere and long remain a reference of extraordinary excellence. It has been many years in preparation. In the introduction, the author states that its first form was a manuscript catalogue that he began to construct in Chicago in 1870, soon after receiving his six-inch Clark refractor, an instrument which he used almost entirely in the observation of double stars and which brought him a larger number of discoveries than any other telescope that he has used in his long and varied astronomical career. At that time no complete list of the known double stars existed, and there were few books in Chicago relating to them. The small refractor showed many pairs not recorded in any of the books available, and to make certain that these were new, he had to search far and wide through nearly the whole range of modern astronomical literature, to see what stars had previously been recorded as double. Observatories were visited and their libraries consulted; books were borrowed and what they contained relating to this particular subject was laboriously copied by hand; books and memoirs were also purchased, making the beginning of a library devoted to this special subject that has since become practically complete.

The manuscript catalogue which Professor Burnham formed at the beginning has been kept continuously posted to date, by adding accounts of new discoveries whenever made, and of new observations wherever published. To make room for the new material, a second manuscript edition eventually became necessary, and later still a third, which finally passed into the hands of the printer and now appears in finished form.

This great work divides into two parts. The first contains a catalogue of 13,665 double stars within 121° of the north celestial pole, and the second, the notes to this catalogue. Besides the catalogue, Part I. includes the introduction, indexes, precession tables and appendix, filling altogether 329 closely printed quarto pages. Part II. makes a similar volume of 836 pages.

To state the number of pages gives but a faint notion of the magnitude of the labor it has been to collect the information compressed within these somewhat extended limits. The labor would have been materially less had it been a mere compilation. This, however, is far from being the case. The predominant virtue of this work is its trustworthiness, and this springs not so much from what has been gathered from the published observations as from the author's long hours at the telescope, searching, verifying, measuring, and from his continuous investigations from all the data available. For many years he has been a most industrious observer, and his energy, devotion and sound judgment have had much to do with placing double-star astronomy in its present satisfactory condition. No matter at how great a cost in time and labor, he has made it his business to know the truth concerning these distant systems, consistently following stars in rapid motion during their critical periods, measuring those suffering from neglect, and in a larger degree than any one else, comparing the double stars in the sky with the record of them and bringing the two into harmony.

This work is arranged in a very convenient and satisfactory form and is beautifully printed. In both volumes the stars are arranged in the order of their right ascensions for the epoch 1880, and are numbered consecutively. The usual double-star numbers, star names, constellation letters and numbers are also given, making identification easy by whatever mode a pair may be designated.

The catalogue in Part I. is in tabular form, with eleven columns to the page. The data there given, in addition to the numbers and names just mentioned, are the position angle, distance and epoch of the earliest reliable measures; magnitudes; indication of the observers and the number of nights on which measures were made; references and brief notes, relating chiefly to notation and colors of components. These are the data most useful to the observer, and they are presented in a form eminently suited to his needs.

The notes in Part II. are usually brief and always to the point. They are generally reduced to a few lines to the star, giving in a few words a synopsis of the history of each pair, measures corresponding to selected epochs, statements respecting relative and proper motions, and complete references to all published observations and to important papers. The stars whose components have moved considerably since the first reliable measures were made are accompanied by diagrams, which by picturing the movement give a clearer indication of the nature of the change than would be possible in any other way. As a rule, observations are quoted sparingly, often not in sufficient numbers to enable one to form an independent opinion respecting the motion. The proper motions are usually quoted from the latest reliable sources, and converted into direction and distance so as to be immediately available in this department. With the exception of Beta Delphini, the only element given of the orbits of the binaries is the periodic time. This is the element that seems to interest the author most. The others are also of importance, and indeed necessary if exact comparisons between observed and computed places are to be made, and it is a distinct loss not to have them quoted also.

The absence of collected information respecting the double stars has in the past made it very difficult for observers to arrange programs which should have the maximum effectiveness in promoting the advancement of this department of science. Many popular stars have been measured repeatedly, sometimes quite unnecessarily, while hundreds of others have been neglected for long intervals. This condition is entirely changed by the appearance of these volumes, and in consequence advance from now on should be accelerated. Professor Burnham has endeavored to bring the histories of all pairs as nearly to date as possible, and this has necessitated the reobservation of the neglected stars. For several years he has devoted himself to this task, and among the observations presented in the notes are the mean results of several thousand measures made for this special purpose, as many as most observers would make in a lifetime, and forming a large and important contribution to knowledge.

The value of this work as a reference is enhanced by the tables following the introduction. Here, in remarkably compact form, the double stars discovered by modern observers, that is, since about 1840, are conveniently indexed, so that any pair of importance, whatever its designation, may be very readily found. These indexes are followed by a provisional grouping of the double stars into classes according to their motions, so far as these may now be determined. Convenient precession tables are also provided, for the reduction of star places from one epoch to another.

Even with the data available, as given in these volumes, it is not possible to make more than a beginning in the separation of the double stars into their various classes. According to the tables given, the number in each class is as follows:

Binaries with computed orbits	88
Binaries without computed orbits	94
Stars probably binary	112
Stars of the type of 61 Cygni	38
Stars with common proper motion	579
Stars with rectilinear motion	387
Total	1,298

These lists include less than ten per cent. of the stars which have been catalogued as double, and to a certain extent they serve as an index to the slowness with which changes in the relative positions of the stars take place. The great majority of all the pairs listed have either remained sensibly fixed, or have moved so little since their first measures were made that it is not now possible to classify them in respect to their movements. In the course of time many more will doubtless be added to the lists above, and rapid accessions may be expected in a few years when the close double stars which have recently been discovered in such large numbers come to be remeasured. To the present the information of value resulting from double-star investigations, rich as it is, has come from a comparatively small number of objects, hardly more than enough to furnish types. In the future, statistical studies, which are now of precarious value, will doubtless hold an important place and yield many interesting results. Professor Burnham has realized this to the full. He has preferred to rely upon the substantial facts derived from observation rather than upon insecure theory and speculation. The volumes before us are singularly free from all attempts to draw far-reaching conclusions from insufficient data.

The publication of this work marks an epoch in the history of double-star astronomy. It becomes at once an authoritative exposition of the state of the sky in respect to the class of objects it considers, and a reference that will take the place of hundreds of publications. No single work has been more pressingly needed these many years, and none could have filled the requirements of practical observers and of astronomers generally more satisfactorily. It will be an instrument of progress, leading and directing; an example to be followed, not only in its own field, but also in other departments.

W. J. Hussey

Ann Arbor, Mich.,
September, 1907

The Frog Book: North American Toads and Frogs, with a study of the habits and life-histories of those of the Northeastern States. By Mary C. Dickerson. New York, Doubleday, Page & Co. 1906. Pp. 253. $4.00.

This book is the twelfth volume in that noteworthy series "The Nature Library." In it we find a most satisfactory solution of the difficult problem of how to make a popular book really good, although of large size and about a group of animals that is not a large group and is less attractive to the layman than birds, fish or insects.

Like others in the series, it is profusely illustrated with original photographs, some 290 of them in 96 plates and 30 in text figures. Most of these show the living frogs and toads exceedingly well in black and white, while 16 plates are nicely colored. Some of the text figures are merely embellishments and twelve plates are photographs of attractive scenery representing the haunts of frogs.

The text begins with an introduction of 40 pages. With this is an artificial key for finding out the names of all the frogs and toads throughout the United States.

The main part of the work is a description of the 56 frogs and toads of this country taken up in systematic order in their seven families and twelve genera. The common toads, their eggs and young, are well treated and their value to agriculture emphasized, but the practical side of the subject is not exaggerated and the author's real interest in nature is expressed in such sentences as: "We also find the toad's song one of the most beautiful sounds in nature. The effect of a 'chorus' of toads is harmonious indeed—a crooning sound that seems a fit companion for amorous spring, bursting flower buds and the feeling of new life in our hearts."

Some thirty-six pages of text and many of the well-colored and spirited illustrations of the book well represent the tree-frogs; one of which on a "Jack-in-the-pulpit" makes the charming frontispiece. Here as elsewhere there are suggestive new facts, such as the statement that some tree-frogs of the species *Hyla squirella*, shut in a pail with no change of condition, continued for some hours to change their colors; which of course emphasizes the fact that color changes in frogs may be brought about without light or other outside cause.

The descriptions of the common larger frogs of our ponds, woods and meadows take up the remaining seventy pages of the volume, which ends with a bibliography of one hundred titles, embracing such diverse works as Wiedersheim's "Anatomy" and White's "Natural History of Selborne."

Not only are the habits of the common frogs well portrayed, but the eggs and tadpoles are figured, as has not been done before, and throughout the work the author's genuine sympathy with nature is in evidence. The naturalist will be glad to have the pictures in this book accessible and the layman should find the book both attractive and useful, while school nature-study could make excellent use of it.

The large amount of original observation made by the author will best be appreciated by those whom the book should stimulate to add more to the facts accumulating towards a complete knowledge of the life histories of all American frogs and toads. E. A. A.

Behavior of the Lower Organisms. By H. S. Jennings. New York, The Macmillan Co. 1906. Pp. xiv + 366; 144 figs.

This volume, which is the tenth in the series of biological treatises published by Columbia University, is a timely exposition of the behavior of the lower organisms by an author who has devoted a large part of his time to an investigation of this subject. The distribution of the materials in the volume follows an admirable plan. The first part of the book deals with the behavior of unicellular organisms, especially *Paramecium.* The second part takes up the behavior of the lower metazoans, including the cœlenterates, echinoderms, worms and crustaceans. The third part treats of the theoretic aspect of the subject, and the volume is concluded by a bibliography and a good index.

The first and second parts, which are naturally more concerned with statements of facts than with speculative matters, are a very full and adequate description of the reactions of the protozoans, lower metazoans, etc., and form, in the reviewer's opinion, the best digest of this subject that has yet appeared. They entirely supersede such recent works as that of Lukas and others, and with their bibliographical references they form a most serviceable introduction to the subject.

The third part of the volume is much less happily conceived. This opens with a chapter in which the essential similarity of the reactions of unicellular and of multicellular animals is pointed out and the true relations of a nervous mechanism to these reactions is made clear, and it closes with chapters on the development of behavior and the relations of behavior to psychic factors, etc., avowedly hypothetical matters. The body of the third part, however, is taken up with a discussion which turns in the main on a comparison of the tropism theory and the author's own views about animal orientation, etc. It is possibly asking too much to expect an author to make a plea for the opposing side, and yet truth is best served by looking facts squarely in the face. Almost no one nowadays, aside from Jennings, would accept the definition of the tropism theory given by him in Chapter XIV. To be sure, it is easy to find in the older literature the form of the theory that he describes, but practically every one at present who believes in the tropism theory at all has discarded as unessential that portion of it that asserts that the stimulus always influences directly the reacting organ. To retain this and demolish it in the belief that the tropism theory falls with it is rather Quixotic than clear-headed. If the modern tropism theory were as weak as Jennings would have us believe, the experimental evidence upon which it rests ought easily to be explained away. Yet it has always seemed to the reviewer that the characteristic circus movements performed by animals immersed in a homogeneous stimulant, but with sense organs unilaterally obstructed, are explainable only on the basis of this theory. There are other crucial observations in favor of the tropism theory and yet none of these have been satisfactorily accounted for by Jennings.

Jennings is perfectly correct in his insistence on the importance of what he formerly called the "motor reaction" as an explanation of the way in which many of the lower animals become distributed or massed, but to prove that this explanation holds in certain cases is not to disprove the tropism theory. The two theories are not mutually exclusive and the processes implied by them may perfectly well take place at the same time in a given animal. It would seem that Jennings in his enthusiasm for his own views had become blinded to the real strength of the tropism theory and not only was unable to accord it fair treatment, but also lacked appreciation of its real value. It is to be regretted that a book excellent in so many particulars should be marred by so considerable a defect. G. H. P.

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for September contains articles on "The Structure of Cilia, Especially in Gastropoda," by Leonard W. Williams; "The Poison Glands of *Noturus* and *Schilbeodes*," by Hugh D. Reed; "The Structure of the Silk Glands of *Apanteles glomeratus* L.," by Robert Matheson and A. G. Ruggles, and "The Nest of the Kelp Fish," by Charles F. Holder. Mr. Reed states that all species of *Noturus* and *Schilbeodes* examined possess an axillary pore that is the opening of a poison gland, and, in addition, some species have poison glands about the dorsal and pectoral spines. Species with serrate spines have no spine glands. There are no special muscles controlling the glands and they are ruptured by the pressure of their contents. Under *Notes* F. T. L. shows that marked specific differences exist in the embryos of vertebrates.

The Museums Journal of Great Britain for August contains an account of the Dundee meeting of the Museums Association. The gathering was attended by the curators of twenty-nine museums, besides many associates, and the papers read were thoroughly practical; two papers dealt with the subject of "School Museums."

The American Museum Journal for October has for frontispiece an excellent plate of "The Warren Mastodon" and in the accompanying article will be found measurements of the skeleton, which has been admirably mounted; it stands 9 feet 2 inches high, much lower than the popular idea of the animal. There are articles on "A Blackfoot Lodge, or Tepee," "The Museum Whales," "A Diplodocus for the Frankfurt Museum" and "The Robley Collection of Maori Heads." This collection, which is practically unique, comprises thirty-five specimens; it will be described in detail later. The museum has recently acquired two examples of the rare *Solenodon paradoxus* from Haiti and a sea otter from Point Lobos, Cal.

The Zoological Society Bulletin for August, which escaped notice at the time of its issue, during the meeting of the International Zoological Congress, is devoted to the subject of Zoology in New York. It contains articles on the universities and other educational institutions, in whose curriculum zoology plays an important part; the museums of natural history, biological laboratories, zoological parks and aquarium. There are brief accounts of the scientific societies of Greater New York and a list of the zoologists of New York and vicinity, which includes about one hundred names.

The Museum News, of the Brooklyn Institute, for October, contains a good account of the "Home of the Guacharo," *Steatornis*, describing a visit to a cave in Trinidad, where a number of adults and young birds were obtained. It is noted that the weight of the excessively fat young is twice that of the old bird. The installation of a group of fishes about a coral reef is something of a novelty, being an attempt to give a glimpse of the life and color of tropical seas. The principal article in the section devoted to the Children's Museum describes the silkworm, which has been made the subject of a rather extensive exhibit.

THE publication is announced in December of a new international monthly, *Revue des études ethnographiques et sociologiques*, edited under the direction of M. Arnold von Gennep and published by Librairie Paul Geuthner.

DISCUSSION AND CORRESPONDENCE

AS TO HOLOTHURIA

TO THE EDITOR OF SCIENCE: In SCIENCE for August 7, Dr. Gill calls attention to the fact that the genus *Holothuria* as originally established by Linnæus contains no species of the group which since 1766 has been universally called "holothurians." In the *Zoologischer Anzeiger* for August 20, Dr. Poche makes the same announcement and goes on to show some of the resulting changes in nomenclature which will be necessary if we adhere to the International Code. Dr. Gill particularly wishes to know what Dr. W. K. Fisher and I propose to do about it. Dr. Fisher in SCIENCE for September 20 states his position: he elects to adhere to the code and accordingly abandons *Holothuria*. In this I am quite unable to follow him, although I find no reason to question the facts regarding *Holothuria* Linnæus, 1758, as given by Gill and Poche. There is no question that the ignoring of these facts has placed us, who are specially interested in echinoderms, in a serious dilemma. Either we must refuse to follow the International Code or we must attempt, not only to substitute an unfamiliar name for the familiar *Holothuria*, and introduce a series of regrettable changes into the nomenclature of ascidians and echinoderms, but we must undertake to replace the colloquial English "holothurian" with some other term. Of these two evils it seems to me that the former is decidedly the lesser, and at the expense of consistency I propose to continue to call "sea-cucumbers," holothurians. Of course, if the International Commission on Nomenclature, in its proposed list of genera to be unchangeably adopted, assigns *Holothuria* to the ascidians rather than to the echinoderms, I shall not stand out against that decision, but meantime I shall sincerely hope that they will agree that an exception to the application of the code is wiser than a consistency which involves such difficult, one might almost say impossible, changes in nomenclature.

And I am confirmed in this attitude by certain facts either ignored or overlooked by Gill and Poche. Aldrovandus and other pre-Linnæan writers used *Holothuria* in the commonly accepted sense, as have all writers since 1766. Jäger in 1833 refers to the *twelfth* edition of the "Systema Naturæ" as the first in which true holothurians are included in the genus and he virtually bases his revision of the genus on that edition. Far more important than this, however, is the fact that if we assign *Holothuria* to the ascidians, it is by no means easy to decide what name shall replace it for sea-cucumbers. Fortunately for euphony's sake, it almost certainly will not be *Bohadschia*, as both Gill and Poche assert. A hasty survey of the literature between 1760 and 1830 shows that the case is quite involved. Mr. Austin H. Clark has called my attention to the fact that a very plausible argument may be made for *Holothusia* Barbut, 1783, Plate 6! Incidentally it should be remarked that there are many zoologists (Drs. Gill and Fisher among them) who will hold that *Holothuria* is properly a siphonophoran genus, and not ascidian, as Poche claims. Careful consideration of all the facts satisfies me that the attempt to radically change the usage of such familiar names as *Holothuria, Actinia* and *Salpa* can only make confusion worse confounded and, until an international congress of zoologists has voted that this shall be done, I for one shall continue to use the names in the commonly accepted sense.

Hubert Lyman Clark
Museum of Comparative Zoology,
Cambridge, Mass.,
September 28, 1907

ERRORS IN TOWER'S "AN INVESTIGATION OF EVOLUTION IN CHRYSOMOLID BEETLES OF THE GENUS LEPTINOTARSA"[1]

In reading over this work, I have noticed a few minor typographical errors and one rather more important biological misstatement or misconception in regard especially to one species of the group, all of which, however, do not affect the work as a whole. The biological misstatement or misconception is unfortunate, as it is founded on innumerable observations, and thus would tend to indicate carelessness in this respect on the part of the author. But I have no doubt that it was due rather to an oversight.

The typographical errors will be stated first:

Page 53,	¶ 2,	line 3,	*specimens* = *species*.
68,	3,	4,	*32* = *22*.
166,	2,	28,	*how* is repeated.
169,	3,	1, 3,	*histonic* = *historic*.
253,	2,	7,	*habitat* = *habit*.
294,	2,	3,	*ohers* = *others*.

In writing of the ontogeny of larval color patterns on page 147, Dr. Tower directly implies three larval instars to *Leptinotarsa signaticollis* Stål, and indirectly so to the species *diversa* Tower and *undecemlineata* Stål. On the next page, and those following, the same fact is implied in regard to the other species of the group, including the common *decem-*

[1] Publication No. 48, Carnegie Institution of Washington, 1906.

lineata Say, and colored figures of the three larval stages are given on plate 17, facing page 146, of more than ten of the species. Elsewhere (pp. 164, 219) general statements to this effect occur. Three larval instars are therefore implied for all, or almost all, of the species of the genus. And it is to this statement, in so far as it concerns the species *decemlineata*, that I desire to call attention.

Rearings of this species, both in nature and the laboratory, carried on in Georgia in 1906 and in Ohio in 1907, showed in both places four larval instars, all of which were distinct, and which have been described.[2] These rearings involved a total of not more than seventy specimens, and while this is very small in comparison with the large total reared by Tower, I can not think otherwise than that they represent the average for the species, and were not exceptions. All of the lots were small and under normal conditions, and the rearings were made especially with the view of determining the duration and number of the larval instars, so that errors in observation were eliminated. As Dr. Tower had other objects in view, I believe his observations in this respect were faulty, at least one ecdysis being overlooked in the larval development of *decemlineata;* and if in that species then as well perhaps in the others, though I am not concerned with them here.

A. Arsène Girault

Washington, D. C.,
September 16, 1907

EVEN PERFECT MEASURING IMPOTENT

The attention of geometers should be directed to a remarkable article by Dr. R. L. Moore, of Princeton, whose extraordinarily elegant proof of the redundancy of Hilbert's axioms first appeared in *The American Mathematical Monthly.*

The new article, in the *Transactions of the American Mathematical Society,* Vol. 8, No. 3, pp. 369–378, July, 1907, is also a perfecting of the work of the Hilbert school, but reaches new results so unexpected, so profound as to be nothing less than epoch making.

We knew that the so-called laboratory method for mathematics, the "measuring" method, was rotten at the core, since mathematics is not an experimental science, since no theorem of arithmetic, algebra or geometry can be proved by measurement.

Our argument was sufficiently cogent: that the theorems of mathematics are absolutely exact, while no human measurement ever can be exact.

But Dr. Moore shows that even granting the impossible, granting the super-human power of precise measurement, we could not thereby ever prove our space Euclidean, ever prove it the space taught in all our text-books.

The title of his article is: "Geometry in which the Sum of the Angles of Every Triangle is Two Right Angles." But, omitting the Archimedes assumption, if this postulate be substituted for Euclid's, there results a geometry not necessarily Euclidean. Nevertheless, no human being confined therein could ever distinguish it from a Euclidean space even though he were supplied with instruments which could decide for him whether any two sects were exactly equal.

The Euclidean space would contain other points, points ideal or *ultra* as regards this "angle-sum" space.

But, most extraordinarily, no *ultra* point is ever between two ordinary points.

George Bruce Halsted

Greeley, Colo.

SPECIAL ARTICLES

PLANKTON FISHING OFF THE ISLE OF MAN[1]

During recent years a good deal of attention has been paid by naturalists in various parts of the world to the *quantitative* distribution of organisms in the sea. It is obvious that exact information in regard to such a matter may be of enormous importance in connection with the fishing industries. Notable methods of work, and instruments for

[2] Girault and Rosenfeld, *Psyche*, XIV., 1907, pp. 47–52.

[1] Read before Section D (Zoology) of the British Association meeting at Leicester on August 6, 1907.

the purpose of capturing and measuring the organisms present, have been devised by some of the German investigators, and these will always be associated with the name of Professor Hensen, of Kiel, to whom very great credit is due for the ingenuity and scientific enthusiasm with which he has conducted the investigation. It is very important that any criticisms which are required should be brought forward before further researches have been made and before further material has been accumulated, and that any imperfections or limitations in the methods employed should be recognized.

The Hensen methods are based upon the assumption that the distribution of the plankton, or assemblage of minute floating organisms, in the sea is so uniform over wide areas under much the same conditions that total populations can be calculated from relatively very small samples. [Examples were given of several of the conclusions arrived at as the result of such calculations by Hensen and his fellow workers.] The correctness of these conclusions, it will be noticed, depends entirely upon the assumed uniformity of distribution and upon the adequacy of a small number of samples as representing the whole area. Some criticisms have appeared which are based upon imperfections of the instruments—variations in the nets employed and such matters. These imperfections can be obviated or allowed for; but I wish to bring before your attention a much more fundamental difficulty, namely, the marked irregularity or want of uniformity in the distribution of the organisms. At the time (five years ago) when I served as a member of the Ichthyological Research Committee, I was much struck by the evidence obtained of irregularity in distribution of marine organisms and of the inadequacy of small samples taken at considerable distances apart in either time or space. It has been a matter of common observation amongst naturalists that many of the larger organisms, such as Copepoda, occur in swarms; and this not merely around our coasts and in the narrow seas, but also in the open ocean. [Recorded instances were given.] *Trichodesmium,* again, is found in the Indian Ocean occurring in enormous profusion over narrow bands. At the last meeting of this association, Dr. G. H. Fowler gave some interesting results he had obtained in regard to irregularity of distribution in the open Atlantic. These and some other results which have been obtained, I believe, are unfortunately not yet published.

Convinced of the fundamental importance of such work, I spent the greater part of last summer vacation in experimenting day after day with various plankton nets under similar and under varying conditions in a limited sea-area off Port Erin in the Isle of Man—with results that were startling in their diversity. It was obvious that the plankton was at that time very unequally distributed over the depths, the localities, and the dates. It seemed clear that one net might encounter a swarm of some organism which a neighboring net escaped, and that a sample taken on one day might be very different in quantity from a sample taken under the same conditions next day.

I stopped this series of observations on September 17. After a few days of wind a spell of quiet, calm weather followed, during which I took some tow-nettings both inside Port Erin Bay and outside, both in the day and at night, and all of these differed entirely in character from the gatherings of the previous weeks—being composed mainly of *Chætoceros* and other diatoms. When the weather broke again, at the end of September, another abrupt change took place, and gatherings taken at the beginning of October showed very few diatoms, but many Copepoda. It is evident that if any observer had been taking quarterly or even monthly samples of the plankton in that sea-area, he would have obtained very different results, according to the exact date of his visit. On three successive weeks about the end of September he might have found evidence for as many different far-reaching views as to the composition of the plankton in that part of the Irish Sea. How it can be supposed that hauls taken miles apart and repeated only at intervals of months, or even weeks, can give any sure foundation for calculations as to the population of wide sea areas, I fail to see.

These conclusions need not lead us to be discouraged as to the ultimate success of scientific methods in solving what may be called world-wide problems, but they suggest that it might be wise to secure by detailed local work a firm foundation upon which to build, and to ascertain more accurately the representative value of our samples before we base conclusions upon them.

I do not doubt that in limited, circumscribed areas of water, in the case of organisms that reproduce with great rapidity, the plankton becomes more uniformly distributed, and a comparatively small number of samples may then be fairly representative of the whole. That is probably more or less the case with fresh-water lakes; and I have noticed it in Port Erin Bay in the case of diatoms. In spring, and again in autumn, when suitable weather occurs, as it did last year at the end of September, the diatoms may increase enormously, and under such circumstances they seem to be very evenly spread over all parts and to pervade the water at all depths; but that is emphatically *not* the case with the Copepoda and other constituents of the plankton, and it was not the case even with the diatoms during the present spring.

With the view of testing plankton methods still further, at another time of year, I devoted a month this spring (March 28 to April 27) to a systematic exploration, from the S. Y. *Ladybird,* of the sea off Port Erin at the southwest corner of the Isle of Man. We worked on 23 days and obtained 276 samples, an average of 12 per day. [Particulars were here given of the localities, the methods and the various nets used.]

All the gatherings obtained are now being worked up in detail, and the results will be published in the Lancashire Sea-Fisheries Report during next winter by Mr. Andrew Scott and myself.

One or two broad features of the collections made were obvious. In the earlier part of the time, up to about the middle of April, diatoms were abundant, and nearly all the gatherings had a greenish tinge. During that period the plants were more abundant in the bottom waters, and the animals at the surface. Day after day we found that the two closing vertical nets hauled up from 20 fathoms to 10 fathoms were of a brownish-green color and contained (especially the Nansen net) an abundant gathering of diatoms. The surface nets during this time contained more Copepoda. On April 15 and 19, however, when the change in plankton was taking place, the diatoms were found to be mainly on the surface and the Copepoda below. As an example of wide distribution I may cite April 10, when the nets gave consistent results all the afternoon at three localities north of Port Erin, the diatoms being in all cases more abundant at the bottom and the Copepoda on the surface.

We were fortunate enough on one occasion to obtain incontrovertible evidence of the sharply defined nature of a shoal of organisms, forming an instructive example of how nets hauled under similar circumstances a short distance apart may give very different results. On the evening of April 1, at the "alongshore" station III., north of Port Erin, off the "Cronk," one mile out, I took six simultaneous gatherings in both surface and deeper waters. Two of the nets were the exactly similar surface tow-nets which I have called B and C. At half-time, as the result of a sudden thought I hauled in B, emptied the contents into a jar, and promptly put the net out again. This half gathering was of very ordinary character, containing a few Copepoda, some diatoms and some larvæ, but *no Crab Zoëas.* At the end of the fifteen minutes, when all the nets were hauled on board, all the gatherings, including B, showed an extraordinary number of Crab Zoëas rendering the ends of the nets quite dark in color. B was practically the same as C although B had only been fishing for seven minutes. It was evident that at about half-time the nets had encountered a remarkable swarm of organisms which had multiplied several times the bulk of the catch and had introduced a new animal in enormous numbers. Had it not been for the chance observation of the contents of B at half-time, it would naturally have been supposed that, as all the nets agreed in their evidence, the catches were fair samples of what the water contained over at least the area traversed—whereas we now know that the Zoëas were confined to, at most, the latter half of the traverse and may have been even more restricted. Under these circumstances, an observation made solely in the water traversed during the first seven minutes would have given a very different result from that actually obtained; or, to put it another way, had two expeditions taken samples that evening at what might well be considered as the same station, but a few hundred yards apart, they might have arrived at very different conclusions as to the constitution of the plankton in that part of the ocean.

It is interesting to note that enormous numbers of *Oikopleura* "houses" covered with diatoms were present in some of the gatherings; and the abundance of the diatom *Thalassiosira Nordenskioldii* was phenomenal. We have some reason to think that there has been an exceptional flow of cold water from the north into the Irish Sea this spring and that may account for the presence of this northern diatom which has not been found in our region before.

As an example of two surface nets hauled together which gave much the same quantity of plankton, but where the gatherings differed widely in their nature, I may give the details of April 13. [Slide shown and details explained.]

The bearing of such observations as these upon some recent speculations as to the fish-population of the sea, and even as to the amounts of food-matters present in the waters of large areas, is obvious. Nothing in the economics of the sea could be more important than such speculations in regard to what I have proposed should be called the "hylokinesis" of the ocean, if we could be certain that our conclusions are correct, or even that they are reasonably close approximations.

It is possible to obtain a great deal of interesting information in regard to the hylokinesis of the sea without attempting a numerical accuracy which is not yet attainable. The details of measurement of catches and of computation of organisms become useless and the exact figures are non-significant, if the hauls from which they are derived are not really comparable with one another and the samples obtained are not adequately representative of nature. If the stations are so far apart and the dates are so distant that the samples represent little more than themselves, if the observations are liable to be affected by any accidental factor which does not apply to the entire area, then the results may be so erroneous as to be useless—or worse than useless, since they may lead to deceptive conclusions.

My view in brief is: (1) That we must investigate our methods before we attempt to investigate nature on a large scale, (2) that we must find out much about our gatherings of organisms before we can consider them as adequate samples; and (3) that we must make an intensive study of small areas before we draw conclusions in regard to relatively large regions such as the North Sea or the Atlantic Ocean.

W. A. Herdman

A SIMPLE ELECTRIC THERMOREGULATOR

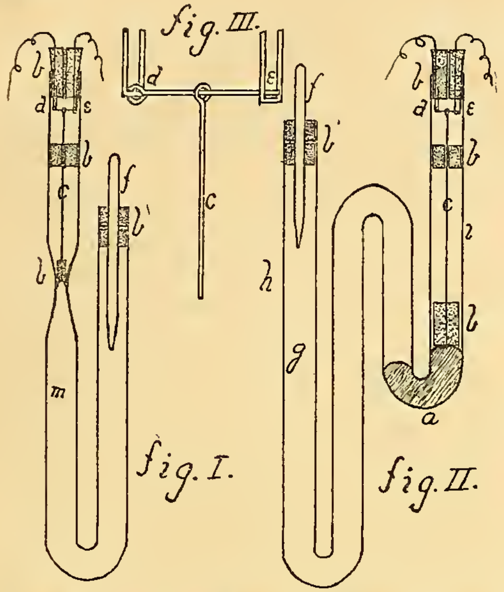
The advantage of electricity over gas for heating paraffin baths, incubators, culture chambers, etc., in laboratories is well known. Electric thermoregulators for use in connection with such apparatus have appeared from time to time; but, as far as I know them, they are all more or less complicated or expensive.

The electric heating coil and regulator devised by Professor E. L. Mark[1] and used with success in the laboratories of the museum of comparative zoology at Harvard University ever since, costs between $25 and $30 for each bath. The expense of this device excludes its use in many laboratories, especially those in which quite a number are desired for individual use.

It was for the purpose of heating a small paraffin bath with a sixteen-candle power incandescent lamp that I first devised an electric thermoregulator. Later modifications of this piece of apparatus resulted in two forms, a mercury regulator and a glycerin or air regu-

[1] Mark, E. L., "A Paraffine Bath Heated by Electricity," *Amer. Nat.*, 37 (434): 115–119, 3 figs., February, 1903.

lator, both of which are represented in the accompanying figures. Their construction will be clearly understood by referring to the figures.



Figs. 1 and 2. Side view of a median vertical section of mercury and glycerin electric thermo-regulators respectively. One half natural size. General outline, wall of glass tube; *a*, mercury or water; *b*, cork; *c* and *d–e*, copper or platinum wire about 0.5 mm. in diameter; *f*, solid glass rod; *m*, mercury; *g*, glycerin, air, toluole, or chloroform.

Fig. 3. An enlarged view of the lever *d–e*, with its connections.

In constructing the lever the ring at *d* must be made large enough, so that the end *e*, where the circuit is broken, will fall with its own weight. This ring should consist of several coils so as to make the ring end of the lever heavier than the opposite end and give space enough for good electrical contact. Five coils, two on either side of the middle, is sufficient. I have also found it advisable to make a single turn loop in the lever near the middle, to connect with the ring on the wire *c*. This insures bearing always on the same point and prevents possible change in the adjustment of the regulator by the sliding of the ring on the lever.

Copper wire has proved very satisfactory in the construction of the lever and its connections. I have, however, had occasion to use it only about one week. It may be that continuous usage for a long period will cause sufficient oxidation at the point *e* where the circuit is broken, to prevent electrical contact. If this proves to be true, platinum will have to be substituted for copper.

If the cork *b′* is cut in half crosswise and a little vaselin put between the two parts as represented in the figures, the glass rod will slip through the cork very easily and there will be no difficulty with leakage.

The glycerin regulator will be more compact and easier to manipulate if the second bend in the glass tube is made in a plane at right angles to that in which the first bend lies, and the third in a plane at right angles to the second, so that the two portions *i* and *h* will lie near each other and a cross-section of the four straight portions will form a rectangle.

If glycerin and mercury are used in the regulator, represented in Fig. 2, it can be easily filled by first nearly filling the entire tube with glycerin, then pouring the desired quantity of mercury into the lever end, and then drawing the glycerin above the mercury off and washing it out thoroughly with water and alcohol. The space above the mercury must be clean and dry or the cork will be likely to stick.

Both regulators are adjusted in the same way. They are immersed in the water in the bath, then the glass rod *f* is partially or entirely withdrawn. This completes the circuit and the temperature begins to rise. As soon as it has reached the desired point, the glass rod is pushed in very slowly until the circuit is broken. The temperature now falls until the circuit is again complete. The adjustment is thus seen to be very simple. It must, however, be remembered that owing to currents in the water due to unequal heating, the temperature of the water in the region of the thermometer compared with that in the region about the regulator is likely to change and so it is to be expected that the regulator will not maintain the temperature recorded when the circuit is first broken. It will, however, soon reach a state of equilibrium and remain nearly constant.

The change in temperature required to make and break the circuit varies with the form and size of the regulator used and its contents. In the mercury regulator constructed as represented in Fig. 1 it is less than one half degree. In the regulator made as represented in Fig. 2, containing glycerin and mercury, it is less than one tenth degree. If air is substituted for glycerin, the regulator is still more sensitive, but the temperature maintained varies nearly two degrees with extremes in barometric pressure. Barometric changes, however, affect the liquid regulators but very little. If water and air are substituted for mercury and air, the temperature variation is slightly increased.

The advantage of glycerin toluole and chloroform over mercury lies in the fact that they have a much higher index of expansion than mercury and, at least glycerin and chloroform, are much cheaper.

Both forms can be made more sensitive, (1) by increasing the length of the chamber containing the mercury, glycerin or other substances, (2) by increasing the diameter of the tube near the electric end so as to admit the use of a longer lever, (3) by increasing the ratio between the diameter of the tube and that of its constriction. (A constriction can be made use of in the glycerin regulator as well as in the one containing only mercury.) It will thus be seen that there is theoretically no limit to the possible sensitiveness of these regulators.

A glass tube having an inside diameter of 7 mm., reduced to 2 mm. at the constriction, was found to be suitable for the construction of these regulators. In making the constriction the tube should be heated and rotated until the walls fall in before it is drawn out, so that they will become thick and the tube will be strengthened at this otherwise weak point. No special care need be exercised in bending the tube; various other forms than those represented will answer the purpose just as well.

Either form of the regulators described can, of course, be used in connection with "heating coils," such as described by Professor Mark or others, or in connection with incandescent electric bulbs. The latter are usually furnished without charge by electric power and lighting companies. They serve the purpose fairly well, although some inconvenience must be expected, owing to the liability with which they burn out, unless several are used in heating each bath.

In case bulbs are used and apparatus is constructed with this in view, I think metal tubes large enough to admit a bulb should be soldered in the side near the bottom. If the cylindrical form of bulb is used these need not be large. The tubes should be dead black inside and closed after the lamps are in. In this way practically all the light energy is transformed into heat energy.

Heating with electricity is somewhat more expensive than heating with gas. I was, however, surprised to find that a sixteen-candle power incandescent lamp, with the circuit broken nearly three fourths of the time, will maintain a temperature between fifty and sixty degrees in a well-insulated bath which holds about one liter.

S. O. Mast
Johns Hopkins University

SEISMOGRAPHS IN UTAH

It may be of interest to many to know that seismographic apparatus has recently been installed at the University of Utah. The university campus covers part of a shore terrace built by the Pleistocene water-body known as Lake Bonneville on the easterly outskirts of the region now occupied by Salt Lake City, and lying practically at the base of the Wasatch range. The Wasatch Mountains are of immature age, and consequently are now rising. Raw scarps at the foot of a spur just northeast from the city, and similar scarps at the base of the main range a short distance to the southeast, tell of comparatively recent up-slips of these sections of the mountain mass. At the Wasatch base directly east from the city, along the line of the bench-land junction with the mountain mass, there is little evidence of fault movement at all comparable as to recency with the fresh scarps northerly and southerly from the locality described.

This fact and others of related significance have inspired the prediction that the next or at least a relatively early orogenic uplift in this section of the Wasatch terrane will result in a break to the east from Salt Lake City, with accompaniments of destructive earthquakes.[1]

The foundation of this prophecy of assured calamity has been questioned by the writer.[2]

It is a fact that slight earth tremors occur at frequent intervals in the Salt Lake Valley. These tremors originate differently, mainly as follows: (1) in orogenic slips incident to the rise of the Wasatch mass, or, more precisely, incident to the upward slip of some particular section of the range, since the mountain mass does not move as a whole; (2) in the slips incident to the readjustment of the monoclinal crust-blocks composing the Basin Ranges to the west. These conditions of crustal movement in this vicinity warrant the statement that sesimographic records here obtained promise results of both interest and value.

The writer is pleased to report the installation of a pair of seismographic pendulums in Utah. The apparatus as a whole may be designated as the Omori-Bosch seismograph. It was imported from Bosch, Strassburg.

Before deciding on the purchase of this type of apparatus, the writer inquired by correspondence and personal visits as to instruments for recording earth movements now in operation in this country. The results showed but few installations, and, according to the reports, a considerable number of these were of doubtful efficiency.

The Omori-Bosch seismograph includes a weight of 100 kilograms suspended by a flexible wire and supported in part by a cone and socket attachment extending from an iron column four and a half feet high, said column being firmly anchored to a massive pillar rising from a deep foundation and isolated from floor and other surface contact. Attached to the weight is a skeleton cone of aluminum rods, which, with frictionless attachments, operates a fine recording pen or point. The tracing point rests on the surface of a paper-covered revolving drum. The paper is glazed on one side, and when placed in position on the drum is lightly smoked.

A reliable contact clock is electrically connected with the recording mechanism, and a metallic point projecting from the armature of an electro-magnet makest its imprint upon the smoked paper at intervals of minutes or seconds. The record during a period free from earth tremors is a series of uninterrupted lines with dots indicating time intervals; disturbances are shown by cross tracings, of wide amplitude and short duration when caused by superficial jarring of the instrument, but smaller as to amplitude, and otherwise distinctively different if caused by an earth tremor reaching the pillar from below.

The equipment at the University of Utah comprises two instruments as described; these are set respectively on the north-south and east-west lines. One clock makes synchronous record on each of the two drums.

The sensitiveness of the apparatus is surprising. A blast from the human lungs impinging upon the side of the supporting pillar is definitely recorded. A heavy hammer blow on the end of the pillar, if delivered on the line of the main axis—north-south or east-west according to the pillar that is struck—makes no tracing beyond that due to a slight upward jolt of the recording pen and the return of the point perhaps a little out of its normal position.

Each instrument is mounted on a pillar or pier of concrete, extending about 15 feet below the floor. The entire apparatus is enclosed within a tight case with glass sides.

On July 2 a powder explosion occurred about three miles from the university grounds. The explosive was fired while packed in freight cars awaiting removal to the magazine buildings near by. According to report 725 kegs of blasting powder and a ton of giant

[1] See Lake Bonneville, by G. K. Gilbert, Monograph I., U. S. Geol. Surv., pp. 361, 362.

[2] *Scottish Geographical Magazine*, September, 1902.

powder exploded. The cars were blown to bits, rails were broken and warped and the pieces were hurled to great distances; houses in the vicinity were wrecked; and the force of the explosion was felt throughout the city. The seismographs recorded the surface movement as a cross tracing, distinct but susceptible of measurement only with the aid of a lens.

J. E. Talmage

MASS AND ENERGY

The following is an outline of some interesting theoretical results, a full account of which will shortly appear elsewhere.

If a piece of matter be considered as an electrical system, possessing any structure or internal motions, but having on the whole a kind of average symmetry, then it may be shown that the electromagnetic mass of such a system for ordinary velocities is given by

$$\text{Mass} = \frac{4}{3}\frac{1}{V^2}E$$

where V is the velocity of light and E is the total electromagnetic energy of the system. Thus the mass of the system is determined solely by its energy content, and the idea is suggested that mass and energy may have something in common. This result has several interesting implications.

Any reaction which is caused by the action of electric forces will involve a change in the electromagnetic energy content of the system, and hence according to the above view will be accompanied by a change of mass. This change will, of course, in general be a decrease. In the case of ordinary chemical reactions calculation shows that this change would be too small to be detected, but in the case of radioactivity, where the energy lost is relatively much greater, a sensible change is to be expected. Thus on this view the atomic weight of the various products of radium can not be accurately calculated from the number of α-particles lost, for there is this further decrease in mass due to the loss of energy.

The evolutionary theory of the elements has always met an almost insuperable difficulty in the fact that there appears to be no *exact* regularity of any kind throughout the list of atomic weights.

Some years ago Rydberg came to the conclusion that it was necessary to consider the atomic weights, up to that of iron, as made up of two distinct parts $N + D$, where D is a very small difference, a slight deviation in fact from (N). Exact harmonious relations exist between the various N's and Rydberg seems to consider the D's as representing real physical deviations and not merely mathematical remainders.

From the point of view of loss of mass accompanying energy dissipation, it is evident that these small irregularities are just what is to be expected.

Finally it is to be noticed that if for all matter the ratio of mass to weight is sensibly the same, the above mentioned proportionality between mass and included energy can only imply that the gravitation of a body is always proportional to its total energy content, and this constant proportionality seems to point toward the conclusion that it is confined energy which gravitates and not mass in any other sense.

It is perhaps well to point out that the conclusion respecting gravitation involves the assumption that all the mass of matter is electromagnetic, while the conclusion respecting loss of mass and atomic weight irregularities requires only that the forces causing the energy change be electric or magnetic, *i. e.*, requires only that *part* of the total mass be of electromagnetic origin.

Daniel F. Comstock

Mass. Institute of Technology,
September 9, 1907

NOTES ON ENTOMOLOGY

Another heavy installment of Wytsman's "Genera Insectorum," has made its appearance. Fascicle 46c by Otto Schwarz completes the Elateridæ or click beetles; it comprises pages 225 to 370, and six colored plates. The types of the genera are not indicated, and the references are incomplete. In the case of new genera there is nothing to show in what genera the component species were formerly placed, and an author's interpretation of a genus is placed under another genus as a synonym without hinting that that author was not the original describer of the genus. A new genus—*Parallelostethus*—includes *P. attenuatus* Say, the *Ludius attenuatus* of the Henshaw list.

Fascicle 50 is on the Plastoceridæ, a small group near Elateridæ; it is by Otto Schwarz; 9 pages, 1 plate. Many species of this group are from California.

Fascicle 51 is on the Dicronychidæ, a small group of African beetles near to the Elateridæ; it is also by Otto Schwarz, 5 pages, 1 plate.

Fascicle 52 is by H. Schouteden on the subfamily Asopinæ of the Pentatomidæ; 82 pages and 5 colored plates. He restricts *Perillus* to *P. confluens*, and for our other species makes a new genus, *Perilloides*. For *Podisus* he uses the same *Apateticus* Dallas, and most of our species fall in a new subgenus—*Eupodisus*. This fascicle is easily above the average of the "Genera."

Fascicle 53 is on the Lampyridæ or fireflies, by E. Olivier; 74 pages and 3 colored plates. His idea of the family is much narrower than that of Leconte; the Lycini, Phengodini and Teleophorini are omitted. He uses *Lecontea* for *Pyractomena* of our lists, and *Ellychnia* and *Pyropyga* fall as synonyms of *Lucidota*. Over 1,000 species are catalogued, but unfortunately many are briefly described in foot-notes.

Fascicle 54 is by J. J. Kieffer on the Dryinidæ; 33 pages, 2 plates. This includes about 300 species. There is no mention of the family Proctotrypidæ, under which family these tiny Hymenoptera are known to most entomologists. The genera are extremely numerous for a small family.

Fascicle 55, by R. Shelford, on the subfamily Ectobinæ of the Blattidæ, or cockroaches; 13 pages, 1 plate. It includes a table of the subfamilies of cockroaches.

Fascicle 56 is by V. L. Kellogg on the fragile flies of the family Blepharoceridæ; 15 pages, 2 plates, one of the plates with figures of larvæ. It is much less valuable than his paper on the American forms.

THE late Baron Edmond de Selys Longchamps made provision for the publication of a descriptive catalogue of his collections, now in the Belgian National Museum. His collection was largely in Neuroptera, and in the Odonata, or dragon-flies, it was the largest and most important in the world. Two parts of this descriptive catalogue are now issued. Fascicle XVII. on the Cordulines, a group of dragon-flies, is by René Martin; 94 pages, 3 colored plates, and 94 text figures. This part includes all the described species, and a description is given of each form, many of them new. The references are often incomplete, and there seems to be a general lack of systematic treatment. The second part to appear is fascicle VI. on the Trichoptera, or caddice-flies; it is by Georg Ulmer, 102 pages, 4 colored plates and 132 text figures. It includes only species in the Selys collection, which was not large in this group. The new species are mostly from Japan; new descriptions are given of several American species. Unfortunately the author has been careless in the use of the word "type."

PROFESSOR C. FRIONNET has treated systematically the caterpillars of France.[1] He gives a general account of caterpillars and chrysalides, and a synoptic table to the caterpillars of the 213 species of butterflies known to occur in France. Under each species there is a description of the caterpillar, the date of feeding, name of food plants, eggs, distribution in France, habits, and the known parasites. There are lists of parasites and hosts, and of plants and caterpillars feeding on each. An extensive bibliography of the subject is given in the early part of the book. A work on the caterpillars of the Eastern States, on the same plan, would be of great value.

[1] "Les premiers états des Lepidoptères français: Rhopalocera," *Mém. Soc. Lett. Sci. Arts Agric. Ind. St.-Dizier;* 322 pp., 3 pls., 1906.

Dr. F. V. Theobald has issued another volume of his monograph of the mosquitoes.[2] This is the second supplementary volume, and we are told in the preface that another volume is in active preparation. This volume contains the descriptions of 160 species described since the publication of Volume III. and the descriptions of seventy-three new species, none of the latter being from our country. There is a review of the classifications that have been proposed since Volume III., and he clings to his former methods, with the addition of some characters derived from the papers of Lutz. Most of the plates represent portions of wings showing the nature of the scales; others show genitalia and larvæ. There is no bibliography included in this volume.

Dr. Otto Schmeideknecht has published a work[3] of great usefulness, not only to Europeans, but to Hymenopterists throughout the world. Many of the European genera occur in our country, and their careful tabulation will assist us in recognizing them. The book contains 800 pages and 120 text figures; more of the latter would materially strengthen the work. Synoptic tables are given to the species in all groups except the three large families of micro-Hymenoptera, the saw-flies, certain Ichneumonidæ, and some genera of bees, as *Colletes* and *Sphecodes*.

The tiny blood-sucking flies of the genus *Phlebotomus*, as little known as the mosquitoes were twenty years ago, now come into prominence through a paper by Professor B. Grassi.[4] He has obtained an Italian species, worked out its life history, studied its anatomy both external and internal, and presented the results on four beautiful double plates. The previous record of a larva of this genus was for an African form found in cesspools, but the Italian species lives in moist soil. This larva has four long terminal bristles, and differs greatly from the larva of *Psychoda*, and would seem to warrant a still greater separation of this genus from the true Psychodidæ. Grassi gives a long account of the previous writings on the genus.

Mr. E. E. Austen's recent work on the blood-sucking flies is chiefly remarkable for the beauty and accuracy of the plates;[5] these are comparable only to the plates issued by the same author on the tsetse flies. Thirty-five species are figured, and several others are referred to in the text; eight of these are mosquitoes, and seventeen are Tabanidæ. He states that our "horn-fly" known to us as *Hæmatobia serrata* should be called *Lyperosia irritans* Linn.

Mr. E. R. Burdon has given us an interesting historical account of the origin of two generic names.[6] He shows that as "Kermes" the dye-insect of the oak was well known in Southern Europe, and so used by Linnæus in the second edition of his "Systema Naturæ." Later, in the seventh edition he put this insect in *Coccus*, and used *Chermes* for other Hemiptera. Geoffroy used *Chermes* for *Coccus* or the original *Kermes* of Linnæus. Then Boitard went back to the original spelling, using *Kermes*, while Hartig retained *Chermes* for the aphid genus.

One of the largest general works on ants has recently been published, but entirely in the Russian language.[7] It includes an extensive bibliography of 915 numbers, an introduction in which he discusses the structure and classification of ants, and a systematic treatment of the Russian forms. Tables to the genera are followed by the characters, habits and distribution of each genus in detail. Then the species are described, with keys

[2] "A Monograph of the Culicidæ of the World," Brit. Mus. Nat. Hist., 1907, pp. 639; 16 plates, 297 figures in text.

[3] "Die Hymenopteren Mitteleuropas, nach ihren Gattungen und zum grossen Teil auch nach ihren Arten analytisch bearbeitet," Jena, 1907.

[4] "Ricerche sui Flebotomi," *Mem. Soc. ital. Scienze* (3), Vol. XIV., pp. 353–390, 1907, 4 pls.

[5] "British Blood-sucking Flies, with Notes," Brit. Mus. Nat. Hist., 1906, 74 pp., 34 plates.

[6] "Note on the Origin of the Name Chermes or Kermes," *Jour. Linn. Soc. Lond., Zool.*, XXX., pp. 5–9, 1907.

[7] "Formicariæ Imperii Rossici," Kasan, 1906, 800 pp., 176 figs., by M. Rusky.

under each genus. Altogether there are 258 forms, of which 161 are species or subspecies, the others being classed as varieties. Many varieties and several subspecies are new, but described only in Russian. The habits and distribution in Russia of each species is given often in much detail. The Caucasus region appears to be the richest in species. The author recognizes but four subfamilies: Camponotinæ, Dolichoderinæ, Myrmecinæ and Ponerinæ.

Nathan Banks
U. S. Department of Agriculture

DIET AND ENDURANCE AT BRUSSELS

Mlle. Dr. J. Ioteyko, head of the laboratory at the University of Brussels, and Mlle. Varia Kipiani, student in science, have published a monograph of seventy-seven pages: "Enquête Scientifique sur les Végétariens de Bruxelles."[1] In this monograph the question of vegetarianism is studied by several methods. The authors have become convinced that the vegetarian régime is for the most part a more rational one than the highly nitrogenous diet ordinarily prevailing in Western Europe and America.

In the brief introduction, general considerations in regard to diet are mentioned and special emphasis given to the subject of toxins. The authors quote, in behalf of their conclusions, the eminent French dietitian, Armand Gautier, "who, without himself being a vegetarian, praises the good effects of the vegetarian régime." The authors quote Gautier as follows:

> The vegetarian régime, modified by the addition of milk, of fat, of butter, of eggs, has great advantages. It adds to the alkalinity of the blood, accelerates oxidation, diminishes organic wastes and toxins; it exposes one much less than the ordinary régime to skin maladies, to arthritis, to congestions of internal organs. This régime tends to make us pacific beings and not aggressive and violent. It is practical and rational.

The authors, while apparently classifying themselves as advocates of vegetarianism, admit that in certain cases it is necessary to prescribe meat as a "medicament"—"just as one prescribes sometimes alcohol and other poisons." The authors also observe that the transition to a vegetarian diet should be gradual.

The personal history is traced of forty-three vegetarians of Brussels. Among other interesting observations is the following:

> For the most part the vegetarians appear younger than their age; notably the ladies are distinguished by their clear and fresh complexion.

The experiments conducted by Mlles. Ioteyko and Kipiani are restricted to vegetarians who have been such for several years. The experiments were, for the most part, comparisons of strength and endurance. So far as strength is concerned, very little difference was discovered between vegetarians and "carnivores." In endurance, on the other hand, a very remarkable difference was found, the vegetarians surpassing the carnivores from 50 to 200 per cent., according to the method of measurement.

This result agrees with the experiment on nine Yale students described in Science.[2] These subjects, by dint of thorough mastication, gradually lost their taste for flesh foods. At the end of five months, while not becoming vegetarians, they had reduced their consumption of flesh foods to one sixth of the amount to which they had originally been accustomed. Their strength remained practically stationary, but their endurance, according to the gymnasium tests, was increased on an average by over 90 per cent.

The method of measuring endurance used by the Belgian investigators was by means of the Mosso ergograph. One of the fingers is used to raise a weight as far as possible. As the experiment proceeds and fatigue sets in, the height to which the weight can be raised is gradually reduced until no further contractions are possible. If a curve be constructed representing the height of the successive contractions, it is called a "curve of fatigue," and it is found that this curve is "different for different individuals, but is constant for the same individual from one day to another and even after an interval of several years, if the

[1] Brussels, Henry Lamertin.

[2] N. S., Vol. XXIV., No. 620, Nov. 16, 1906.

conditions of the experiment remain the same."

The authors compared the endurance of seventeen vegetarians, six men and eleven women, with that of twenty-five carnivores, students of the University of Brussels. Comparisons for the right hand differed somewhat from those for the left, the superiority of the vegetarians being greater for the latter than for the former. Comparing the two sets of subjects on the basis of mechanical work, it is found that the vegetarians surpassed the carnivores on the average by 53 per cent. Comparing the two groups on the basis of the number of contractions—or, what amounts to the same thing, the length of time during which the ergograph could be continuously operated—it was found that the vegetarians could work on the ergograph two or three times as long as the carnivores before reaching the exhaustion point.

This last result corresponds to conclusions[3] of the present writer in an experiment in which forty-nine subjects, about half of whom were flesh-eaters and half flesh-abstainers, were compared. It was found that the flesh-abstainers had more endurance, as measured by gymnasium tests, than the flesh-eaters, to the extent of from two to three fold.

The Brussels investigators found also that the vegetarians recuperated from fatigue far more quickly than the meat-eaters, a result also found in the Yale experiment.

An interesting mathematical study of the fatigue curve is made in which the equation

$$\eta = H - at^3 + bt^2 - ct$$

is used. In this equation η represents the height of the contraction at any time; t represents time and $H, a, b, c,$ are constants. H is the height of initial or maximum contraction. The authors believe that a is a parameter measuring the toxicity of albumenoids in their effect on the muscles. The numerical value of a is very small, but as it is a coefficient of the cube of the time during which the experiment is continued, the cumulative effects of these toxins is very rapid. The parameter b is believed to refer to the excitability of the central nervous system, and c to the utilization of carbohydrates. The authors refer to previous memoirs of J. Ioteyko to justify these interpretations of the coefficients. After laborious computations, it is found that the average of the coefficient a for the carnivores is .00305 and for the vegetarians .00015. The average coefficient b for the carnivores is .086 and for the vegetarians .023. The average coefficient c for the carnivores is 1.94 and for the vegetarians 1.46. The average of the constant H of the carnivores was 38.7 and for the vegetarians 31.7.

The authors conclude by advocating a vegetarian régime as a proper system for working men, and believe that its use would reduce the accidents on railways and in industry which come from over-fatigue, increase the productivity of labor, as well as have other economic benefits.

The monograph of Mlles. Ioteyko and Kipiani is especially interesting as confirming the trend of many modern studies. It agrees in substance with the conclusions in a popular book published a year ago in England by T. Russell on "Diet and Strength." The philosophy, however, by which these harmonious results are explained by various investigators is not the same. Russell and Mlles. Ioteyko and Kipiani regard the inferior endurance of meat-eaters as due to specific toxins in flesh foods, and therefore are avowed vegetarians. Under Professor Chittenden's theory, on the other hand, the facts brought forward by Mlles. Ioteyko and Kipiani, as well as by Mr. Russell and the writer, would be interpreted as primarily due to the superiority of "low proteid" rather than of a non-flesh diet. For this and other reasons, Professor Chittenden and most other modern physiologists avoid the term "vegetarian" as inappropriate and misleading. A vegetarian may, through a wrong selection of his food materials, suffer from the evils of high proteid, and a flesh-eater may, if he consumes flesh sparingly, have the advantages of a low-proteid diet.

It is possible that flesh-eating, as ordinarily practised, is injurious both because of ex-

[3] "The Influence of Flesh-eating on Endurance," *Yale Medical Journal*, March, 1907.

cessive proteid and because meat, as such, contains poisonous elements. It is well known that Liebig came to repudiate the idea that the extractives of meat were nutritious, and that investigation has shown them to be poisonous. Recently, Dr. F. B. Turck has found[4] that dogs, mice and rats fed on meat extractives exhibit symptoms of poisoning and often die. The poisonous effect is aggravated by intestinal bacteria which find in these extractives an excellent culture medium. Dr. Turck concludes:

(1) It is clearly evident from these experiments, which correspond to the investigations of others, that the injurious effects of meat are not due so much to the muscle proteid, myosin, as to the extractives.

(2) That the injurious effects of the extractives are increased through the action of intestinal bacteria.

Dr. Turck does not find any evidence that the extractives in small quantities are injurious.

Dr. Turck therefore concludes that the "high liver" who uses much flesh and also an excess of starch and sugar is a "bad risk" for life insurance companies. He recommends, if meat is to be used, that the extractives first be removed by special processes which he explains. He finds that the remaining part of the meat is highly nutritious and an invaluable aid in many cases of weak stomachs. He supplies much clinical evidence of the evils of ordinary meat-eating, as well as of the benefits obtainable from extract-free meat.

These investigations, with those of Combe of Lausanne, Metchnikoff and Tissier of Paris, as well as Herter and others in the United States, seem gradually to be demonstrating that the fancied strength from meat is, like the fancied strength from alcohol, an illusion. The "beef and ale of England" are largely sources of weakness, not strength. Whether in moderation they are harmful may still be a matter of conjecture. While the trend of recent experiments is distinctly against the excessive use of flesh foods, there are still needed many more experiments—medical, athletic and industrial—before the economics of diet can be established on a secure basis. The experiment with a vegetarian or semi-vegetarian diet at the University of Chicago, which Director Stagg is to make with the athletic teams, will be watched with interest.

[4] "Effect on Longevity of High Living," by Fenton B. Turck, M.D., *The Medical Examiner and Practitioner*, Vol. XVII., No. 8, August, 1907.

Mlles. Ioteyko and Kipiani seem to place a larger reliance on the ergographic tests than most physiologists. A thoroughly reliable method of measuring endurance seems still to be a desideratum.

Irving Fisher

A NEW NATIONAL BUFFALO HERD

The buffalo herd which was presented to the national government by the New York Zoological Society last year, to form the nucleus of a great southwestern herd, was shipped on October 11 to the new range of 7,680 acres that has been prepared for it in the best portion of the Wichita Game Reserve, southwestern Oklahoma. On October 10 fifteen fine animals, the pick of the splendid herd of forty-five head in the New York Zoological Park, were crated for shipment, each in a roomy and comfortable crate, and shipped to Cache, Oklahoma. In view of the nature and object of the shipment—a gift to the people, for the express purpose of helping to preserve the American bison from ultimate extinction—the American Express Company and the New York Central Lines transport the two cars free of charge from New York to St. Louis, and the Wells-Fargo Express Company also makes a free gift of the transportation over the 'Frisco Road from St. Louis to Cache. Both these favors are greatly appreciated by the Zoological Society, which had undertaken to make delivery at Cache.

In 1906, the New York Zoological Society received from the director of the Zoological Park a suggestion that the society offer to the national government, as a gift, a herd of fifteen buffaloes with which to start a new national herd. The proposal was warmly endorsed by the executive committee of the society. The offer was made to the Secretary of Agriculture, who immediately accepted it, and invited the society to select a site for the new fenced range that would be necessary. Forthwith the society despatched a special agent, Mr. J. A. Loring, who went to the Wichita Reserve, and with Supervisor E. F. Morrissey, carefully examined the whole available territory. A location was agreed upon, and duly mapped out. Mr. Loring submitted to the society an elaborate and thorough report, which was transmitted to the Department of Agriculture, and to Congress. Secretary Wilson secured a special appropriation of $15,000 for the erection of a wire fence to enclose twelve square miles of range, and to erect corrals, sheds, and a hay barn. This work has been proceeding, and will soon be completed, under the direction of the Forestry Bureau of the Department of Agriculture, whose officers have from the first been keenly interested in the undertaking. All the improvements were planned by Mr. Hornaday, and the animals for the nucleus herd were carefully selected by him.

The buffalo herd of the New York Zoological Park has for a long time been one of the finest sights of that great home for wild animals. Originally planned to contain twenty head, it numbered previous to this shipment forty-five as handsome buffaloes of all ages as ever were brought together. Ten lusty calves have been born this year.

But, notwithstanding the fine condition of this herd, the officers of the Zoological Society know that the only sure way by which the American bison can be preserved in full vigor for the next two hundred years, or more, is by establishing herds under national or state ownership, on public lands, in ranges so large and so diversified that the animals will be wild and free. Under such conditions, Dr. Hornaday declares that no ill effects from inbreeding ever need be feared.

The herd forwarded to Oklahoma is composed as follows: six breeding cows; one big bull, "Comanche," five years old, and master of the herd; one bull three and one half years old, two bulls and one cow in third year, one bull and one cow in second year, and one pair of calves, male and female, six months old. In this collection, four different strains of blood are represented, and after this succession of breeding males has been exhausted, there will be nothing to fear from inbreeding.

The shipment went forward in charge of Frank Rush, keeper of the Wichita Buffalo Range, and H. Raymond Mitchell, chief clerk of the New York Zoological Park. The buffaloes were shipped in two patent stock cars, and traveled in passenger trains the whole distance. On arriving at Cache, teams were in readiness, and the animals were hauled, crated as they were, twelve miles to the new range. The utmost care will be observed to prevent infection by the Texas fever tick that is such a scourge to cattle in the southwest.

THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

THE survey is just closing its field season for 1907. In addition to the regular income of $10,000, the survey received from the last legislature a special appropriation of $10,000 annually for two years; to be used chiefly for roads. The state has a constitutional prohibition against the use of money for internal improvements, and an amendment for the repeal of this prohibition has passed two successive legislatures and will be submitted to popular vote in 1908. Meanwhile, the survey will use this small fund in advising local authorities how to build roads as well as may be under present conditions. Mr. W. O. Hotchkiss, the economic geologist, is devoting most of his time to this department. Mr. A. R. Hirst, formerly in the employ of the State Highway Commission of Illinois, has been appointed engineer. Under their direction a stretch of experimental road was built at the state fair in Milwaukee during September and a roads convention was held, attended by several thousand persons from all parts of the state.

Dr. Samuel Weidman and Mr. E. B. Hall of the department of areal geology have extended their survey of the northwestern counties of the state and have nearly completed the field work of this area. Dr. Weidman's report on the north central area, including about

7,200 square miles, has just been issued in a volume of some 700 pages.

The survey of the lead and zinc region of Southwestern Wisconsin, which is under the direction of Mr. Hotchkiss, has been extended by the work of a party of geologists and topographers, under the immediate charge of Mr. Edward Steidtmann. Nearly 100 square miles have been surveyed and maps are being prepared on the scale of four inches to the mile, with ten-foot contours. Much detailed information has been secured from drill holes, regarding the contours of the surface of the base of the Galena limestone, which forms the bottom of the zinc-bearing horizons.

The survey has continued its work on lakes on a more extensive scale through cooperative aid furnished by the U. S. Bureau of Fisheries and the Wisconsin Commissioners of Fisheries. The season was spent in the study of the lake region of Northeastern Wisconsin. Messrs. George Wagner and C. T. Vorhies were engaged throughout the summer in collecting fish from these lakes, especially whitefish and lake trout. During August Mr. Chancey Juday, biologist, with Messrs. R. D. Hall and George Kemmerer, as chemist, and Mr. E. V. Hills, as assistant, investigated the lakes as to temperature, oxygen, carbon dioxide, plankton, etc. Materials for study were obtained from nearly 70 lakes. This work was under the immediate charge of the director, Mr. E. A. Birge.

In addition to Dr. Weidman's report, the survey has just issued a bulletin by Dr. J. W. Goldthwait, on the abandoned beaches of Lake Michigan. Reports on the water powers of the state, by L. S. Smith, and on underground waters, by A. R. Schultz, are now in press.

SCIENTIFIC NOTES AND NEWS

Dr. Keysselitz and Dr. Martin Meyer, members of the Institute for Ship and Tropical Diseases at Hamburg, have been sent to the Agricultural and Biological Station at Amani in German East Africa to study the disease-causing protozoa.

During the past summer, Professor J. W. Toumey, of the Yale Forest School, made an extensive tour of inspection for the United States Forest Service through many of the national forests, investigating the condition of the forest tree plantations and nurseries which the national government is maintaining.

Dr. Heinrich Rubens, professor of physics at Berlin, has been elected a member of the Berlin Academy of Sciences.

Dr. Franz Richarz, professor of physics at Marburg, has been elected to membership in the Academy of Sciences at Halle.

Professor Bätz, of Stuttgart and formerly of Tokyo, has been elected president of the German Society of Tropical Medicine, recently founded in Berlin.

Mr. R. I. Smith, formerly state entomologist of Georgia, has accepted the position of entomologist to the North Carolina College of Agriculture and Mechanic Arts and the Agricultural Experiment Station at West Rayleigh.

Of the Western Reserve medical staff, Dr. William T. Howard has returned from one year's leave of absence, during which time he has done research work at the University of Munich. Dr. Howard D. Haskins, absent upon leave, has returned from research work at the University of Strassburg. Dr. Norman W. Ingalls, absent upon leave, returns after a year's research work at Freiburg and Leipzig.

Mr. W. L. Abbott, chief engineer for the Chicago Edison Company, has been elected president of the board of trustees of the University of Illinois.

Mr. E. S. Goodrich, M.A., F.R.S., has been elected to an official Fellowship at Merton College, Oxford, on condition of his carrying on scientific researches in zoology and continuing educational work in the university.

Dr. Hugo Hertzer, professor of graphics, in the technical high school at Berlin, has retired from active service.

The first lecture in the present year's Harvey Society course will be delivered by Professor E. O. Jordan, University of Chicago, at the New York Academy of Medicine on Saturday evening, October 26, at 8:30 p.m. Subject: "The Problems of Sanitation." All interested are invited to be present.

Professor Josiah Royce is this year giving courses on ethics and metaphysics at Yale

University on the Harvard lectureship foundation. Professor Royce also gives a course of six Lowell lectures on the "Philosophy of Loyalty," beginning on November 18.

During the first half of the present academic year Professor Frederick J. E. Woodbridge, of Columbia University, will continue to lecture on philosophy at Amherst College on Saturdays.

Professor Th. W. Richards, of Harvard University, will give a course of eight Lowell lectures on "The Early History and Recent Development of the Atomic Theory," beginning on Monday, February 17.

The first Thomas Young oration before the London Optical Society was given on October 17, by Professor H. E. Tscherning, of the Sorbonne, Paris.

The International Congress of Hygiene, meeting in Berlin, on September 27, sent on that day, which was the anniversary of Pasteur's death, a telegram to his widow gratefully recalling the memory of the immortal genius and unforgettable benefactor of humanity.

M. Maurice Loewy, director of the Paris Observatory, born in Vienna in 1833, died on October 15, while attending a meeting of the national board of French observatories of the Ministry of Public Instruction.

Dr. Edmund von Mojsisovics, formerly vice-director of the German Geological Survey, has died at the age of sixty-nine years.

The observatory of the University of Michigan is being enlarged under the direction of Professor Hussey. The old instruments are being reconstructed and a new reflecting telescope added, having an aperture of about 37½ inches. The optical work for this is being done by the John A. Brashear Company, of Allegheny.

The Sixth International Conference on Tuberculosis, held in Vienna from September 19 to 21, adopted a resolution calling for general compulsory reporting, in a specified manner, of all deaths from tuberculosis of the lungs or throat.

The Association of Collegiate Alumnæ will hold its quarter-centennial meeting at Boston on November 5 to 9. Addresses at the public meeting on November 6 are to be given by Professor Ellen H. Richards, of the Massachusetts Institute of Technology, on "Professional Education," by President Charles R. Van Hise, of the University of Wisconsin, on "University Education," and by President M. Carey Thomas, of Bryn Mawr College, on "Women's College and University Education." Among those who will address the association are President Eliot, of Harvard University; Professor Briggs, president of Radcliffe College; President Hazard, of Wellesley College, and Professor William James, of Harvard University.

The forty-fifth university convocation of the state of New York was held in the senate chamber at Albany on Thursday evening, Friday, and Saturday, October 17, 18, and 19. Among the speakers announced were St. Clair McKelway; John H. Finley, president of the College of the City of New York; Sir C. Purdon Clarke, director of the Metropolitan Museum of Art; Frank Damrosch, director of the Institute of Musical Art; Hollis E. Dann, professor of music at Cornell University; Brander Matthews, professor of dramatic literature, Columbia University; Rush Rhees, president of Rochester University, and Paul H. Hanus, professor of the history and art of teaching, Harvard University.

A Reuter representative on board the *Ragnvald Jarl* has received the following details of the Arctic expedition undertaken by the Duc d'Orléans, who, together with Dr. Recamier, the surgeon and naturalist of the expedition, has arrived in England by that steamer from Bergen. The expedition, which was on board the duke's polar yacht *Belgica*, under the command of Captain de Gerlache, included four men of science, Dr. Recamier, Lieutenant Bergendal, Lieutenant Rachlew and Dr. Stappers. The ship left Vardö on July 9, and passed through the Matotchkin Shar on July 14. Soon after, the *Belgica* was beset with heavy ice, from which she was not liberated until August 21. During this period a continuance of northeast winds eventually drifted the ship through the Kara Sea into Barent's Sea. Afterwards the expedition explored the west coast of Novaya Zemlya. The ship unfortunately grounded on an unknown shoal, and it was found necessary to lighten her by throwing out coal, a course which seriously impaired her steaming powers. In spite of this the voyage was continued up the northern part of Novaya Zemlya to 78° north. The expedition returned to Hammerfest on September 15, all the explorers being in excellent health, notwithstanding the anxious time they had had. The scientific work accomplished will, it is said, prove of the greatest interest, since during the whole period of imprisonment in the ice a continual systematic series of observations was made. The *Belgica* with the rest of the expedition is now returning home *via* the Norwegian fjords.

According to a bulletin of the U. S. Geological Survey, the total value of the stone product of the country in 1906 was $66,378,794, an increase of $2,570,046 over that of 1905, and an increase of $42,413,565 over that of 1896. The value of the granite, trap rock, marble, bluestone and limestone increased, while the value of the sandstone decreased. The figures are:

Limestone	$27,320,243
Granite	18,569,705
Marble	7,582,938
Sandstone	7,147,439
Trap rock	3,736,571
Bluestone	2,021,898

Almost all the producers, especially the small quarrymen, state that the cost of production was greater in 1906 because of the increase in the cost of supplies and in the rates of wages, especially for common laborers. The increased use of cement and concrete has also had an important effect on the stone industry. Pennsylvania, producing chiefly limestone and sandstone, but also granite and marble, reported the greatest value of stone output for the entire United States, which was 13.27 per cent. of the total; Vermont, producing granite, marble, and a small quantity of limestone, was second, with 11.34 per cent. of the total; New York, producing sandstone, limestone, granite and marble, ranked third; Ohio, producing limestone and sandstone, was fourth; Massachusetts, producing granite, marble, sandstone and limestone, was fifth; Indiana was sixth, followed by Illinois, Maine, California and Missouri, each producing stone valued at over $2,000,000.

Mr. James W. Ragsdale, consul-general at Tientsin, reports that in view of the enormous forestry enterprise in the three eastern provinces of Manchuria, Viceroy Hsu Shih-chang is going to establish a school of forestry for teaching the modern methods, so as to protect China's interest in future. The proposed school will be opened in Mukden shortly. He also states that, according to a Tientsin paper, Viceroy Tuan Fang has notified the board of education and the Chinese foreign office that the German consul-general at Shanghai has intimated the desire of the College of Eastern Languages in Berlin to engage the services of four educated Chinese to teach Mandarin. The instructors would only be required to teach for six hours a week each, and the salary offered is 1,500 Marks a month each. The students would also be afforded every opportunity for continuing their own studies in accordance with the best modern standard. Tuan Fang has accordingly nominated Messrs. Wang, Chang, Chiang, and Liu for these posts, and proposes to grant them from the Nankin treasury 2,340 Marks each per month to cover incidental expenses.

UNIVERSITY AND EDUCATIONAL NEWS

Harvard University has received a gift of 2,000 acres of timber land for the Division of Forestry. The tract, which is said to be the best body of timber on an equal area in Massachusetts, was formerly the property of Mr. James W. Brooks, who offered it to Harvard at a price below its true value. Mr. John S. Ames, of Boston, has given the university the purchase money and $5,000 additional for the repair and equipment of the building.

The official report of the Yale University alumni fund shows contributions during the last fiscal year of $72,283. The amount of the principal of the alumni fund on July 1 was $242,998. The net receipts of the fund for the last seventeen years during which it has been collected have been $464,787.

William Waldorf Astor, who has already given $50,000 to Oxford University, has now offered to give another $50,000 as soon as $500,000 is subscribed by others.

The City of Saratov, Russia, has donated to the university which is to be established there, 26 desjatins of ground and 1,123,000 rubles in money.

The reorganized Bulgarian University, at Sofia, was opened this month.

The Mohammedan University at Cairo, Egypt, is celebrating the thousandth anniversary of its foundation.

The British Medical Journal states that the professors of the medical faculty of the University of Rome have at last succeeded in inducing the Italian parliament to give heed to their representations as to the inadequacy of salaries. The average amount of the salaries attached to the medical chairs is only £280, while the deputy professors and assistants are of course paid on a still lower scale. A bill has been introduced into the Chamber of Deputies providing for such an increase as will enable the professors to devote themselves wholly to scientific work.

New appointments have been made in the faculty of Bryn Mawr College as follows: Professor Robert Matteson Johnston succeeds Professor Charles M. Andrews, who has been appointed to the chair of colonial history in Johns Hopkins University. Professor Johnston, who is a graduate of the University of Cambridge, has been lecturer in history at Harvard University for the last three years and is a specialist in modern European history. Professor Theodore de Leo de Laguna, of the University of Michigan, comes as professor of philosophy as a successor to the late Professor David Irons, who died last January. Dr. Charles Clarence Williamson, recently university fellow in political economy at Columbia University, has been appointed associate in political science, succeeding Professor Henry Raymond Mussey, who has been called to the University of Pennsylvania. Dr. George Shannon Forbes, of Harvard University, and lately student in the universities of Berlin and Leipzig, has been appointed associate in chemistry. Dr. Daniel Webster Ohern, of the Johns Hopkins University, has been appointed associate in geology, succeeding Dr. Benjamin Le Roy Miller, who has been called to Lehigh University. Professor Florence Bascom, professor of geology, has returned after a year's leave of absence in Europe.

Professor Lewis Ehrhardt Reber, dean of the School of Engineering and professor of mechanical engineering of the Pennsylvania State College, has been appointed director of the university extension and correspondence study at the University of Wisconsin.

Dr. Ralph H. Curtiss, formerly of the Lick and more recently of the Allegheny Observatory, has been appointed assistant professor of astrophysics in the University of Michigan.

Dr. Arthur W. Weysse has given up his post in the department of biology of the Massachusetts Institute of Technology, as he wished to give his undivided attention to instruction in Boston University. Dr. Percy G. Stiles, in addition to his work as instructor in physiology at the institute, will this year act as assistant professor at Simmons College.

The vacancy in the department of mining and metallurgy at Colorado College, in Colorado Springs, caused by the resignation of Dr. Thomas T. Read, who goes to the Imperial University, at Tientsin, China, has been filled by the appointment of Clyde T. Griswold, a graduate of Amherst College and of Columbia University. During the past two years Mr. Griswold has been connected with the Canadian Copper Company.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, NOVEMBER 1, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE VAGARIES OF BERYLLIUM [1]

As it has become a custom in the American Chemical Society that the chairmen of the various sections, into which the sessions of the general meetings are divided, shall present an address upon some branch of their work in which they are especially interested, I have decided to speak this morning upon beryllium and especially upon those peculiarities of the element which stand out prominently as characteristic of itself. I realize fully the narrowness of the subject and fear that what I have to say will scarcely be of interest to all of you, but must plead as my excuse that, realizing fully the limitations of my own knowledge, I can select no other subject with which I am more familiar.

Even at its christening beryllium started on a vagarious career and its early sponsors as well as those who followed have recognized it under different names and have ascribed to it and to its compounds properties as widely variant as the conditions under which they worked. Referred to first by Vauquelin, its discoverer, as "la terre du Béril" the German translators naturally adopted Berylerde as the name of its oxide and although Vauquelin later accepted, under virtual protest, the suggestion made that glucine be used on account of the sweetish taste of the salts of the element, the name never secured adoption

[1] Address of the chairman of the Section on Inorganic Chemistry, Toronto Meeting, American Chemical Society.

outside of France and in the early literature was frequently written glycine. When later the element itself was separated by Wohler he used the term beryllium for the first time and a few weeks after glucinium appeared in the French press due to Bussy's almost simultaneous discovery. It is useless to go into the subsequent usage of the term or why the "i" was dropped and glucinum used for a time in American practise. It is sufficient, I think, to say that by far the majority of chemists of the world prefer and use the name beryllium in their conversation and writings, and since neither priority nor usage can be shown for glucinium it should be dropped as rapidly as possible in the interests of uniformity. I especially believe this to be true since there is no prospect of its ever replacing the more popular and, in my opinion, more justifiable beryllium.

Although the literature of inorganic chemistry is quite generally overburdened with compounds which have no actual existence and which have obtained place and been assigned formulas simply by the *analysis* of solid phases obtained under variable conditions and without other attempt to prove their individuality, it is doubtful if there is any branch of the field that needs more careful revision than the chemistry of beryllium. Its literature is full of errors. Compound after compound has been claimed which has no actual individual existence, but whose place in literature and whose formula depend solely upon analysis of mixed crystals, residues of evaporation or indefinite gummy precipitates, without attempt to separate the individuals present. Formerly this could not always be done, but with the more recent and simple applications of the phase rule to these problems there is no excuse for similar errors which, unfortunately, still continue to creep into our journals.

The metal beryllium itself has been but little studied, and for the main part simply as a dark steel-gray powder obtained by the reduction of its chloride by sodium or potassium or as small hexagonal plates obtained by the electrolysis of its double fluorides in a manner quite similar to the production of aluminum. Its melting point, its solution tension and many others of its important properties have never been determined, and many diverse statements are to be found in regard to it, although the very careful researches of Lebeau can undoubtedly be fully relied upon so far as he went into the subject. It is recorded, for example, that it does and it does not combine directly with hydrogen, sulphur, selenium and phosphorus, that it is and it is not reduced from its oxide by aluminum and magnesium, that it has been produced (even manufactured) by the electrolysis of its bromide and that its bromide is not a conductor of electricity. In each case the negative is probably true. For many years its valency was, and, for that matter, still is a matter of dispute. Even before it was seen that the only vacant place for beryllium in the periodic system was between lithium and boron, there were strong arguments for both its divalency and its trivalency on account of its close resemblance to both zinc and aluminum in its action. When Mendeléef finally pointed out its proper place in his table the controversy grew even more animated and most of the researches on the element in the seventies and eighties had the establishment of the true valency as the main object. All the early determinations of the specific heat lead to the figure 13.6 as the atomic weight and it was not until Nilson and Pettersson, after conquering unusual difficulties in a masterly research, finally determined the vapor density of the chloride and established its formula as $BeCl_2$ that real light was thrown on the problem. Shortly afterward in 1886 Humpidge showed that beryllium was abnormal as to its specific heat, which increased regularly with the temperature at which determined, until between 400° and 500° it approached normal with a value of 6.2. A determination of the vapor density of the bromide, of the acetylacetonate and of the basic acetate, all seemingly in agreement with the idea of the divalency of the element, would have seemed to have settled the matter and probably has done so, but the controversy itself goes merrily on. Wyrouboff still argues in his articles for the trivalency and Tanatar claims that the basic acetate can only be explained on the supposition that the element is in reality tetravalent.

Of the binary compounds of beryllium only the oxide, the carbids and the halides have any real standing in literature, although the sulphide has been made by Lebeau. Of these the oxide is the only one that is stable in ordinary moist air and even it shows decided variability in its hydroscopicity for reasons not yet determined. Ordinarily white, it is said to be blue by Levi-Malvano when made from his hexahydrated sulphate, although it is almost inconceivable that the difference of two molecules of water in the sulphate should cause this change and the existence of the hexahydrate itself is not yet confirmed. The halides, with the possible exception of the fluoride, can only exist in the complete absence of water, which causes them immediately and violently to lose part of their anion as hydracid. In this respect they are even more sensitive than the corresponding compounds of aluminum. On evaporating their solutions in water they lose more or less of the remainder of the gaseous hydracids, the residue becoming more and more basic and remaining soluble until a surprising degree of basicity is reached. This hydrolytic action is comparatively small in the case of the fluoride, but is practically complete in the case of the chloride, bromide and iodide. By careful manipulation residues of almost any degree of basicity, up to the pure oxide, can be obtained, and these mixtures of base and normal salt have given rise to claims for numerous *oxyfluorids* and oxychlorides for the existence of which there is no other evidence than the analysis of the variable residues obtained.

The hydroxide of beryllium is one of the most interesting of its compounds and one that has properties which vary greatly with the conditions of its preparation. Among the most noteworthy may well be mentioned its great solubility, of from two to five equivalents, in concentrated solutions of its own salts, and its precipitation therefrom on dilution; its solubility in saturated solutions of acid sodium and ammonium carbonates, and its very much diminished susceptibility to reagents when dried at high temperature or boiled in water, as instanced by the fact that when freshly precipitated and washed with cold water it will take up one third of an equivalent of carbon dioxide, but on boiling becomes so immune to its action that the gas has been passed through it for three months without any considerable absorption.

Probably the fact which has the greatest bearing upon the chemistry of beryllium and has caused more failures of researches undertaken upon the element than any other one thing, is the great influence which water has upon all of its salts, acting to many of them almost as if it were itself a strong hydroxide and in a manner that is hard to understand from our ordinary conceptions of solution and hydrolysis.

For this reason normal salts of the nonvolatile acids only can be crystallized from water, and indeed but very few of them, such as the sulphate, the selenate and the oxalate have been so prepared. These are so strongly acid in reaction that they act almost as solutions of the acids themselves, attacking metals with evolution of hydrogen, setting free carbon dioxide from carbonates and reddening litmus even after surprising quantities of free base have been added. In spite of this fact the sulphate, chloride and nitrate have been shown to be less hydrolyzed, as determined by the sugar inversion method, than the corresponding salts of aluminum and iron, although they attack metals and carbonates vigorously even after many times enough excess of their own hydroxide has been dissolved to throw back the hydrolysis. Other normal salts like the nitrate can be prepared only by crystallizing from concentrated acid, and even anhydrous acid yields only basic compounds in the case of the fatty acid series. Normal salts of more readily volatile acids, like the nitrite and carbonate, have not been produced at all or only, as in the case of the sulphite, from absolute alcohol or, as with the halides, by the direct combination of the elements themselves, with special precautions to eliminate water. Many normal salts, such as the borates, the chlorates, the bromates, the iodates, the chromates, the acetates, etc., have not been obtained, apparently because a concentration of acid sufficient to overcome the so-called hydrolytic solution tension of the salts can not be attained.

On the other hand, only one *acid* salt, the mono acid phosphate, has any real claim for recognition and, although the peculiar nature of phosphoric acid would seem to render the existence of this compound as probable as any of an acid nature, its existence rests solely upon the testimony of a single analysis of a non-crystalline precipitate obtained by Scheffer nearly fifty years ago.

The action of water upon the compounds of beryllium is highly modified, as is the case with some of the compounds of aluminum and magnesium, by the entrance of another metallic element into the molecule, and some of the double salts of this element are well defined and readily obtained in the presence of water, where the simple normal salt could not be produced at all or only with difficulty. This is notably true of the double carbonates, chlorids, iodides, nitrites and sulphites, although in general these salts have been studied but little, their discoverers being content with their identification and analysis. Among the double salts time permits of the mention only of the truly interesting double alkali tartrates and malates studied by Rosenheim and Itsig, and of the remarkable fact that the introduction of beryllium into their molecule enormously increases the molecular rotation of the compound, so that the diberyllium alkali tartrates have from five to six times the molecular rotation of the corresponding alkali bitartrates, and the diberyllium malates a molecular rotation more than twenty times as great as the alkali bimalates. This is particularly surprising since Walden has shown that beryllium has no undue influence upon the molecular rotation of the alpha brom camphor sulphonates.

Some of the most interesting problems of the chemistry of beryllium lie in the equilibrium relations that exist between the various acid radicals and quantities of the oxide in excess of that required to produce the normal salt, *i. e.,* in the so-called basic compounds. It is certainly true that many of these acids can hold in solution phenomenally large amounts of beryllium oxide or hydroxide, extending in the case of the acetate to six equivalents, while the chloride can hold four, the sulphate three and the oxalate nearly three equivalents. Even after these abnormal amounts have been dissolved the solutions still remain acid to litmus, and if heated in contact with basic beryllium carbonate the carbonate is attacked, the carbon dioxide set free and an equivalent amount of hydroxide thrown out of solution. These highly concentrated solutions, on being diluted with water, throw down precipitates of a highly basic nature, or on evaporation leave gummy masses, the basicity of which depends upon the amount of the dissolved hydroxide, while, physically, they differ but little. Both the precipitated bodies and the residues of evaporation are amorphous and glassy in structure and vary widely in composition. The basic precipitates on equilibrium, being reached, approach closely to the hydroxide in composition, but always contain a small amount of occluded acid or normal salt, which it is impossible to entirely remove by washing. These facts have given rise in literature to a large number of so-called basic compounds which have no existence as independent individuals, but are in reality the impure hydroxide, or, perhaps, more properly come under the domain of homogeneous phases of variable composition or solid solutions.

It is, indeed, difficult to understand how the solution of the normal sulphate, nitrate and chloride can dissolve several equivalents of their own hydroxide, attack metals and carbonates almost as vigorously as if they were the free acids themselves yielding these basic solutions, and still be less hydrolized than the corresponding salts of aluminum and iron as Leys and Brunner have both shown to be the case. It is, perhaps, equally difficult to demonstrate why the basic solutions so obtained should have less osmotic activity per equivalent of the acid present than the normal salts, should show no indication of a colloidal nature and should contain no complex anion, but this is, indeed, the fact. The most probable explanation would seem to be that we have here a case of simple solution of a substance (beryllium hydroxide) in a mixed solvent (water and normal salt) in one of which alone (water) it is insoluble. The whole action of these solutions is perfectly analogous to those cases where a substance, being dissolved in a mixed solvent, *raises* the freezing point whenever it is insoluble in that component which separates as the solid phase on cooling and which Miller has mathematically shown is a necessary sequence of the theorem of Gibbs.

In contradistinction to the basic solutions, solid or liquid, already mentioned, we have the truly phenomenal and actually basic compounds of beryllium, discovered in Urbain's laboratory by Lacombe, which are produced pure only in contact with anhydrous acid or acid so nearly anhydrous that the mass of the water present becomes negligible to produce hydrolysis. These very interesting, volatile and perfectly unique basic compounds are apparently confined to the fatty acid series and have the general formula $Be_4O(AC)_6$. Of these the formate, acetate, propionate, butyrate, isobutyrate and isovalerianate have been made and studied.

And now after this brief summary of the main characteristics of the chief classes of beryllium compounds I must, in closing, honor those who have been most prominent in developing our knowledge of this element by mentioning the names of Vauquelin, Wöhler, Bussy, Andejew, Weeren, Debray, Joy, Gibbs, Atterberg, Nilson and Pettersson, Humpidge, Hartly, Krüss and Moraht, Lebeau, Rosenheim and Itsig, and Urbain and Lacombe and paying my sincere respect to the many others who, from time to time, have struggled through the difficulties incident to the peculiar and decidedly vagarious action of this element to greater light and truth. And finally I feel that I should call the attention of this inorganic section most particularly to the fact that not only the future chemistry of beryllium, but of all the elements in our branch of the greatest of sciences, is becoming more and more dependent for its exactness and wealth of discovery upon the application of those laws which are now correlated under the head of physical chemistry. At the same time we must not be engulfed by this more recent branch of our science, but must always look to her as the handmaiden and not the mistress.

Charles L. Parsons
New Hampshire College

THE APPLICATION OF SCIENTIFIC METHOD TO EDUCATIONAL PROBLEMS[1]

Notwithstanding the fact that the greater part of my life has been spent in educational work, in teaching, in examining, in organization, and in the investigation of foreign systems of instruction, I have experienced considerable difficulty in selecting, from the large number of subjects that crowd upon me, a suitable one on which to address you as president of a section of the British Association devoted to educational science.

At the outset I am troubled by the title of the section over which I have the honor to preside. I can not refrain from asking myself the question, Is there an educational science, and if so, what is its scope and on what foundations does it rest? The object of the British Association is the advancement of science, and year by year new facts are recorded in different branches of inquiry, on which fresh conclusions can be based. The progress of past years, whether in chemistry, physics or biology, can be stated. Can the same be said, and in the same sense, of education? It is true that the area of educational influence is being constantly extended. Schools of every type and grade are multiplied, but is there any corresponding advance in our knowledge of the principles that should govern and determine our educational efforts, or which can justify us in describing such knowledge as science? If we take science to mean, as commonly understood, organized knowledge, and if we are to test the claim of any body of facts and principles to be regarded as science by the ability to predict, which the knowledge of those facts and principles confers, can we say that there exists an organized and orderly arrangement of educational truths, or that we can logically, by any causative sequence, connect training and character either in the individual or in the nation? Can we indicate, with any approach to certainty, the effects on either the one or the other of any particular scheme of education which may be provided? It is very doubtful whether we can say that educational science is yet sufficiently advanced to satisfy these tests.

But although education may not yet fulfil all the conditions which justify its claim to be regarded as a science, we are able to affirm that the methods of science, applicable to investigations in other branches of knowledge, are equally applicable to the elucidation of educational problems. To have reached this position is to have made some progress. For we now see that if we are ever to succeed in arriving at fixed principles for guidance in determining the many difficult and intricate questions which arise in connection with the provision of a national system of education, or the solution of educational problems, we must proceed by the same methods of logical inquiry as we should adopt in investigating any other subject matter.

In order to bring education within the range of subjects which should occupy a place in the work of this association, our first efforts should be directed towards obtaining a sufficient body of information from all available sources, past and present, to afford data for the comparisons on which our conclusions may be based. One

[1] Address of the president of the Educational Science Section of the British Association for the Advancement of Science, Leicester, 1907.

of the five articles of what is known as the Japanese Imperial Oath states, "Knowledge shall be sought for throughout the whole world, so that the welfare of the empire may be promoted"; and it may certainly be said that, as the welfare of our own empire is largely dependent on educational progress, a wide knowledge of matters connected with education is indispensable, if we are to make advances with any feeling of certainty that we are moving on the right lines.

There can be no doubt that of late years we have acquired a mass of valuable information on all sorts of educational questions. We are greatly indebted for much of our knowledge of what is being done in foreign countries to the reports of different commissions, and more particularly to those special reports issued from the board of education, first under the direction of my predecessor in this chair, Professor Sadler, and latterly of his successor at the board, Dr. Heath. But much of the information we have obtained is still awaiting the hand of the scientific worker to be properly coordinated and arranged. A careful collation of facts is indispensable if we are to deduce from them useful principles for our guidance, and unfortunately we in this country are too apt to rest content when we have provided the machinery for the acquisition of such facts without taking the necessary steps to compare, to coordinate, and to arrange them on some scientific principle for future use. Within the last week or two a bill has passed through several stages in parliament for requiring local authorities to undertake the medical inspection of school children, but, unless the medical inspectors throughout the country conduct their investigations on certain well-considered lines laid down for them by some central authority, we shall fail to obtain the necessary data to enable us to associate educational and physical conditions with a view to the improvement of the training given in our schools.[2] On the other hand, although I personally am sceptical as to the results, we have reason to believe that the inquiry recently undertaken into the methods adopted here and elsewhere for securing ethical as distinct from specifically religious training will be so conducted as to give us not only facts, but the means of inferring from those facts certain trustworthy conclusions.

The consideration of education as a subject capable of scientific investigation is complicated by the fact that it necessarily involves a relation—the relation of the child or adult to his surroundings. It can not be adequately considered apart from that relation. We may make a study of the conditions of the physical, intellectual, and ethical development of the child, but the knowledge so obtained is only useful to the educator when considered in connection with his environment and future needs, and the means to be adopted to enable him, as he grows in physical, intellectual and moral strength, to obtain a mastery over the things external to him. Education must be so directed as to prove the proposition that "knowledge is power." It can only be scientifically treated when so considered. Education is imperfectly described when regarded as the means of drawing out and strengthening a child's faculties. It is more than this. Any practical definition takes into consideration the social and economic conditions in which the child is being trained, and the means of developing his faculties with a view to the attainment of certain ends.

[2] Since this was written the president of the Board of Education has stated in the House of Commons that "it was the intention of the board, if the bill now before parliament passed, to establish a medical bureau, which would guide and advise the local authorities as to the nature of the work they would have to do under the act."

It is in Germany that this fact has received the highest recognition and the widest application, and for this reason we have been accustomed to look to that country for guidance in the organization of our schools. We have looked to Germany because we perceived that some relation had been there established between the teaching given to the people and their industrial and social needs; and further, that their success in commerce, in military and other pursuits was largely due to the training provided in their schools. Unmindful of the fact that education is a relation, and that consequently the same system of education is not equally applicable to different conditions, there were many in this country who were only too ready to recommend the adoption of German methods in our own schools. Experience soon showed, however, that what may have been good for Germany did not apply to England, and that, in educational matters certainly, we do well to follow Emerson, who when addressing his fellow citizens, declared: "We will walk on our own feet; we will work with our own hands, and we will speak our own minds." Still, the example of Germany and the detailed information which we have obtained as to her school organization and methods of instruction have been serviceable to us.

Whilst all information on educational subjects is valuable, I am disposed to think that in our efforts to construct an educational science we may gain more by inquiring what has been effected in some of the newer countries. Wherever educational problems have been carefully considered and schemes have been introduced with the express intention and design of training citizens for the service of the state and of increasing knowledge with a view to such service, those schemes may be studied with advantage. Thus we may learn much from what is now being done in our colonies. Their efforts are more in the nature of experiments. Our colonies have been wise enough not to imitate too closely our own or any foreign system. They have started afresh, free from prejudice and traditions, and it is for this reason that I look forward with interest to the closer connection in educational matters of the colonies with the mother country, and I believe that we shall gain much knowledge and valuable experience from the discussions of the Federal Conference which has recently been held in London, and which, I understand, is to be repeated a few years hence.

But valuable as are the facts, properly collated and systematically arranged, which a knowledge of British and foreign methods may afford us in dealing scientifically with any educational problem, it is essential that we should be able to test and to supplement the conclusions based on such knowledge, whenever it is possible, by direct experiments, applicable to the matter under investigation. We have not yet recognized the extent to which experiments in education, as in other branches of knowledge, may help in enabling us to build up an educational science. Some years since there was established in Brussels an *Ecole modèle* in which educational experiments were tried. I visited the school in the year 1880, and I could easily point to many improvements in primary education which found their way from that school through the schools of Belgium and France to our own country, and, indeed, to other parts of the world. From a special report on schools in the north of Europe, recently published by the board of education, we learn that in Sweden the value of such experiments is fully recognized. We are told that in that country "it was early felt that the uniformity in state schools was of so strict a kind that some special provision should be made for carrying out educational experiments," and experiments in many directions have been made, mainly in private schools, which receive, however, special subventions from the state. We gather from the same report that the state regards the money as well earned "if the school occasionally originates new methods from which the schools can derive profit." I venture to think that experimental schools might with advantage be organized under the direction of some of our larger local authorities. The children would certainly not suffer by being made the subjects of such experiments. The intelligent teaching which they would receive—for it is only the most capable teachers who should be trusted with such experiments—would more than compensate for any diminution in the amount of knowledge which the children might acquire, and indeed such experimental schools might be conducted under conditions which would ensure sound instruction. Many improved methods of teaching are constantly advocated, but fail to be adopted because there is no opportunity of giving them a fair trial. As a general rule it is only by the effort of private individuals or associations that changes in system are effected, and teachers are enabled to escape from the old grooves on to new lines of educational thought and practise. It is not difficult to refer to many successful experiments. The general introduction into our schools of manual training was the direct result of experiments carefully arranged and conducted by a joint committee of the city guilds and the late London School Board. Experiments in the methods of teaching physical science, chemistry and geometry have been tried, with results that have led to changes which have revolutionized the teaching of those subjects. The age at which the study of Latin should be commenced with a view to the general education of the scholar has been the subject of frequent trial. I would like to see such experiments more systematically organized, and I am quite certain that the curriculum of our rural and of our urban schools would soon undergo very considerable changes, if the suggestions of competent authorities could receive a fair trial under conditions that would leave no manner of doubt as to the character of the results.

It would seem, therefore, that if our knowledge of the facts and principles of education is not yet sufficiently organized to enable us to determine *a priori* the effect on individual or national character of any suggested changes, education is a subject that may be studied and improved by the application to it of scientific method, by accurate observation of what is going on around us, and by experiments thoughtfully conducted. This is the justification of the inclusion of the subject among those that occupy the attention of a separate section of this association. Our aim here should be to apply to educational problems the well known canons of scientific inquiry; and, seeing that the conditions under which alone any investigation can be conducted are in themselves both numerous and complicated, it is essential that we should endeavor to liberate, as far as possible, the discussion of the subject from all political considerations. Such investigations are necessarily difficult. We have to determine both statically and dynamically the physical, mental and moral condition of the child in relation to his activities and surroundings, and we have further to discover how he is influenced by them, how he can affect them, and the character of the training which will best enable him to utilize his experiences, and to add something to the knowledge of to-day for future service.

Notwithstanding the undoubted progress

which we have made, it can not be denied that in this country there still exists a large amount of educational unrest, of dissatisfaction with the results of our efforts during the last thirty years. This is partly due to the fact that there is much loose thinking and uninformed expression of opinion on educational questions. No one knows so little as not to believe that his own opinion is worth as much as another's on matters relating to the education of the people. In this way statements, the value of which has not been tested, pass current as ascertained knowledge, and very often ill-considered legislation follows. In this country, too, the difficulty of breaking away from ancient modes of thought is a great drawback to educational progress. Suggestions for moderate changes, which have been most carefully considered, are deferred and decried if they depart, to any great extent, from established custom, and the objection to change very often rests on no historical foundation. Occasionally, too, the change proposed is itself only a reversion to a previous practise, which was rudely broken by thoughtless and unscientific reformers. The opposition which was so long raised to the establishment of local universities was largely due to want of knowledge on the subject; and certainly the creation, some seventy years ago, of a teaching university in London was actually hindered through a mere prejudice, which broader views as to the real purposes of university teaching and fuller information on the course of university development would have removed.

There never was a time perhaps when it was more necessary than now that education should be regarded dispassionately, apart from political bias, as a matter of vital interest to the people as a whole. Education nowadays is a question which affects not only the life of a few privileged, selected persons, but of the entire body of citizens. The progress that has been made during the last few years in nationalizing our education has been very rapid. It may be that it has been too rapid, that sufficient thought has not been given to the altered social and industrial conditions which have to be considered. We have witnessed a strong desire and a successful effort to multiply secondary and technical schools and to open more widely the portals of our universities. The object of the desire is good in itself. As the people grow in knowledge the demand for higher education will increase; but the serious question to be considered is whether the kind of education which was supplied in schools, founded centuries ago to meet requirements very different from our own, is equally well adapted to the conditions which have arisen in a state of society having other needs and new ideals. Very rightly our students in training for the profession of teachers are expected to study the writings of Locke, Rousseau, Milton, Montaigne and others; but many are apt to overlook the fact that these writers had in view a different kind of education from that in which modern teachers are engaged, and that their suggestions, excellent as many of them are, were mainly applicable to the instruction to be given by a tutor to his private pupil, and had little or no reference to the teaching of the children of the people in schools expressly organized for the education of the many. Only recently have we come to realize that a democratic system of education, a system intended to provide an intellectual and moral training for all citizens of the state, and so organized that, apart from any consideration of social position or pecuniary means, it affords facilities for the full development of capacity and skill wherever they may occur, must be essentially different in its aims and methods from that under which many of us now living have been trained. It has also been brought home to us that the marvelous changes in our environment, in the conditions under which we live and work, whether in the field, the factory or the office, have necessitated corresponding changes in the education to be provided as a preparation for the several different pursuits in which the people generally are occupied. Yet, notwithstanding these great forces which have broken in upon and disturbed our former ideals, forces the strength and far-reaching effects of which we readily admit, we still hesitate to face the newly arisen circumstances and to adapt our educational work to its vastly extended area of operation and to the altered conditions and requirements of modern life.

When I say we hesitate to face the existing circumstances I do not wish to be misunderstood. As a fact changes are continually being discussed, and are from time to time introduced into our schools. But such modifications of our existing methods are generally isolated and detached, and have little reference to the more comprehensive measures of reform which are now needed to bring our teaching into closer relation with the changed conditions of existence consequent on the alterations that have taken place in our social life and surroundings.

Four years ago, it will be remembered, a committee of this section was appointed to consider and to report upon the "Courses of Experimental, Observational and Practical Studies most Suitable for Elementary Schools." That committee, of which I had the honor to be chairman, presented a report to this section at the meeting of the association held last year at York. The general conclusion at which they arrived was that "the intellectual and moral training, and indeed to some extent the physical training, of boys and girls between the ages of seven and fourteen would be greatly improved if active and constructive work on the part of the children were largely substituted for ordinary class teaching, and if much of the present instruction were made to arise incidentally out of, and to be centered around, such work." It is too early, perhaps, to expect that the suggestions made in that report should have borne fruit, but I refer to it because it illustrates the difference between the spasmodic reforms which from time to time are adopted, under pressure from bodies of well-meaning representatives of special interests, and the well-considered changes recommended by a committee of men and women of educational experience who have carefully tested the conclusions at which they have arrived.

There can be no doubt that, as regards our elementary education, there is very general dissatisfaction with its results, since it was first nationalized thirty-seven years ago. Our merchants and manufacturers and employers of labor, our teachers in secondary and technical schools all join in the chorus of complaint. They tell us that the children have gained very little useful knowledge and still less power of applying it. There is enough in this general expression of discontent to give us pause and to make us seek for a rational explanation of our comparative failure. The inadequacy of the results attained to the money and effort that have been expended is in no way due to any want of zeal or ability on the part of the teachers, or of energy on the part of school boards or local authorities. They have all discharged the duties which were imposed upon them. It is due rather to the fact that the problem has been imperfectly understood, that our controlling authorities have had only a vague and indistinct idea of the aim and end of the important work which they were charged to administer. If we look back upon the history of elementary education in this country since 1870, we can not fail to realize how much its progress has been retarded by errors of administration due very largely to the want of scientific method in its direction. It is painful to reflect, for instance, on the waste of time and effort, and on the false impressions produced as to the real aim and end of education, owing to the system of payment on results, which dominated for so many years a large part of our educational system. We must remember that it is only within the last few decades that education has been brought within reach of all classes of the population. Previously it was for the few; for those who could pay high fees; for those who were training for professional life, whether for the church, the army, the navy, law or medicine, or for the higher duties of citizen life. This had been the case for centuries, not only in this country but in nearly all parts of the civilized world. If we read the history of education in ancient Greece or Rome, or mediæval Europe, we shall see that popular education, as now understood, was unknown. All that was written about education applied to the few who got it, and not to the great mass of the people engaged in pursuits altogether apart from those in which the privileged classes were employed. Trade and manual work were despised, and were considered degrading and unworthy of the dignity of a gentleman. I need scarcely say that these social ideas are no longer held. The fabric of society is changed, and we have to ask ourselves whether the methods of education have been similarly changed, whether they have been wisely and carefully adapted to the new order of things. What is it that has really happened? Is it not true that we have annexed the methods and subjects of teaching which had been employed during many centuries in the training of the few and applied them to the education of the people as a whole—to those who are engaged in the very callings which were more or less contemned? Surely it is so, and the results are all too manifest. We have applied the principles and methods of the secondary education of the middle ages to our new wants, to the training of the people for other duties than those to which such education was considered applicable, and it is only within the last few years that we have begun to see the error of our ways. In the report of your committee, to which I have referred, it is pointed out that the problem of primary education has been complicated by the introduction of the methods which for many years prevailed in secondary schools, and at a meeting of the National Education Association, held only a few weeks since, it was truly said: "In this country secondary education preceded primary by several centuries, and so the nation now finds itself with the aristocratic cart attempting to draw the democratic horse."

Let it not be supposed that in the days not so far distant, yet stretching back into the remote past, the people as a whole were uneducated. This was not so. But we have to widen the meaning of education to include the special training which the people then received—an education that was acquired without even the use of books. It can not for one moment be said that the artisans, the mechanics, the farm hands, male and female, were wholly uneducated in those far-off days. In one sense possibly they were. Very few of them could read or write. But from earliest childhood they had received a kind of training the want of which their descendants have sadly felt in the cloistered seclusion of the modern elementary school. They were brought face to face with nature. They learned the practical lessons of experience; and as they grew up their trade apprenticeship was an education which we have been trying vainly to reproduce. They gained some knowledge of the arts and sciences, as then understood, underlying their work. Their contact with their surroundings made them thoughtful and resourceful, for nature is the most exacting and merciless of teachers. The difficulties they had to overcome compelled them to think, and of all occupations none is more difficult. They were constantly putting forth energy, adapting means to ends, and engaging in practical research. In the field, in the workshop, and in their own homes boys and girls acquired knowledge by personal experience. Their outlook was broad. They learned by doing. It is true that nearly all their occupations were manual, but Emerson has told us, "Manual training is the study of the external world."

Compare for a moment this training with that provided in a public elementary school, and you can not be surprised to find that our artificial teaching has failed in its results, that our young people have gained very little practical knowledge, and that what they have gained they are unable to apply; that they lack initiative and too often the ability to use books for their own guidance, or the desire to read for self-improvement. We seem to have erred in neglecting to utilize practical pursuits as the basis of education, and in failing to build upon them and to evolve from them the mental discipline and knowledge that would have proved valuable to the child in any subsequent occupation or as a basis for future attainments. We have made the mistake of arresting, by means of an artificial literary training, the spontaneous development of activity, which begins in earliest infancy and continues to strengthen as the child is brought into ever closer contact with his natural surroundings. We have provided an education for our boys which might have been suitable for clerks; and, what is worse, we have gone some way, although we have happily cried a halt, to make our girls into "ladies," and we have run some risk of failing to produce women.

If we are to correct the errors into which we have drifted, if we are to avert the consequences that must overtake us through having equipped our children for their life-struggle with implements unfitted for their use, we must consider afresh the fundamental ideas on which a system of elementary education should be based. Instead of excluding the child from contact with the outer world we must bring him into close relationship with his surroundings. It was given to man to have dominion over all other created things, but he must first know them. It is in early years that such knowledge is most rapidly acquired, and it is in gaining it that the child's intellectual activities are most surely quickened.

It is unfortunate that we failed to realize this great function of elementary education when we first essayed to construct for ourselves a national system. The three R's, and much more than that, are essential and incidental parts of elementary education. But what is needed is a *Leitmotif*—a fundamental idea underlying all our efforts and dominating all our practise, and I venture to think that that idea is found in basing our primary education on practical pursuits, on the knowledge gained from actual things, whether in the field, the workshop or the home.

Instead of fetching our ideas as to the training to be given in the people's schools from that provided in our old grammar schools, we should look to the occupations in which the great mass of the population of all countries are necessarily engaged, and endeavor to construct thereon a system with all such additions and improvements as may be needed to adapt it to the varied requirements of modern life. By this process—one of simple evolution adjusted to everyday needs—a national system of education might be built up fitted for the nation as a whole—a system founded on ideas very different from those which, through many centuries, have governed the teaching in our schools. In the practical pursuits connected with the field, the workshop and the home, and in the elementary teaching of science and letters incidental thereto, we might lay the foundation of a rational system of primary education.

These three objects—the field, the workshop and the home—should be the pivots on which the scheme of instruction should be fixed, the central thoughts determining the character of the teaching to be given in rural and urban schools for boys and girls. It was Herbart who insisted on the importance of creating a sort of center around which school studies should be grouped with a view to giving unity and interest to the subjects of instruction. I have elsewhere shown how a complete system of primary education may be evolved from the practical lessons to be learned in connection with out-door pursuits, with workshop exercises and with the domestic arts, and how, by means of such lessons, the child's interest may be excited and maintained in the ordinary subjects of school instruction, in English, arithmetic, elementary science and drawing. In the proposals I am now advocating I am not suggesting any narrow or restricted curriculum. On the contrary, I believe that, by widening the child's outlook, by closely associating school work with familiar objects, you will accelerate his mental development and quicken his power of acquiring knowledge. I would strongly urge, however, that the child should receive less formal teaching, that opportunities for self-instruction, through out-door pursuits, or manual exercises, or the free use of books, should be increased, so that as far as possible the teacher should keep in view the process by which in infancy and in early life the child's intelligence is so rapidly and marvelously stimulated. Already we have discovered that our unscientific attitude towards primary education has caused us to overlook the essential difference between the requirements of country and of town life, and the training proper to boys and girls. Our mechanical methods of instruction, as laid down in codes, make for uniformity rather than diversity, and we are only now endeavoring, by piecemeal changes, to bring our teaching somewhat more closely into relation with existing needs. But the inherent defect of our system is that we have started at the wrong end, and, instead of evolving our teaching from the things with which the child is already familiar, and in which he is likely to find his life's work, we have taken him away from those surroundings and placed him in strange and artificial conditions, in which his education seems to have no necessary connection with the realities of life.

The problem of primary education is to teach by practical methods the elements of letters and of science, the art of accurate expression, the ability to think and to control the will; and the ordinary school lessons should be such as lead to the clear apprehension of the processes that bring the child into intimate relation with the world in which he moves. During the last few years the importance of such teaching has dimly dawned upon our educational authorities, but, instead of being regarded as essential, it has been treated as a sort of *extra* to be added to a literary curriculum, already overcrowded. What is known as manual training is to some extent encouraged in our schools, but it forms no part of the child's continuous education. It is still hampered with conditions inconsistent with its proper place in the curriculum, and is uncoordinated with other subjects of instruction. Moreover no connecting link has yet been forged between the teaching of the kindergarten and workshop practise in the school. We speak of lessons in manual training as something apart from the school instruction, as something outside the school course, on the teaching of which special grants are paid. Twenty or thirty years ago people used to talk about "teaching technical education," and from this unscientific way of treating the close connection that should exist between hand-work and brain-work our authorities have not yet freed themselves.

It is true we have long since passed that stage when it was thought that the object of instruction in the use of tools was to make carpenters or joiners; but, judging from a report recently issued by the board of education, it would seem that it is still thought that the object of cookery lessons to children of twelve to fourteen years of age is the training of professional cooks. Until the board's inspectors can be brought to realize that the aim and purpose of practical instruction in primary schools, whether in cookery or in other subjects, is to train the intelligence through familiar occupations, to show how scientific method may be usefully applied in ordinary pursuits, and how valuable manipulative skill may thus be incidentally acquired, it does not seem to me that they themselves have learned the most elementary principles of their own profession. An anonymous teacher, writing some weeks since in the *Morning Post,* said:

> The cookery class can be made an invaluable mental and moral training ground for the pupils, the most stimulating part of primary education. It teaches unforgettable lessons of cleanliness and order, of quickness and deftness of movements. The use of the weights and scales demands accuracy and carefulness, and the raw materials punish slovenliness or want of attention with a thoroughness which the most severe of schoolmasters might hesitate to use. Practical lessons in chemistry should form an important feature of each class. . . . The action of heat and moisture on grains of rice provides an interesting lesson on the bursting of starch cells, and the children's imagination is awakened by watching the hard isolated atoms floating in milk change slowly to the creamy softness of a properly made rice pudding. The miraculous change in the oily white of egg when it is beaten into a mountain of snowy whiteness gives them interest in the action of air and its use in cookery.

Can the teaching of grammar or the analysis of sentences provide lessons of equal value in quickening the intelligence of young children?

I must add one word before passing from this suggestive illustration of the value of scientific method in the treatment of educational questions. We live in a democratic age, and any proposed reform in the teaching of our primary schools must be tested by the requirement that the revised curriculum shall be such as will provide not only the most suitable preparatory training for the occupations in which four fifths of the children will be subsequently engaged, but will, at the same time, enable them or some of them to pass without any breach of continuity from the primary to the secondary school. There must be no class distinctions separating the public elementary from the state-aided secondary school. The reform I have suggested is unaffected by such criticism. The practical training I have advocated, whether founded on object lessons furnished by the field, the workshop or the home, would prove the most suitable for developing the child's intelligence and aptitudes and for enabling him to derive the utmost advantage from attendance at any one of the different types of secondary schools best fitted for his ascertained abilities and knowledge. The bent of the child's intellect would be fully determined before the age when the earliest specialization would be desirable. No scheme of instruction for primary schools can be regarded as satisfactory, which is not so arranged that, whilst providing the most suitable teaching for children who perforce must enter some wage-earning pursuit at the age of fourteen, or at the close of their elementary school course, shall at the same time afford a sound and satisfactory basis on which secondary and higher education may be built. And I hold the opinion, in which I am sure all teachers will concur, that a scheme of primary education pervaded by the spirit of the kindergarten which, by practical exercises, encourages observation and develops the reasoning faculties, and creates in the pupil an understanding of the use of books, would form a fitting foundation for either a literary or a scientific training in a secondary school.

I have purposely chosen to illustrate the main subject of this address by reference to defects in our primary instruction, because the success of our entire system of education will be found, year by year, to depend more and more upon the results of the training given in our public elementary schools. We have scarcely yet begun to realize the social and political effects of the momentous changes in our national life, consequent on the first steps which were taken less than forty years ago to provide full facilities under state control and local management for the education of the people.

At present all sorts of ideas are afloat which have to be carefully and scientifically considered. The working classes have to be further and somewhat differently educated, in order that they may better understand their own wants and how they are to be satisfied. We have placed vast powers in the hands of local bodies, popularly elected, powers not only of administration, for which they are well adapted, but powers of determining to a very great extent, by the free use of the rates, the kind of instruction to be given in our schools, and the qualifications of the teachers to impart it. Moreover, these local bodies have shown, in many instances, a distrust of expert advice and a desire to act independently as elected representatives of the people, which can not fail for some time at least to lead to waste of effort and of means. It was said years ago, when the center of our political forces received a marked displacement, that we must educate our masters. Our masters now, both in politics and education, are the people, and it is only, I believe, by improving their education that we can enable them to undertand the essential difficulties of the problems which they are expected to solve, and can induce them to rely, to a greater extent than they do at present, on the results of the application to such problems of scientific method, founded on the fullest information obtainable from historical and contemporary sources.

I might have illustrated my subject by reference to the acknowledged chaotic condition of our secondary education. In the report of the board of education published in December last we read:

> While the development of secondary education is the most important question of the present day, and is the pivot of the whole education as it affects the efficiency, intelligence and well-being of the nation, yet its present position may be described as "chaos."

The "chaos" by which the present position of our secondary education is here described is intimately connected with the questions relating to primary education, which I have been engaged in considering. If we construct a system of primary education which serves equally for children of all classes, apart from social conditions—a system educationally sound, both as a preparation for immediate wage-earning pursuits and for more advanced and somewhat more specialized training in a secondary school, many of the difficulties which confront the board of education, and which are largely of an administrative order, would disappear. The difficulties are in part dependent on the question of curriculum, to the discussion of which a day will be devoted during the present meeting.

University education in this country, and indeed in other countries, has also suffered much from the hands of the unscientific reformer. In Germany, owing to many causes, the higher education has made considerable advances during the past century; but, even in that country, a more critical study of the development of university education and a truer recognition of the twofold function of a university might have prevented the early separation in distinct institutions and under separate regulations of the higher technical from university instruction. Only within recent years has France retraced her steps and returned to the university ideal of seven centuries ago. But perhaps the climax of unscientific thinking was reached in the scheme, happily abandoned, of founding a new university in Dublin on the lines suggested by Mr. Bryce in his now famous speech of January last.

Our conception of the functions of a university has undergone many violent changes. Between the ideal of the University of London prior to its reorganization and that of a medieval university, in which students were never plucked, obtaining their degrees whether they did their work well or badly, there have been many variations; but I think it may be said that, recently at any rate, we have come to realize the fact that our universities, to fulfil their great purpose, must be schools for the preparation of students for the discharge of the higher duties of citizenship and professional life, and institutions for the prosecution of research, with a view to the promotion of learning in all its branches, and that examinations for degrees, necessary, as they undoubtedly are, as tests of the extent of a student's acquired knowledge, must be regarded as subordinate to these two great functions.

I will not detain you longer. I have endeavored to show under what limitations education may lay claim to be included among the sciences, and how a knowledge of the history of education and the application of the methods of scientific inquiry may help in enabling us to solve many of the intricate and complicated questions which are involved in the establishment on a firm foundation of a national system of education. I have taken my illustrations mainly from the reform of elementary, or, as I prefer to call it, primary education, and I have sought to indicate some of the errors into which we may fall when we fail to apply to the consideration of the problem the same principles of inductive inquiry as are employed in all investigations for the attainment of truth.

I believe that this section of the British Association has the opportunity of rendering a great service to the state. Numerous educational societies exist, in which questions of importance are discussed, and all, perhaps, do useful work. But none is so detached from separate and special interests; none stands so essentially apart from all political considerations; none is so competent to discuss educational problems from the purely scientific standpoint as are the members of this association. If, in the remarks I have offered, somewhat hastily prepared under the pressure of many different kinds of work, I have contributed anything to the solution of a problem, the difficulty and national importance of which all will admit, I shall feel that I have not been altogether unworthy of the honor of occupying this chair.

PHILIP MAGNUS

SCIENTIFIC BOOKS

Report on the Diatoms of the Albatross Voyages in the Pacific Ocean, 1888–1904. By ALBERT MANN. Assisted in the bibliography and citations by P. L. RICKER. Contributions from the United States National Herbarium, Vol. X., Part 5. Washington, Government Printing Office. 1907.

According to the author, the object of this report is, first, to contribute to the systematic study of the diatoms, and, second, to call attention to the value of further investigations in this field for throwing light upon certain meteorological and geological problems connected with marine investigations. There also has been prepared a set of carefully identified specimens of all the species enumerated, including types of all new species, which collection has been deposited in the United States National Museum. On account of the inadequate methods used in making the gatherings from the *Albatross*, the number of species listed is not nearly so great as might be expected. In fact, considering the large number of soundings and dredgings made and the years over which the work extends, the results are disappointing. It seems unfortunate that the amount of energy and time necessary to properly examine gatherings of this kind should have to be wasted upon barren samples, when the adoption of other methods would have undoubtedly resulted in rich hauls of diatoms. Critical notes upon some three hundred species, thirty-seven of which are new, are given and a sufficiently full discussion of the fifty odd genera concerned is included. The account of the species discussed is considerably more than a mere list, and is of such worth that one regrets all the more the limitations which have been put upon the work. A most careful comparison of the views of various authorities upon each species has been made and should do much towards giving a really clear conception of the forms discussed. When one considers the inaccessibility of a large amount of the literature upon the diatoms, it seems probable that this part of the report will be one of the most helpful features.

While it may not have been practicable under the circumstances to prepare an absolutely exhaustive list of the synonymy, there seems to be no reason for the omission of names elsewhere cited, even though "the horde of synonyms would be so great as to become most misleading unless accompanied by extensive explanations." Instead of such a discussion "being quite foreign to the purpose of this report" it would seem to be the very place in which to set forth as fully as might be necessary, the reasons for retaining or rejecting names. Certainly the present chaotic conditions of the nomenclature of the diatoms can not be cleared up so long as this tedious but necessary aspect of the subject is disregarded.

The number of stations from which diatoms were collected was altogether too meager to warrant any generalizations regarding either the origin of the bottom from which they came, or the course of the ocean currents which carried them. However, the importance of planning future work with such an end in view is very properly pointed out and some good examples are given of specific knowledge of this character being obtained from a study of the diatoms of a given region.

It is a satisfaction to know that all of the species reported upon have been permanently mounted in such a way as to make them readily accessible to those who may have occasion to refer to them. Not only is there a series of group slides containing specimens of all the forms gathered in a specific locality, but each species has been mounted separately, and the position definitely indicated so that it may be instantly found under the microscope. The value of such a set of slides can only be appreciated by those who have had to search for a particular species in the heterogeneous mass of diatoms and other organisms with which it is usually mounted.

It appears that Mr. Ricker has not only assisted in the bibliography and citations to diatom literature, but has passed upon the many taxonomic problems involved. The painstaking manner in which this has been done adds greatly to the value of the report.

The new species, together with a few others, are well figured by some very good microphotographs.

GEORGE T. MOORE

Leitfaden für den biologischen Unterricht. Von K. KRAEPELIN, Direktor des Natürhistorischen Museums in Hamburg. Leipzig und Berlin, B. G. Teubner. 1907.

This little manual forms one of a series devoted to the extension of biological interest and the improvement of teaching in the German schools. Others of the series are devoted explicitly to the teaching of botany and zoology. Of similar import are still others devoted to nature study, for example, "Naturstudien in Wald und Feld"; and "Naturstudien in der Sommerfrische." All of which may be taken as indicative of the broadening and liberalizing movements in education the world over.

This particular book, as its name implies, is devoted to the distinctively biological aspects of nature study, but with reference to the higher schools, as indicated in the full title, "Leitfaden für den Biologischen unterricht in den Oberen Klassen der Höheren Schulen."

The book comprises something over three hundred pages of well-printed and amply and beautifully illustrated matter. One finds, as the author himself admits, some question as to just where to draw the line of a happy medium between the "Scylla" of too much, and the "Charybdis" of too little; and to the reviewer it seems as if the former rock had been barely missed. At any rate, for American high schools we should regard of doubtful educational value the introduction of the intricate problems of prehistoric man and archeology. It must be said, however, that these are touched upon in the present book in only a very elementary manner.

Something of the scope of the book may be gathered from the following partial glimpse of the table of contents.

First Section. The dependence of life on the influence of the surrounding world. Of the factors may be mentioned: (1) The *temperature* limits of plant life, and in a later section the same in reference to animal life. (2) Influence of light on plant life. (3) Surrounding media, soil, atmosphere, water, etc.

A section is devoted to the relations of plants to each other, and also to animals, or what we usually understand as ecology. The author employs this and several other terms in designating phases of these relations, going into what seems to the reviewer unnecessary details for an elementary treatise.

The second section is devoted to the "structure and vital activities of the organic world." Under this head are presented some of the more profound and difficult problems of his subject, yet on the whole the treatment is clear and stimulating, though rather difficult for pupils of the age of those concerned.

The third section deals with man as an object of scientific consideration. Brief reference has already been made to phases of this section. In general it deals with the structure and functions of the human body, problems of nutrition, metabolism, etc.

On the whole the book is worthy of cordial approval. It is well printed on good paper, and is marred by very few typographical errors.

CHAS. W. HARGITT

SYRACUSE UNIVERSITY

Elements of Physiology. By THEODORE HOUGH and WILLIAM T. SEDGWICK. Boston, Ginn & Co.

The present book is a reprint of the physiological portion of our larger work entitled "The Human Mechanism," together with chapter XX., . . . which has been added to meet the requirements of law in some states with regard to the teaching of physiology. (From the preface.)

It fell to the lot of the present writer to review the "larger work" referred to above in the issue of SCIENCE for April 19 of the current year. And since the present book is, as stated above, a reprint of the former, it will only be necessary to briefly refer to a very few points not specially noted in the former.

As the title suggests, the book comprises the *elements* of *physiology,* and this it really is. Few text-books now available for use in the schools under the title of physiology are such in fact. Most are more or less cumbered with anatomy, hygiene, etc., and the physiology is thus confused with other matter. Without here considering the relative merits or demerits of these points, it is worth while emphasizing the fact that in this we have a book of essentially pure physiology, based on adequate and well-established facts. In its size and the scope of its matter it comes well within the time usually given to the subject in the average school. In its mechanical features the book is worthy of all praise. C. W. H.

Practical Physiological Chemistry. By Philip B. Hawk, M.S., Ph.D. 416 pages, illustrated. Philadelphia, P. Blakiston's Son & Co. 1907. Price, $4.00.

The appearance of another work on physiological chemistry is a further evidence of the rapid growth of this department of science in our American universities, and a proof, also, that something more than the old, so-called "medical chemistry" is beginning to find favor in our schools of medicine. This book by Dr. Hawk is written for students of medicine and general science, who have already secured a good groundwork in the more fundamental branches of chemistry, and presents a very good outline of those facts of physiological chemistry which may be clearly demonstrated in a laboratory course. While the title might be taken to indicate that the work is a laboratory manual only this is by no means the case, as many of the discussions are full enough to constitute a general treatise on the subject.

In an experimental way the book presents not only the usual general tests and qualitative reactions, but also a very considerable number of quantitative methods applicable in physiological-chemical investigations. Most of these are clearly described, and are full enough for working conditions, but in a few cases the value to the student would be greatly increased by the addition of fuller explanations. For example, in describing the determination of total and inorganic sulphates in the urine practically nothing is said concerning the reasons for the several steps, and at first sight the student is very likely to fail to recognize the real distinction between the two processes. A number of similar cases have been noticed.

The mechanical work on the book is most excellent. It is printed from clear type on good paper, and is bound in such a manner that it remains flat when opened on a table, a good quality not very often found in books intended for the laboratory. J. H. Long

Elements of Physical Chemistry. By Harry C. Jones. Third Edition. 8vo. Pp. 650. New York, The Macmillan Company. 1907.

This text-book is so well known that the appearance of a new edition calls for only a brief statement in regard to the changes that have been made in it.

The revised edition follows very closely the plan of the first, but it has been somewhat enlarged by the addition of matter pertaining to recent advances in the science. The chief additions deal with Thomson's work on electrons, Morse's work on osmotic pressure, recent work on radioactivity, and there are about twenty pages devoted to the author's hydrate theory and his work on conductivity in mixed solutions. There are many minor changes, and some of the rather complicated cases of equilibrium discussed in the first edition have been wisely omitted. Many references to the original literature have been added, which make the book a valuable one for reference.

H. W. Foote

Outlines of Psychology. By Wilhelm Wundt. Translated by C. H. Judd, Ph.D. Third English from the seventh revised German edition. Leipzig, Wm. Englemann. Pp. xxiii + 392.

The third edition of the English translation of Wundt's "Outlines" brings the work to the English-speaking student as it appears in the seventh and doubtless the definitive German edition. For those who have not been able to keep in touch with the rapid succession of German editions, it may be interesting to note that both in form and matter the new edition holds closely to the first. As compared with the second English edition, the present shows only two additions to the table of contents; and one of these merely emphasizes a division of the text already in existence. Thus those familiar with the earlier editions will find the relation between chapters, paragraphs and their subdivisions unchanged. Moreover, in the glossary of technical terms there is no change save that occasioned by the changes in German orthography and the substitution of *K* for the initial *C* in the words "Komplication" and "Kontrast."

The most conspicuous change in plan between the second and the third English editions is the introduction of some twenty odd figures and diagrams. They must be distinctly helpful to the student. As one might expect, they are wonderfully simple and effective. To the present reviewer at least they seem to lose something of their force by retaining the German words that occur within the figure. The translation below seems hardly to balance the possibility of initial discouragement by the unfamiliar designations.

In the text itself, in spite of the general similarity of arrangement and terminology, there are many minor changes and some marked ones. Most of these changes are simple revisions of the English phrase, or changes occasioned by some modification of the German phrase. Many of them consist of additional matter relating to the new cuts and figures. Some few of them, as for example the modification of the statement of the correlation between feeling and pulse (pp. 96–97), are concessions to criticism or indicate minor changes of attitude on the part of the author. Such changes, however, are rare.

English-speaking students are fortunate in possessing such a scholarly translation of the great psychologist's answer to the average student's needs.

RAYMOND DODGE

WESLEYAN UNIVERSITY

SOCIETIES AND ACADEMIES

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION

THE first regular meeting of the session of 1907–08 was held at the Chemists' Club, 108 West 55th Street, on October 11.

Dr. Hugo Schweitzer read an obituary of the late Durand Woodman, who has always taken an active interest in the work of the section. He was secretary and treasurer for several years and was a member of the executive committee when he died.

Mr. C. B. Zabriskie was elected to succeed Dr. Woodman on the executive committee.

The following papers were read:

Report on Toronto Meeting: M. T. BOGERT.

Some Transmutations of the Past Century: CHAS. BASKERVILLE.

Ignition Temperature of Gaseous Mixtures (Second Paper): K. G. FALK.

Discussion of Dr. Falk's Results with Reference to their Bearing upon Gas Engine Problems: C. E. LUCKE.

C. M. JOYCE,
Secretary.

THE AMERICAN PHILOSOPHICAL SOCIETY

AT the stated meeting held on October 18, the following paper was read:

The Growth of the Albino Rat as compared with the Growth of Man (with lantern illustrations): Professor HENRY H. DONALDSON.

SPECIAL ARTICLES

HEREDITY OF EYE-COLOR IN MAN

IT has been known that eye-color in man is inherited as an alternative character. Alternative inheritance is usually associated with Mendelism. Is human eye-color inherited in Mendelian fashion? The importance of knowing whether it is depends on the fact that, if Mendelian, the result of any combination of eye-colors of the parents upon the eye-color of the offspring can be, within certain limits, predicted.

The data on which this stndy has been made were collected with the assistance of school principals and other friends. The records were made on blanks calling for the eye-color through three generations. The total number of cards—each giving the ancestry of one individual—is 132, of which 57 are single cards to a family while the remaining 75 are distributed in 20 families, an average of $3\frac{3}{4}$ children to a family.

Human eye-color falls into the main classes, blue and brown. The blue color of the iris is what is known as a structural color; no blue pigment is present, but there is a small quantity of scattered granules, reflection of the light from which gives a blue color exactly as reflection from suspended particles makes the air blue. The black pigment of the choroid coat gives a background that favors the reflection of light and prevents transmission; in albinos, who have no black choroid coat at the retina, light is reflected from the back of the eye and the iris appears reddish by transmitted light even as the sky is red at sunset. Brown eyes, on the contrary, contain melanic pigment, reflection from which yields black. Thus the blue eye is the absence of pigment. In addition to the two fundamental types we have black eyes, due to a greater quantity of pigment, and light (*i. e.*, dilute) brown eyes. In addition to black pigment the iris frequently contains more or less yellow in specks or patches. This is doubtless a fat-pigment or lipochrome. The combination of black and yellow pigment gives a green color as it does in the green canary, and such green and blue eyes are commonly called "gray." But "gray" is also used for blue eyes with some brown pigment in larger or smaller patches.

The nomenclature of eye-color which collaborators were requested to employ was as follows: Light blue, dark blue, blue-green or gray, hazel or dark gray, light brown, brown, dark brown, very dark brown or black. This nomenclature was generally followed and seemed to be understood except in the case of "hazel," which we suspect was employed in certain dark bluish-grays. The classification was probably too detailed and the three groups of blue, gray and brown would doubtless have sufficed. In the following summaries minor divisions of these three fundamental groups will frequently be neglected.

The first result which an analysis of the pedigree data reveals is that blue eye-color is recessive to brown. The first evidence of recessiveness is the purity of the germ cells of the recessive type, so that when two recessive individuals are mated *inter se* they throw only the recessive type. Of the offspring of two blue parents 69 are blue and 6 blue-gray or gray. Two additional cases of so-called "hazel" eyes we suspect to be of a blue type. Again, whenever in one family, both father and mother have blue eyes, all children have blue eyes. This is true in the Ge. and Sw. families of three children each, the Hur. family of 4 children and the Re. family of 6 children.

The second criterion of recessiveness is the absence of offspring of the recessive type from parents one of which is of the recessive type and the other a homozygous dominant. The only family that seems to meet the conditions of having a homozygous dominant brown parent is a small one (Sa_1) as follows:

Children	Parents	Grandparents
Boy, dark brown Girl, dark brown	light brown	brown brown
	blue	blue light blue

A third criterion is found in crosses of the $R \times DR$ type where a recessive is mated with a heterozygous dominant; in this case there should be an equal number of offspring of each type. Six matings of this sort give 16 dark-eyed to 9 light-eyed offspring—a deficiency of the light-eyed group which is probably due to the small numbers.

Since blue or absence of pigment is recessive we should expect to find some cases of two homogametous dominant browns which produce only brown-eyed offspring. We apparently have one such family (McB.) in which the four grandparents, two parents and five children have all dark brown eyes. The behavior of brown alone thus confirms that of browns when crossed with blues, and all results prove that black iris pigment is dominant over its absence.

Reference Letters	Children	Mother Father	Nature of Mating	Mother's Mother Father's Mother	Mother's Father Father's Father
Al.	1 Gray	Gray Blue	D × R	Br (gray?) Gray (blue?)	Gray Blue
Be.	5 Blue	Blue Blue	R × R	Dk Br (Blue?) Blue	Blue ——
Br.	1 Blue 4 Gray	Gray (blue?) Blue	DR × R	Gray Gray (blue?)	Dk Br (blue?) Blue
Bu.	1 Gray	Blue Gray (blue)	R × DR	Gray (blue?) Blk (gray?)	Dk Br (blue?) Blue
Do.	4 Br	Blue Dk Br (blue)	R × DR	Blue Dr Br	Blue Blue
Ge.	3 Blue	Blue Blue	R × R	Blue Blue	Gray (blue?) Blue
He.	1 Gray	Blue Gray	R × D	Blue "Blue"	Blue "Blue"
Huf.	3 Blue	Blue Blue	R × R	Blue Blue	Blue Blue
Hur.	4 Blue	Blue Blue	R × R	Blue Br (blue?)	Blue Gray (blue?)
La.	3 Br 2 Blue	Br (blue) Gray (blue)	DR × DR	Blue Gray	"Gray"?? Blue
Lu.	1 Gray	Gray (blue) "Blue-gray"	R × R	Blue Blue	Gray Blue
Ma.	1 "Blue-gray"	Blue Blue	R × R	Blue ——	Blue Blue
McB.	5 Dk Br	Dk Br Dk Br	D × D	Dk Br Dk Br	Dk Br Dk Br
McC.	1 Gray	Gray (blue) Blue	DR × R	Gray Blue	Blue "Blue-gray"
Mi.	2 Blue 4 Dk Br	Blue Dk Br (blue?)	DR × R	Gray (blue?) Dk Br	Blue Dk Br (blue?)
Oa.	6 Gray 2 Blue	Gray (blue?) Blue	DR × R	Gray Blue	—— Blue
Re.	6 Blue	Blue Blue	R × R	Gray (blue?) Blue	Blue Blue
Ri.	1 Gray	Gray Br (blue)	DR × R	Br (gray?) Br	Gray Blue
Sa_1.	2 Dk Br	Br Blue	D × R	Br Blue	Br Blue
Sa_2.	3 Br 2 Blue	Blue Br (blue)	R × DR	Blue Dk Br	Blue Blue
Sa_3.	2 Br 3 Blue	Br (blue) "Gray"	DR × R	Blue Gray	"Gray" ?? Blk (blue?)
St.	1 Gray	Gray (blue) Gray	DR × R	Blue Gray	Gray Gray
Sw.	3 Blue	Blue Blue	R × R	Blue Blue	Blue Blue
Th.	1 Gray	Gray Blue	D × R	Gray Gray (blue?)	Gray Gray (blue?)

Reference Letters	Children	Mother Father	Nature of Mating	Mother's Mother Father's Mother	Mother's Father Father's Father
Va.	1 Gray	Gray (blue) Blue	DR × R	Br (gray?) Blue	Violet Blue
Vo.	1 Blue 2 Gray	Blue Gray (blue?)	DR × R	Br (blue?) Gray	Blue Br (blue?)
Wal.	1 Gray	Gray Blue	D × R	"Blue" Blue	"Blue" Blk (blue?)
War.	1 Blue 1 Br	Dk Br (blue) Blue	DR × R	Dk Br Blue	Blue Blue

Abbreviations: Br, brown; Dk Br, dark brown; Blk, black; D, dominant; DR, dominant and recessive (heterozygous); R, recessive.

Colors in parentheses are recessive; without a ? means observed, with a ? means hypothetical. Quotation marks means doubt if the term is used with precision. Double query, doubt as to correctness of color assigned.

It remains to consider the behavior of gray in inheritance. Upon tabulating the crosses of blue with gray we find that gray dominates over blue. This is true, for example, in the Al., Bu., He., Lu., McC., Ri., Va. and Wal. pedigrees given in the Appendix. In families where blue × gray parents have a blue-eyed child (Br., Oa., Vo. families) the gray is doubtless heterogametous, containing recessive blue. Again, when both parents are gray-eyed they have produced 9 gray-eyed to 2 blue-eyed children—indicating that both grays are DR (containing recessive blue) expectation being three gray to one blue. Consequently, gray or partial pigmentation is dominant over the pigmentless blue and the occasional enumeration (Ma. family) of descendant of two blue-eyed parents as "blue-gray" or "gray" is due to a slight inaccuracy of classification. On the other hand, gray is recessive to brown (La. family), *i. e.*, a slight pigmentation to an extensive one.

The facts brought out by these statistics show, first, that there are two principal classes of eye-color—brown and blue: that brown varies in intensity from black to light brown; that blue or absence of pigment varies from pale to deep; that blue is frequently imperfect owing to the presence of specks or patches of pigment—the "gray" or "hazel" color; that blue is recessive to gray and gray is recessive to brown.

The practical applications of these results to human marriage are as follows: Two blue-eyed parents will have only blue-eyed children; two gray-eyed parents will have only blue-eyed and gray-eyed but not brown- or black-eyed children; brown-eyed parents may have children with any of the colors of eyes. Gray and blue-eyed parents will tend to have either gray-eyed children only or an equal number of gray- and of blue-eyed children according as the gray-eyed parent is homozygous or heterozygous. When one parent has blue eyes and the other brown the children will be all brown-eyed, if the brown-eyed parent is homozygous—otherwise they will have eyes of various colors according to the gametic constitution of the brown-eyed parent. In case one parent has gray eyes and the other brown we may have the following cases in the offspring: all of them brown-eyed (dark parent homozygous); 50 per cent. gray and 50 per cent. brown (brown parent heterozygous in gray or blue); 25 per cent. blue, 25 per cent. gray and 50 per cent. brown (both parents containing recessive blue germ-cells).

Gertrude C. Davenport
Charles B. Davenport

THE NOMENCLATURE OF DEXTRAL, SINISTRAL AND ATTENTIONAL ORGANS AND FUNCTIONS

In the *Popular Science Monthly*, August, 1904 (republished in *Biographic Clinics*, Vol. III.), I made some suggestions as to the nomenclature of the organs and functions pertaining to right-handedness, left-handedness, etc. After a more extended study and experience of the snbject I recognize that I made some errors and more omissions, and these I may now correct. The terms *right-handed* and *left-handed* are so firmly fixed in the language, and so recognized as expressing the unconscious choice and superior expertness of one or the other hand for certain tasks, that it is useless to attempt putting them aside for more accurate words. Established usage and habit make language and govern the world. "Right-handed," "left-handed," etc., imply nothing of expertness, etc., literally, but usage has put such meanings into them. Terms merely localizing the organs without added significance must therefore be devised, *e. g., dextral, sinistral, dextromanual, dextrocular,* and all the rest. To extend the idea of expertness to the corresponding organs, *right-eyed, left-eyed, right-footed, right-eared,* etc., may be used after the analogy of *right-handed.* The words *ambidextral* and *ambidexterity* should never be used by sensible persons. No one has yet existed with two dextral hands; no left-handed person has ever been trained to have an equal proficiency or expertness of each hand for all tasks; it would be most undesirable and wasteful of life to have such equal expertness; all or most such attempted training results in unhappiness, confusion, inexpertness and disease; the right-handed, according to the crazy theory, should be trained to an equal and ludicrous sinistromanual expertness, etc. The violinist should bow or finger equally expertly with each hand; the pianist play upon a reversed keyboard, the base notes to the right, half the time; soldiers should carry their guns and swords half the time in the left hand, step-off with the right foot first on alternate days; and all sewing, writing, use of the knife and fork, handshaking, etc., done alternately with the sinistral and the dextral hands, etc.

As to right-eyedness, left-eyedness, etc., there is a world of new facts coming to light of profound importance, medically, surgically, socially, and especially to the person abnormal in these respects. In practical ophthalmology, "dominance" of the dextral eye in the right-handed, and the preservation of it, or reestablishment of it when lost (*vice versa* in the case of the left-handed), is of vast import, possibly to the life of many individuals. With divided or alternate dominance one of my patients was constantly making mistakes, confused, running into objects, steering his automobile into collisions, etc. (The tests are many and easily made: For instance, looking through the held-up pencil or finger at the opposite wall, an image, one image, of the pencil is seen by the dominant eye—the dextral, of course, normally, in the right-handed, the sinistral in the left-handed. If the dextral is the dominant eye, then by putting something over the left, the image will not be displaced; if the dextral eye is shut off, the image of the pencil will "jump" to the right. If the sinistral is the dominant eye, the reverse will take place.) If two images are seen, then the person has divided dominance or equidominance, and he is a patient, having confusions of mind and action which may cause accidents at any time, and which must decidedly abnormalize him in many ways. Probably equidominance is a half-way stage of the change from normal to reversed dominancy. It would be better that the right-handed should have the sinistral eye dominant (*vice versa* in the left-handed) than that he should have equidominance. I have had four patients reaching middle adult life who used one hyperopic eye solely for distance-vision (*i. e.,* for objects over about two feet away), and the other myopic eye solely for all vision in reading, writing, etc. Of course the hyperopic eye in such cases (as in one of my patients), although the left (in a right-handed person), must become the dominant eye, because dominance has existence and use only in distance-seeing.

The necessity for new terms to designate the states and functions of attention comes to view in the fact that civilization is creating a new sort of consciousness and attention. The old psychology considered that attention or consciousness was to be likened to the passing of single grains of sand through the constriction of the hour-glass. That view was largely true, because I believe that attention is genetically and chiefly a product of vision, and that vision of the older and simpler type of eye and mind was indeed that of a continuous linear stream of single images (objects) focused one after another at the macula. But the modern mind (of the great and rapid reader, of the musician, and of men in many trades and callings) is learning to see and know and use many synchronous and coordinated images, and streams of images, both at and away from the macula. There is a growth and extension of the macular region and of its imaging, one may say, or the power of attention and consciousness is growing more and more able to receive, interpret and control the many streams (which is the same thing as the enlarged stream of sand grains), of images focused in and about the macula. Thus mental largeness, power, attention and consciousness are growing at a great rate in our complex and differentiating civilization, and the old nomenclature based upon the hour-glass comparison is no longer adequate. Especially if is added the marvelous power of the ear, as in the musician, to receive, encompass and be conscious of ten, fifty or even a hundred streams of discrete synchronous tones. The following terms may therefore be found useful:

Right-handed.—Preferring the dextral hand for the more expert or intellectual tasks. Whence *right-handedness.*

Left-handed.—Preferring the sinistral hand for the same tasks. Whence *left-handedness.*

Right-eyed.—Preferring the dextral eye as the dominant one.

Left-eyed.—Preferring the sinistral eye as the dominant one.

Right-eared.—Preferring the dextral ear as the one with which to hear sounds.

Left-eared.—Preferring the sinistral ear with which to hear.

Right-footed.—Choosing the dextral foot as the one to guide and base action, from which to spring in beginning to march, in spading, etc. "Step off with the left foot forward."

Left-footed.—The power is furnished and governed by the sinistral foot.

Right.—Moral, good, etc.

Sinister.—Unlucky, gloomy, etc.

Dexterity.—Expertness, agility, etc.

Dextrous.—Expert, agile, etc.

Because of popular usage, the four preceding may retain their vague significance in common speech, but not in science.

Dextral.—Pertaining to the organs on the right side of the body, regardless of expertness, preference, etc. When facing east the dextral hand is on the south side, the sinistral on the north side.

Sinistral.—Pertaining to the organs on the left side of the body, regardless of special preference, expertness, etc.

Dextrality, Sinistrality.—The corresponding abstract qualities, regardless of expertness, etc.

Dextrad, Sinistrad.—Toward the dextral or sinistral side of the body, respectively.

Dextromanual, Sinistromanual.—Pertaining, respectively, to the dextral or to the sinistral hand without regard to expertness, etc.

Dextrocular, Sinistrocular.—Pertaining to the eye on the dextral side, or the sinistral side, respectively, regardless of expertness, etc.

Dextropedal, Sinistropedal.—Pertaining to the feet, in the same way.

Dextraural, Sinistraural.—Pertaining to the ears, in the same way.

Dextrocerebral, Sinistrocerebral.—Located in the right, or the left, cerebral hemisphere, respectively.

Ambidextral, Ambidexterity.—Words without significance, or existence in fact, "ghost-words," which should never be used.

Dominant Eye.—The eye which is unconsciously and preferentially chosen to guide decision and action.

Divided Dominance, or Equidominant Eyes.—With shared or equal dominance.

Alternating Dominance of the Eyes.—Dominance of one eye at one time or for one function, alternating with that of the fellow for another time or function.

Reversed Dominance.—The left, because of ametropia, disease, operation, etc., of the right, becoming the dominant eye in the right-handed; or *vice versa* in the case of the left-handed.

Dextroexpertness.—Conjoint and superior expertness of the dextral sensory and muscular organs of the body; the union of right-handedness, right-eyedness, right-earedness and right-footedness. The innervational centers of the more expert organs are located in the left side of the brain.

Sinistroexpertness.—Conjoint and superior expertness of the sinistral sensory and muscular organs of the body; the union of left-handedness, left-eyedness, left-earedness, and left-footedness. The innervational centers of the more expert organs are located in the right half-brain.

Mixed Dextrosinistral Expertness.—Some of the centers of the more expert organs in conjoint action are located in one, and some in the opposite half-brain. What was once meant by the really meaningless term "ambidexterity," as applied only to the hands.

Trailing Hand, "The Trailer."—In synchronous writing of both hands, that upon which the attention, visual or central, is not fixed.

Visual Attention.—That existing when the eyes consciously observe a fixed or moving object; during the act central or mental attention is fused with it.

Central Attention.—The "imagination," or mental remaking, of the image, by the mind or central mechanism when the peripheral visual attention is abrogated.

Single-stream Visual Attention.—That form of visual attention existing when the eyes follow a linear concatenation of single or unitary macular images to the exclusion of all others.

Single-stream Central Visual Attention.—That when the central visual attention, without objectively forming images, follows the passing of imagined single or unitary images in single file.

Multiple Synchronous Visual Attention.—That when the attention recognizes two or more discrete sets of retinal images at the same time—as when the musician reads several staffs of music-notes, observes key-boards and pedals, the indications as to stops, tempo, expression, etc.

Multiple Synchronous Central Visual Attention.—The imagining or mental reproduction of multiple synchronous visual trains without the objectively formed images.

Single-stream Auditory Attention.—That when a monotone, a sound, or concatenation of single notes or sounds, is listened to, exclusive of others.

Single-stream Central Auditory Attention.—That without the objective audition.

Multiple Synchronous Auditory Attention.—Two or more synchronous tones or sounds, or lines of such tones or sounds, are recognized by consciousness, as in the case of the orchestra-leader who gives attention to a large number.

Compound Synchronous Attention.—In this the consciousness recognizes and correlates or combines multiple streams of synchronous and diverse stimuli, visual, auditory, etc. Illustrated by expert telegraphers, locomotive engineers, musicians, etc., seeing, hearing and feeling consciously at one instant.

George M. Gould

COLOR VARIETIES OF LOCUSTIDÆ

In Science for August 16, 1907, Mr. A. Franklin Shull publishes some notes on a pink form of *Amblycorypha oblongifolia* and calls attention to the rarity of records and data relating to such specimens. Mr. Shull's communication touches upon a most interesting subject that has been but little investigated, namely, the direct influence of food upon the coloration of certain phytophagous insects. The following remarks may stimulate some investigator to take up this neglected subject.

A live specimen of the pink form of *Amblycorypha oblongifolia* was recently presented to the National Museum by Dr. J. N. Rose, who captured it at the New York Botanical Garden on August 15, 1907. This specimen is perhaps the most richly colored one that has come to notice and it was captured in surroundings that suggest a derivation of this unusual coloration from food. The following descriptive notes were made from the living insect. The color is a deep rose, which could almost be called a crimson; it shows a delicate but distinct violet tinge. This violet cast is most pronounced upon the more delicately colored soft parts—the mesothorax, metathorax and abdomen. This coloration hardly agrees with that of the two specimens described by Scudder, the female as "pale coral-red verging on magenta" and the male as "orange red." The present specimen is a female and the green color of the common form is replaced by red throughout. There are only a few dark brown markings: on the pronotum the lateral carinæ are heavily marked with deep brown and the tegmina have a patch of the same color on the apical portion of the dorsal field; at the sides the tegmina show three rows of more or less confluent brown spots, the upper row longest and heaviest. There are many indistinct whitish maculations on the sides of the prothorax and particularly dense upon the cheeks and the face. The ocelli are opaque white. The eyes are light gray, creamy white along the inner margin and in the middle, with irregular dark blotches suffused with red. The tegmina show many indistinct creamy maculations. The corneous portion of the wings, which projects beyond the tegmina, is red, the membranous portion hyaline with the network of veins rose-red. The ovipositor is brown at the tip. The legs are a slightly fuller crimson than the body, the tibiæ and tarsi deeper colored than the femora. The hind tibiæ are a very dark crimson-brown.

It should be noted that brown specimens of Locustids occur occasionally and in some of these there is a trace of pink, as it were, showing through the brown. Some years ago the writer took a specimen of *Amblycorypha oblongifolia*, near Springfield, Mass., of a pale brown color suffused with pink. There is a similar specimen in the National Museum collection, taken at Dorsey, Md., August 20, 1904, by Miss R. Jones. It is such a specimen that Mr. Shull describes in his article.

It is a well-known fact that color variations of the same character occur in many green lepidopterous larvæ. Caterpillars showing these variations in color may be found upon the same food plant under the same conditions; these colors apparently do not depend upon any particular environment, but are directly due to the insect's food. Incidentally they are protective in most cases. Poulton in his statement "that some of the colors of certain Lepidopterous larvæ are made up of modified chlorophyll derived from the food-plant" refers to this green or brown general body-color.[1] Through experiment he reached the conclusion that "etiolin, no less than chlorophyll, can be transformed into a larval coloring matter, which may be either green or brown, and is so disposed as to form a ground color."[2] It should be added that the processes which produce the change from green to brown or red in chlorophyll are understood to be of a very subtle nature. The colors of the Locustidæ are in all probability of the same origin. These insects are almost wholly phytophagous and their coloration strongly resembles in character that of the lepidopterous larvæ in question. In both cases, through the rapid assimilation of food, the plant juices are taken into the organism practically unaltered. With the Lepidoptera these colors are eliminated during the pupal period; in the Locustidæ, which reach maturity by a series of molts and continue feeding in all stages, the colors persist to the adult insect. Scudder has already pointed out that season or temperature are hardly admissible as agents in these color variations.[3] The pink or brown specimens appear at the same season with the green ones and they occur among the Locustidæ of the tropics as well as with those of temperate regions. Dr. Rose has called my attention to the fact that at the New York Botanical Garden, where the above-described red specimen was taken, there is an abundance of crimson foliage. It is, therefore, not improbable that in this specimen the crimson color is due to a coloring matter contained in the foliage upon which the insect fed.

Two methods of investigating these colors of the Locustidæ may be suggested: One is by comparative spectroscopic tests of the coloring matter of the insects and plants, the other is

[1] *Proc. Roy. Soc. London*, Vol. 54, p. 41, 1893.

[2] *L. c.*, p. 426.

[3] *Entomological News*, Vol. 12, p. 131, 1901.

by rearings of the insects in separate lots, fed upon green and red foliage respectively.

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CONE IN CONE

SIMILAR limestones of same geological age are seen high in the Missouri bluffs from the Platte and Buchanan County line to the Andrew County line. Beyond the Nodaway River we find these beds lower in the hills and within two miles are seen near the railroad grade.

These limestones are No. 150 and 152 of my section of the Upper Coal Measures, published in the Missouri Geological Report entitled "Iron Ores and Coal Fields," 1872, in part 2, page 92.

No. 150 occurs in strata of irregular thickness. Near Amazonia certain beds of it have been reported to make a good quality of hydraulic cement. Twenty feet is the total thickness of No. 150.

No. 152 lies above and is separated from 150 by two feet of clay shales. No. 152 is sometimes oolitic and also shows cross lamination. It furnishes an excellent building stone. Lander's quarry, a few miles north of Savannah, Andrew County, is of this rock. Overlying No. 152 we sometimes find a two-inch bed of cone in cone.

At only one other horizon in Missouri has cone in cone been obtained. It is found at Henry Kunkel's, on Nichols Creek, in Holt County, occupying a position approximately 175 feet above the other I have mentioned. Very fine specimens have been obtained from Nichols Creek, where it is about three inches thick.

The finest specimens of cone in cone I obtained from a branch of Dry Fork, in the northwest part of Bond County, Illinois, near James Valentine's and probably in Sec. 19 T. C. N. R. 4 W. Pocahontas is probably the nearest town. We found here twenty feet of argillaceous shale beds with flattened ironstone concretions resting on three feet of gray fossil-bearing limestones. The cone in cone occurs twenty feet above the limestone and is about two and a half inches thick. In composition it is an argillaceous limestone and shows perfect cones interlocking from each surface. It was traced along the branch for several hundred yards. [See Vol. VI., Ill. Geol. Surv., p. 133.]

In Geological Survey of Wisconsin, Iowa and Minnesota D. D. Owen, Phila., 1852, p. 112, mention is made of "Tutenmergel" being found in Iowa near certain briny springs. He states that in Germany its origin is thought to be from shrinkage of strata. But Owen speaks of it in Iowa and refers it to the imperfect crystallization produced by mineral matter filtering through marly beds. Dr. B. F. Shumard, who was much with Owen, informed me that Owen's tutenmergel was cone in cone. I think the former probably due to imperfect crystallization under pressure. Its origin and that of arragonite may be the same. Von Cotta speaks of it as "Tuten-nagel."

Stylolite structure, so common in many of our Lower Carboniferous limestones, may have a similar origin, but the cone is wanting.

G. C. BROADHEAD

COLUMBIA, MO.,
July, 1907

QUOTATIONS

EXTERNALISM IN AMERICAN UNIVERSITIES

IT is but natural, where organization is so important and the office of administration is magnified, that the presidency should fast lose its connection with active and advancing scholarship. There is so much governing to be done—because in our universities we trust so much to government—that in but few places can a president continue a scholar's life. So the old type of leader, learned and temperate, fast yields to the new type,—self-confident, incisive, Rooseveltian. And with the coming of the new type, there seems to be an increasing stress upon rapid accomplishment, upon "doing things," with grave risk that our places of learning will preserve a less clear vision of what is catholic and enduring.

The constitution of our universities is an appearance of their indwelling mind, and therefore is of moment for their future. It is difficult to foretell whether the American will continue forever the government that was well enough for a boys' academy in colonial times. The desire is unquestionably awakened in us to have universities that can stand with the greatest of the world; and the desire will in the end, I believe, lead us more and more to distrust external rule. Our present forms have served our nonage; the days of our ignorance have been winked at, but now we are commanded everywhere to repent. We shall hardly reproduce in haste the European models, with all their clear advertisement that they are scholars' commonwealths, are municipalities of science; and yet it can not be thought that we shall continue forever and without regret upon our present course. We shall in the end place less reliance upon commercial methods in discovering and bringing into harmony the choicest minds; the university will perceive that it must become for them a hospitable place, showing in its very laws and customs that it is a union of gifted persons sanely working together to increase the store of intelligence among men. It will feel that it must bestow on all who come within its walls the keys and freedom of a great city.—Professor George M. Stratton in the *Atlantic Monthly* for October.

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

BRITISH RAINFALL

The forty-sixth annual volume of that unique publication, *British Rainfall* (1906), is at hand. Dr. H. R. Mill informs us, much to our regret, in his preface, that "the stationary condition of the available funds" has made it necessary for the editor to "divert a considerable part of his time from editorial duties to remunerative work." It is a great pity that the British Rainfall Organization, which is of such immense importance to the people of the British Isles, should suffer for lack of support. In this connection we note that His Majesty the King heads the subscription list. Dr. Mill points out that by means of an automobile, kindly placed at his disposal by one of his regular observers, he was able to make inspections of several rainfall stations in a very much shorter time than would have been taken up had he traveled in any other way. The present volume of *British Rainfall* contains a discussion, by L. C. W. Bonacina, of "The Effects of Exposure to Wind upon the Amount of Rain caught by Rain Gauges, and the Methods of Protecting Rain Gauges from them," with a bibliography. We desire once more to call attention to Dr. Mill's study of "Heavy Falls on Rainfall Days in 1906," in which the cyclonic control of special rainfalls is discussed and illustrated. It would be well if for every state in the American union we had such studies each year.

LIGHT AND BACTERIA

Dr. John Weinzirl has recently investigated anew "The Action of Sunlight upon Bacteria, with Special Reference to Bacillus Tuberculosis" (*Bull. Univ. New Mex., biol. ser.*, III., No. 12, 1907). The results obtained by previous investigators were, in the opinion of the writer of this paper, markedly and unfavorably affected by reason of the investigators' methods of exposing the organisms to sunlight, exposure under glass necessitating reflection and absorption of a large proportion of the sun's rays. By improved methods Dr. Weinzirl believes that he has come much nearer the truth. He finds the effect of sunlight much more powerful than previous results indicated. From two to ten minutes of direct exposure to sunlight is sufficient to kill the bacteria. This gives added emphasis to the advantage of a dry climate, like that of the western United States, where dryness and sunshine quickly destroy most bacteria. The importance of well lighted and ventilated houses is also emphasized. "The results by direct exposure of the bacteria indicate that sunlight is a much more powerful germicidal agent, and consequently a more important hygienic factor, than it has heretofore been considered; that the bacteria, when freely exposed, are killed in one fifth to one twentieth of the time formerly considered necessary."

PHENOMENAL RAINFALL IN SUVA, FIJI

The Quarterly Journal of the Royal Meteorological Society for July, 1907, contains a discussion of a phenomenal rainfall in Suva, Fiji, August 8, 1906, which came during a thunderstorm. Unfortunately, the exact amount had to be, in part, estimated, owing to the observer's having failed to measure the fall at intervals during the night. The measurements showed a fall of over 37 inches, without taking into account the overflow, which was an unknown quantity. The gauge was twenty-five feet above the ground, and the observer calculates that the total fall must have been fully 41 inches in about 13 hours. Considerable uncertainty naturally attaches to this record, but there can be no doubt that the rainfall was a very heavy one.

RAINFALL IN THE LAKE REGION

A study of the average annual precipitation in the Lake region, by Professor Alfred J. Henry, of the United States Weather Bureau, appears in the *Meteorological Chart of the Great Lakes,* No. 1, 1907, and is illustrated by a chart. Measurements of rain and snow have now been made for a period of thirty-six years (1871–1906) at 21 stations. The period 1871–1906 is taken as the fundamental period. The total number of stations used was 107, all but 7 of which had more than ten years' observations. The records of ten years and over were generally reduced to the fundamental period. The total annual amount of rain and melted snow is about 31 inches. The increase in precipitation due to the presence of the Great Lakes is probably not more than 2 or 3 inches annually.

VARIATIONS IN LEVEL OF LAKE CHAD

The Scottish Geographical Magazine, August, 1907, summarizes the results of military reconnaissances undertaken in 1906 by the troops in the Lake Chad region, including notes obtained from the natives in regard to the changes of level of Lake Chad. There seems to be a twenty-year periodicity, and at the end of four or five twenty-year periods there seems to come an almost complete desiccation, and then a great rise of level. An old native remembered a drying up which has been placed between 1828 and 1833, while in 1851, about twenty years later, the level was high. In 1906 the lake appears to have been very low.

ROUMANIAN METEOROLOGICAL WORK

A recent mail has brought renewed evidence of the excellent work which the Meteorological Institute of Roumania is carrying on. As lately reported in Science, M. Stefan C. Hepites has retired from the directorship, and has been succeeded by M. I. St. Murat. Vol. XVIII. of the *Analele* of the institute is a publication of nearly 1,000 pages, 4to, containing, in French and Roumanian, the 17th report of the work of the institute (for 1905–06); a study of the climatology of Craiova; memoirs on rainfall, earthquakes and sunshine, and the usual climatological tables. Separate brief reports concerning the hydrometric and agricultural conditions of January–May, 1907, in Roumania, throw further light on the activities of the Meteorological Institute.

BRIGHT SUNSHINE IN THE BRITISH ISLES

"The Distribution of Bright Sunshine over the British Isles" is discussed by Richard H. Curtis in *Symons's Meteorological Magazine* for September, 1907, and is accompanied by a chart showing the average annual duration of sunshine. The records used in the preparation of this chart are those of the burning recorders. A few records exceed twenty-five years, and series for shorter periods are available for a large number of stations. The short series have been weighted for the length of period they cover. The number of hours of bright sunshine is indicated by "isohels." In 1891 the London Meteorological Office published Dr. R. H. Scott's "Ten Years' Sunshine in the British Isles." Dr. H. N. Dickson drew the first sunshine map for the British Isles from the data in that paper (*Scot. Geogr. Mag.,* 1893). The *Atlas of Meteorology* (pl. 18) reproduces Dr. Dickson's map.

SYMONS'S METEOROLOGICAL MAGAZINE

The five-hundredth number of *Symons's Meteorological Magazine* is that for September, 1907. The first number was dated February, 1866, and was published by the late Mr. G. J. Symons. Meteorologists the world over will unite in congratulating Dr. H. R. Mill upon the appearance of No. 500 of this unique magazine, and in wishing him continued success in carrying on his important work for British meteorology.

R. DeC. Ward

Harvard University

THE NEW PHILIPPINE MEDICAL SCHOOL ESTABLISHED BY THE GOVERNMENT OF THE PHILIPPINE ISLANDS

The second annual meeting of the Philippine Islands Medical Association was held in Manila during the early months of 1905, and in the course of the discussions the fact was brought out that the Philippine archipelago has an average of only one physician to every 21,209 of the population, or one to every 430 square miles of territory. The association consequently deemed it its duty to bring this matter forcibly to the attention of the government and to request that some action be taken looking towards the establishment of a permanent and modern medical school in the Philippine Islands. The conditions for the success of such a school were very auspicious, as the Bureau of Science and the Bureau of Health would be able to furnish a number of trained men to take part in the teaching.

As a result of this agitation and also as an expression of an ideal which for some time had been in the minds of the secretary of the interior and of the various directors and members of the large scientific institutions in the Philippines, the United States Philippine Commission on December 1, 1905, passed an act establishing a medical school in the Philippine islands, placing it in charge of a board of control which consists of the secretary of public instruction, the secretary of the interior, one other member of the Philippine Commission and a member to be designated by the governor-general. The dean of the faculty of the school after its establishment also became a member of the board of control. The school is to form a department of the future Philippine University.

The actual work of organization was not undertaken until more than a year after this, one reason for the delay being that other scientific undertakings were in the course of active growth, and the other because much time was necessary to perfect the actual working plans. However, a faculty was finally appointed, including the chairs of chemistry, clinical medicine, tropical medicine, surgery, hygiene, pathology and bacteriology, pediatrics and obstetrics, with associate professors in several of the branches and with assistant professors in charge of anatomy, pharmacology, and physiology. The full professorships of the latter three chairs were left open because it was realized that the three assistants would need to be called from the United States, and it was desired to leave the higher positions open so as to give more opportunity for advancement to the right men. About one third of the faculty consists of natives of the islands, the other two thirds being either government employees or American physicians or surgeons engaged in hospital practise in Manila.

The most serious subjects to consider in planning the work for the first year were the nature of the entrance examinations to be required, the number of years of study and the feasibility of admitting students to advanced classes who were either graduates of the present medical school of the University of Santo Tomas or who had taken one or more years of medical study therein. These questions present different phases than they do in the United States, as in America there already are a sufficient number of medical schools of good standing, and no communities are actually suffering from lack of medical attendance; whereas in these islands we must endeavor to furnish reasonably well educated physicians as soon as possible, so that the duty of the faculty is not only to elevate the grade of medical instruction in the Philippine Islands, but also as rapidly as may be feasible to fit with at least a fair knowledge of medicine young men who should be able to take their places in the provinces where no medical attendance whatsoever is now possible. A rigid standard of entrance examinations could be lived up to, provided these were so to be gauged as to provide not only for admission from the government schools conducted under American auspices and giving a grade of instruction parallel to that in the United States, but also from a number of academies and colleges under ecclesiastical control. The entrance examinations for the first year were therefore conducted so as to secure for us a very good class of students, some of them perhaps not the equal of our own high school graduates in certain branches of study, but all of them with sufficient training of one kind or another to enable them successfully to carry on their medical studies. It seemed impossible to secure students on examination for the advanced years, as our courses of study would be so different from the ones which had been conducted in the ecclesiastical medical school existing in the Philippine Islands, that it would be hopeless to expect candidates to pass the same questions as would be submitted to our own scholars; consequently, the faculty decided it to be advisable to admit to the advanced classes only special students not candidates for a degree, and to permit the latter gradually to become regular upon passing the examinations at the end of each college year.

The government approved of the above plans, and to enable the school to establish the first four years of its five years' course, it appropriated the sum of $64,000 United States currency to meet the ordinary expenses of equipment and salaries. A temporary building was assigned to the faculty, which was fitted up to serve fairly well for two years, the laboratories being those of chemistry, anatomy, bacteriology and pathology, clinical microscopy, histology, physiology and pharmacology. In addition to this appropriation there also were provided fifty additional free beds in St. Paul's hospital, so that the number at the disposal of the school for clinical purposes in the first year will be one hundred. Rooms were also prepared for an out-of-door, free dispensary in the same hospital building. The members of the civil government who were to teach in the Philippine Medical School accepted their positions without additional remuneration, so that the expenses for salaries were only to pay members of the faculty not otherwise engaged in government work.

As soon as the funds were available, the necessary microscopes and apparatus for a thoroughly modern equipment were ordered from abroad and the entrance examinations were held on June 10. The school began its first year with fifty-four matriculates and it must be confessed that the standard of work among the students in the first three months has been very high. The school was able to secure the services of Dr. Robert Bennett Bean in anatomy and Dr. Philip K. Gillman in pathology, but as yet has not called any incumbent to the chairs of physiology and pharmacology.

As soon as the temporary quarters were occupied and instruction was being carried on systematically, the faculty began to plan for its new medical building and for a general hospital, the staff of which should be the members of the faculty of the school. The government, realizing the necessity of these improvements has appropriated $125,000 for the Medical School building and $390,000 for a general hospital of 350 beds. These permanent structures insure the future of the medical school, and will in all probability be occupied within the next eighteen months.

The establishment of this medical school is one of the greatest steps recently made in the advance of the American government. The great benefits to be derived from the obstetrical ward and our out-door clinic alone would warrant the outlay, as we strongly hope soon thereby to exert a marked influence upon the alarmingly high infant mortality in the Philippines. The graduates of the school in a few years will also begin to make their presence felt. The American physician has never been able to reach the common people in the same way as the native, and the missionary work of a good number of well educated native physicians in the matter of hygiene and public health can not be underestimated.

The training and character of the members of the faculty render it certain that their time will not only be devoted to teaching but also to the advancement of research in tropical medicine.

Paul C. Freer,
Dean of the Philippine Medical School

SOME ASTRONOMICAL CONSEQUENCES OF THE PRESSURE OF LIGHT[1]

The experiments of Lebedew and Nichols and Hull have proved conclusively that light presses against any surface upon which it falls, and the extraordinarily accurate experiments of Nichols and Hull have fully confirmed Maxwell's calculation that the pressure per square centimeter is equal to the energy in the beam per cubic centimeter.

A clearer idea of the effect of light or radiation pressure is obtained by thinking of a beam of light as a carrier of momentum. We then see that not only does it press against a receiving surface, but also against the surface from which it started.

Some experiments by Dr. Barlow and myself appear to bring to the front this conception of light as a momentum carrier. If a beam falls on a black surface at an angle to the normal, there should be a tangential stress along the surface. An experiment was described in which light fell on a blackened disc at the end of a torsion arm, the disc being at right angles to the arm.[2] The disc was pushed round by the tangential stress. The experiment was carried out in a partially exhausted vessel, but the residual air was a source of disturbance by convection and radiometer effects. A better experiment was made by suspending a disc of mica blackened beneath, about two inches in diameter by a quartz fiber, the disc being horizontal and suspended from its center. When a beam of light fell at 45° on a part of the disc, the horizontal component of the beam being at right angles to the radius to the part where it fell, the disc moved round through the combined effects of convection, radiometer action and the tangential stress, When the beam was allowed to fall on the same place at 45° on the other side of the vertical, convection and radiometer action were very nearly as before, but the tangential stress was reversed. The difference in torsion in the two cases was twice that due to the tangential stress. An experiment with prisms[3] was also described.

Regarding a beam of light as a momentum carrier, it is easily seen that if the receiving surface has velocity u towards the source and the velocity of light is U, the pressure is increased by the motion by the fraction u/U. If the velocity is reversed, the pressure is decreased by this fraction. This is the "Doppler reception effect."

If the source is moving, and we assume that the amplitude of the emitted waves depends on the temperature and nature of the source alone, it can be shown that the pressure on the source is $U/(U \mp u)$ of its value when the source is at rest. This is the "Doppler emission effect."

In considering the consequence of light pressure, it is necessary to know the temperature of a body exposed to the sun's radiation. It can be shown that a small black particle, at the distance of the earth from the sun, has about the mean temperature of the earth's surface, say 300° Abs., and that the temperature of the sun is about twenty times as high, say 6000° Abs. The temperature of the particle varies inversely as the square root of its distance from the sun.

The direct pressure of sunlight is virtually a lessening of the sun's gravitation pull. On bodies of large size this is negligible. On the earth it is only about a forty-billionth of the sun's pull, but the ratio increases as the diameter decreases, and a particle one forty-billionth of the earth's diameter, and of the same density, would be pushed back as much as it is pulled in, if the law held good down to such a size. If the radiating body is diminished, the ratio of gravitation pull to light pnsh is similarly diminished, and it can be shown that two bodies of the temperature of the earth's surface and of the earth's mean density would neither attract nor repel each other, if their diameter was about one inch. The consequence of this on a swarm of me-

[1] Abstract of an address before the Royal Institution of Great Britain.

[2] *Phil. Mag.*, IX. (1905), p. 169.

[3] *Ibid.*, p. 404.

teorites is obvious. It is probable that this balancing of gravitation and light pressure must be taken into account in the motion of the particles supposed to constitute Saturn's rings.

When we consider the motion of a small particle round the sun, we have, first, the direct pressure lessening gravitation. If it has density equal to that of the earth and diameter one one-thousandth of an inch, the lessened pull at the distance of the earth will imply a lengthening of the year by nearly two days. Secondly, the Doppler emission effect comes into play, for the particle crowds forward on its own waves emitted in front, and draws away from those emitted behind, so that there is increase of pressure in front and a decrease behind. Thus there is a force resisting the motion. The particle will then tend to fall inwards in its orbit, and in the case considered, about 800 miles in the first year. It would probably move in a spiral into the sun, and reach it in less than 100,000 years. A particle one inch in diameter would reach the sun from the earth in less than a hundred million years.

The Doppler reception effect will not come into play in a circular orbit, but in an elliptic orbit it acts as if it were a force resisting change of distance, and therefore it tends to make an elliptic orbit even more circular.

Applying these considerations to a comet regarded as a swarm of small particles coming into our system, a sorting action will at once begin. The smaller particles will have their period of revolution lengthened out more than the larger ones, and they will tend to trail behind. The Doppler emission effect will damp down the motion, and again, more markedly with the smaller particles, and all will tend to spiral into the sun. The Doppler reception effect will tend to destroy the ellipticity of the orbit, more especially with the smaller particles, and ultimately the particles of different sizes may move in orbits so different that they may not appear to belong to the same system. In course of time they should all end in the sun. Perhaps the zodiacal light is due to the dust of long dead comets.

It appears just possible that Saturn's rings may be cometary matter which the planet has captured, and on which these actions have been at play for so long that the orbits have become circular.

J. H. POYNTING

SCIENTIFIC APPOINTMENTS AT THE UNIVERSITY OF WISCONSIN

A NUMBER of changes have been made at Wisconsin in the several scientific departments. The board of regents have named Dr. Charles R. Bardeen, at present professor of anatomy, dean of the new college of medicine. The faculty of the new medical college includes, besides Dean Bardeen as professor of anatomy, Dr. Joseph Erlanger, professor of physiology; Dr. H. L. Russell, professor of bacteriology; Dr. M. P. Ravenel, professor of bacteriology; Dr. W. D. Frost, associate professor of bacteriology; E. G. Hastings, assistant professor of bacteriology; Dr. C. A. Fuller, instructor in bacteriology and assistant in the hygienic laboratory; Dr. Harold C. Bradley, assistant professor of physiological chemistry; Dr. J. R. Blackman, assistant in physiology; Dr. Richard Fischer, assistant professor of pharmacy; Dr. Edward Kremers, professor of pharmaceutical chemistry; Dr. Louis Kahlenberg, professor of physical chemistry; Dr. Victor Lenher, associate professor of chemistry; Dean E. A. Birge, Associate Professor W. S. Marshall, and Assistant Professor S. J. Holmes in the department of zoology; Professor R. A. Harper, Associate Professor C. E. Allen and Assistant Professor R. H. Denniston of the department of botany; and Professor B. W. Snow, Professor C. E. Mendenhall, and Assistant Professor A. H. Taylor of the department of physics.

Professor Mazyck Porcher Ravenel takes charge of the Department of Bacteriology, succeeding Dr. Harry L. Russell, who was appointed dean of the College of Agriculture, vice W. A. Henry, resigned. Dr. Ravenel has been assistant medical director of the Henry Phipps Institute for the Study of Tuberculosis in Philadelphia, and was formerly bacteriologist for the State Sanitary Live Stock Board of Pennsylvania, where he carried on research work in connection with treatment of tuberculosis and rabies.

Orville H. Ensign has been appointed to the professorship of electrical engineering, in place of D. C. Jackson, now head of the department of electrical engineering at Massachusetts Institute of Technology. Professor Ensign has been general electrical and mechanical engineer of the United States Geological Survey Reclamation Service, in charge of the work on electrical and pumping problems on the Pacific coast.

A. M. Winchell, who comes from the Montana School of Mines, is assistant professor of mineralogy and petrology. Otis A. Gage, Cornell, is the new assistant professor in the physics department, and James H. Wolton, University of Illinois, is assistant professor of chemistry. Among the lecturers secured for the coming year in various departments are W. A. Richards, chemical engineer, and Charles H. Hawes, anthropologist, of Cambridge University, England.

In the department of chemistry R. K. Brewer, W. G. Wilcox, Edward Wolesensky, C. W. Hill and Charles B. Gates have been made assistants, the latter to take the place of W. H. Doughty, resigned. James T. Bowles is sanitary chemist in the hygienic laboratory, S. K. Susiski is research assistant in agricultural chemistry, and E. V. McCollum is instructor in agricultural chemistry.

John R. Roebuck, who is a graduate of Toronto University and for the past year has been professor of physics at McGill Medical College, Toronto, has been appointed instructor in physics in place of A. L. Colton. Two other instructors appointed in this department are A. W. Smith, Haverford College, and H. C. Heil, and as assistants W. A. Titsworth, of Rutgers College, W. F. Steve, H. J. Plagge, D. S. Dye, O. H. Gaarden, F. W. Forsythe, F. K. Brainard and L. B. Aldrich were named. Raymond Schulz was made assistant in pharmacy in place of Florence Gage, resigned, and C. C. LeFebre is the assistant. The resignation of G. M. Reed as instructor of botany was accepted, and the following assistants in the department were named: E. G. Artzburger, J. M. Brannon, Mary A. Hickman and Hallie D. M. Jolivette. The assistantship made vacant through the resignation of A. B. Clawson is filled by Robert W. Hegner. The new assistant in bacteriology, in place of N. W. Wayson, resigned, is O. O. Nelson, and C. W. Smith is instructor in the department. E. L. Eaton was made instructor in astronomy in the correspondence department. In the mathematics department, George D. Berkhoff and A. L. Underhill are instructors and Bruce Bartholomew, assistant. Edward Steidtman is the new assistant in mineralogy and petrology.

In the College of Engineering the following changes have been made: Ernst Flanner is instructor in electrical engineering, vice John C. Potter, resigned, and H. B. Sanford is assistant in the same subject. W. L. Dobney is instructor in mechanical practise, and J. B. Kommers and A. H. Miller are instructors in mechanics, the latter succeeding H. F. Moore, resigned. W. C. Penn is instructor in topographical engineering, and John C. Wied in steam engineering. E. E. Parker has been made instructor in bridge engineering. Paul Sladky succeeds B. S. Anderson as assistant in machine design. Robert E. Egelhoff is instructor in mechanical drawing, and M. R. Hammar succeeds J. E. Boynton in the same work. Frank W. Warner is instructor in drawing and descriptive geometry. F. W. Lawrence is instructor in hydraulics, with W. A. Gattiker as assistant.

The changes in the College of Agriculture include the appointment of Miss Louise Jahns as instructor in soils, and J. F. Reubensaal as instructor in pasteurizing.

SCIENTIFIC NOTES AND NEWS

Dr. Richard Wettstein, Ritter von Westerheim, professor of systematic botany at Vienna, has been elected president of the Association of German Men of Science and Physicians for the meeting to be held next year at Cologne.

Dr. Emil Fischer, professor of chemistry in the University of Berlin, gave the Faraday lecture before the London Chemical Society on October 18. On the preceding day he received the degree of doctor of science from the University of Cambridge.

An oil portrait of Dr. John Guiteras has been hung in the position of honor in the eastern amphitheater of the medical laboratories of the University of Pennsylvania, where he was professor of pathology until his return to Havana in 1900. The painting is by Armando Menocal, of Havana.

Dr. Albert E. Leach, formerly of the Massachusetts Board of Health, has accepted the position of chief of the new United States Food Inspection Laboratory to be established at Denver.

The following appointments have been made to the staff of the Rockefeller Institute for Medical Research: Dr. Hideyo Noguchi, promoted to associate in pathology; Dr. G. W. Heimrod, assistant in biological chemistry; Dr. W. A. Jacobs, fellow in biological chemistry; Mr. P. A. Kober, scholar in biological chemistry; Dr. R. V. Lamar, scholar in pathology.

Professor R. M. Wenley, of the University of Michigan, has been appointed to the Baldwin lectureship for the year 1908–9.

Dr. Mazyck P. Ravenel, who had just returned to Philadelphia from Berlin, where he took part in the Fourteenth International Congress of Hygiene and who has now left for Madison, to take the chair of bacteriology at the University of Wisconsin, was given a farewell dinner at the University Club on October 17.

Dr. Robert Koch has returned from his work at Uganda on the sleeping sickness, and was expected to arrive in Berlin about November 1.

Professor William Bateson is about to return to Cambridge after giving a number of lectures in this country. On November 2 he will lecture at Harvard University on "Heredity, as illustrated by Mendel's Law"; on October 30 he lectured before the New York Academy of Sciences on "The Inheritance of Color in Animals and Plants."

At the request of the government of Mauritius, the colonial office has arranged with Major Ronald Ross, professor of tropical medicine in the University of Liverpool, to proceed to Mauritius in order to advise the government of that colony as to the best methods of dealing with malaria.

Professor Charles Schuchert, the curator of the geological department of Peabody Museum, Yale University, spent the greater part of the summer collecting fossils and studying the geology of New Jersey, Maryland, Virginia and western Tennessee.

Dr. George B. Gordon has reached Seattle, after spending the summer in archeological explorations in Alaska for the archeological department of the University of Pennsylvania. He cabled from Nome that he had been adrift in Behring Sea for twenty days.

Dr. Charles Peabody, of the anthropological department of Harvard University, has returned from a four-months' archeological tour abroad. He officially represented the Peabody Museum and the Division of Anthropology at the Prehistoric Congress of France held at Autun, and at the International Reunion of Anthropologists held at Cologne.

Professor W. B. Cannon, of the Harvard Medical School, addressed the Academy of Medicine, Cleveland, O., October 11, on "Some Physiological Processes in the Region of the Pylorus."

Dr. Hector Mackenzie opened a discussion on the complications and sequelæ of pneumonia and the possibilities of treatment by serum or vaccine at the first meeting of the medical section of the newly-established Royal Society of Medicine, which met on October 22, at 5:30 p.m.

Mr. A. Henry, reader in forestry at Cambridge University, gave his inaugural lecture on October 15, the vice-chancellor presiding. Mr. Henry dwelt upon the causes which had retarded the scientific development of forestry in Great Britain, pointed out the necessity of reafforesting the waste lands and described the course he purposed to pursue in developing the teaching of and research in forestry in the university.

Friends of the late Walter Frank Raphael Weldon, M.A., D.Sc., formerly Linacre professor of comparative anatomy at Oxford and fellow of Merton College, have offered the university a sum of about £1,000 for the foundation of a prize, with a view to perpetuate the memory of Professor Weldon and to encourage biometric science. The prize will be called the Weldon memorial prize and will be awarded every three years. It will consist of a bronze medal and a grant of money.

The Geographical Society of Philadelphia will hold a meeting on November 6, in memory of the late Angelo Heilprin, founder of the society. Institutions and societies with which Professor Heilprin was connected will be represented by speakers, as follows: Mr. Alba B. Johnson, president of the Geographical Society of Philadelphia; Mr. Henry G. Bryant, Geographical Society of Philadelphia; Mr. Herbert L. Bridgman, American Geographical Society and Peary Arctic Club, New York; Mr. Gilbert H. Grosvenor, National Geographic Society, Washington, D. C.; Professor Russell H. Chittenden, director of the Sheffield Scientific School, Yale University; Dr. Edward J. Nolan, Academy of Natural Sciences, Philadelphia; Dr. Edgar F. Smith, American Philosophical Society, Philadelphia; Dr. Theodore Le Boutillier, Geographical Society of Philadelphia.

A memorial meeting in honor of the late James Carroll was held by the Johns Hopkins Hospital Historical Club on October 14. Addresses were delivered by Drs. William H. Welch, Howard A. Kelly and William S. Thayer.

Sir David Gill and Major P. A. MacMahon represented the Royal Society and the Royal Astronomical Society at the funeral of the late M. Maurice Loewy, director of the Observatory of Paris.

Mr. Allen H. Curtiss, a collector and student of the plants of the southern United States and of the West Indies, died in Jacksonville, Fla., on September 1, in the sixty-third year of his age.

The death is announced of Dr. J. Grancher, professor of the diseases of children at Paris and eminent for his work on tuberculosis among children.

Dr. William Marshall, associate professor of zoology at the University of Leipzig, has died at the age of sixty-two years.

There will be a civil service examination on November 13 to fill a number of vacancies in the position of constructing engineer, in the Forest Service, at salaries ranging from $1,500 to $2,000 per annum. These positions are for field service in the western part of the United States, with no permanent station, and require much travel.

The administration building of the Mount Weather Meteorological Observatory of the Weather Bureau was destroyed by fire on October 23. The loss is said to be $25,000, including some valuable instruments.

An imperial edict issued on October 9 ordered the Board of Revenue and Commerce forthwith to introduce a uniform system of weights and measures throughout the Chinese empire, the standards, whose character is not stated, to be fixed within six months.

It was announced at the International Congress of Psychiatry and Neurology, held recently at Amsterdam, that arrangements had been made for an International Institute for the Study of Causes of Mental and Nervous Affections. The king of Italy has offered the use of a villa near Lugano, but the institute will later be transferred to Zurich.

During the academic year 1907–8 Columbia University, in cooperation with the officers of the United States Navy and the United States Coast and Geodetic Survey, offers a series of public lectures in navigation and nautical science. They are intended for yachtsmen, officers of merchant vessels in New York harbor, and all persons interested in the safe navigation of the seas. The lectures will be given in 309 Havemeyer Hall on Tuesday afternoons at 4:30, and will be illustrated.

November 12—Rear-Admiral C. F. Goodrich, U.S.N.: Introductory Address.

November 12—Lieut.-Commander W. S. Crosley, U.S.N.: "Dead Reckoning and Coastwise Navigation."

November 19—Lieut.-Commander W. S. Crosley, U.S.N.: "The Bottom of the Sea and its Uses in Navigation."

November 26—Lieut.-Commander R. H. Leigh, U.S.N.: "Deep-sea Navigation: Latitude."

December 3—Lieut.-Commander R. H. Leigh, U.S.N.: "Deep-sea Navigation: Longitude."

December 10—Professor Poor: "The Sun and its Motions."

December 17—Professor Poor: "The Making of an Almanac."

January 14—Dr. R. A. Harris: "Tides: their Characteristics, Observation and Prediction."

January 21—Dr. R. A. Harris: "The Causes and Representation of the Tides."

January 28—Dr. R. A. Harris: "Tidal Currents and Meteorological Tides."

February 4—"How Charts are made and used." Lecturer to be announced.

February 11—Dr. L. A. Bauer: "The Magnetic Survey of the Pacific Ocean by the Carnegie Institution."

February 18—Professor Hallock: "Finding the North Magnetic Pole."

February 25—Capt. Howard Patterson: "The History of the Compass and its Errors."

THE Reed collection of heads, horns and skins of Alaskan big game animals, which for three years has been on exhibition at the Union Club in Victoria, B. C., has been secured for the New York Zoological Park. The collection was formed by Mr. A. S. Reed, an English sportsman, during an extensive series of hunting adventures in the northwest, and contains the finest lot of heads of giant moose, caribou, Alaskan brown bear, white mountain sheep and walrus ever brought together. Owing to the disappearance of the big game of Alaska, it is doubtful whether it would now be possible for any one to bring together such a collection of extra large specimens. Several of the objects are, by experts, believed to be the finest of their kinds in existence. The collection is widely known among the sportsmen of America and Europe. It arrived at the Zoological Park on October 16, and was temporarily stored in the horn room of the lion house. The collection was secured through the efforts of Dr. W. T. Hornaday, who last winter was instrumental in founding the National Collection of Heads and Horns, owned by the New York Zoological Society. It comes to New York as the gift of Emerson McMillin, Esq., a prominent member of the Camp-fire Club of New York. The collection is valued at $10,000; but by reason of the purpose to which it will be devoted, it was finally acquired at a total cost of $5,500. It was secured barely in time to forestall its sale abroad. A German sportsman passed through New York City on his way to Victoria to purchase the collection, when he learned that it had been secured two weeks previously by the authorization of Mr. McMillin.

Nature states that a meeting of the International Meteorological Committee was held at Paris on September 10 and following days. The committee consists of seventeen members, appointed at the conference at Innsbruck in 1905. Ten members were present, including the director of the Japanese service. Two places were vacant by death. The principal subjects discussed were the scheme of organization of international meetings for meteorological purposes; marine charts and weather signals; a number of items of the international daily weather service, including reports by wireless telegraphy; and various propositions concerning the meteorology of the globe, in which were included one on the necessity for observing stations in the regions of centers of action of the atmosphere, another on the necessity for new charts of isotherms for the globe, and a third on the desirability of daily observations from selected stations, in order to trace the course of meteorological changes over the globe. A number of special commissions were appointed to report upon, or carry out, the various proposals. M. Mascart, president of the committee, was unfortunately prevented by illness from attending the meetings with the exception of one held at his house for the discussion of the question of international organization. At the close of the session he resigned the office of president, and Dr. Shaw, director of the British Meteorological Office, was elected president. M. Angot, M. Mascart's successor at the Bureau Central, takes his place also as a member of the committee. Dr. Hellmann, director of the Prussian Meteorological Institute, was elected secretary, in succession to Professor Hildebrandsson, who retires upon his withdrawal from the post of director of the Royal

Meteorological Observatory at Upsala. Dr. Hamberg, director of the Swedish Meteorological Office, was elected to succeed Professor Hildebrandsson as a member of the committee. The other vacant places were filled by the appointment of Dr. Maurer, director of the Swiss office, and Mr. Stupart, director of the Canadian office.

The lime produced in the United States in 1906 amounted to 3,197,754 short tons, valued at $12,480,653, an increase over the production for 1905 of 213,654 tons in quantity and of $1,130,425 in value. The average price per ton in 1906 was $3.90, against $3.67 in 1905, an increase of $0.23. These figures are reported by Mr. E. C. Eckel, in an advance chapter from "Mineral Resources of the United States, 1906," published by the U. S. Geological Survey and now ready for distribution. The distribution of the production by states shows that Pennsylvania, with 624,060 tons valued at $1,857,754, has first place, its nearest competitor being Ohio, with 331,972 tons valued at $1,100,133. Maine, Wisconsin and Minnesota each produced more than 200,000 tons, with values approximating $1,000,000; and Maryland, Illinois, Massachusetts, New York and Vermont follow in the order named, with productions of more than 100,000 tons. West Virginia, Alabama and Connecticut each exceeded 90,000 tons. The value per ton increased in almost every state, the producers giving as the cause the increased cost of fuel, supplies and labor. Of the total production, 2,647,724 tons were sold for structural uses as building lime, hydrated lime, for sand-lime brick manufacture, for slag cement, and for quick-lime brick; 550,030 tons were used in various chemical industries.

UNIVERSITY AND EDUCATIONAL NEWS

The will of Robert N. Carson provides for the establishment of an industrial school for girls at the death of Mrs. Carson. The school, which is to be on the model of Girard College, will, it is said, have an endowment of five million dollars.

A fellowship in physics of the value of $500 annually has been established at the University of Cincinnati in memory of the late Henry Hanna, of Cincinnati, who was the giver of one of the university halls. The foundation was made by his widow and daughter.

A College of Medicine, in which for the present only the first two years of the medical course will be given, has been formally organized at the University of Wisconsin. The entrance requirements include at least two years of college work. There are specific requirements in Latin, French and German and in physics, chemistry and biology. Dr. C. R. Bardeen is dean.

Dr. Ezra Brainerd has resigned the presidency of Middlebury College, which he had held for the past twenty-three years, having been in all instructor, professor and president of the institution for forty-three years. Dr. Brainerd is known for his work on the geology of the Champlain Valley and the botany of Vermont. Dr. John M. Thomas, pastor of the Presbyterian church at East Orange, N. J., has been elected president of the institution.

Dr. Emery Taylor, associate in anatomy at the Wistar Institute of Anatomy, has been elected assistant professor of anatomy at Cornell University.

Dr. F. W. Thyrig has been appointed Bullard Fellow in embryology at the Harvard Medical School, and will devote himself to researches on the anatomy of human embryos and on the comparative embryology of the pancreas.

Mr. L. E. Emerson, Ph.D. (Harvard), has been appointed instructor in philosophy in the University of Michigan.

Professor J. J. Charles has retired from the chair of anatomy and physiology at Queen's College, Cork, which he has held since the establishment of the college. The chair has been divided—Dr. B. C. A. Windle, president of the college, having been made professor of anatomy and Dr. David Barry, professor of physiology.

Dr. Ludwig Brunner, has been promoted to an associate professorship of chemistry in the University of Krakau, and Dr. Erich Marx, to an associate professorship of physics in the University of Leipzig.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, NOVEMBER 8, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ADDRESS DELIVERED AT THE OPENING OF THE SEVENTY-SEVENTH SESSION OF THE ALBANY MEDICAL COLLEGE, SEPTEMBER 24, 1907

Gentlemen: We assemble to-day to inaugurate the seventy-seventh lecture session of the Albany Medical College. The need of any formal beginning has often been questioned, but the custom has been long established and there seems to be a certain propriety in maintaining old forms when they do not impede modern progress. To those here present who to-day begin, in a definite way, their medical study, this hour, which marks their entrance to a noble profession, is fraught with interest. It is for them a point of departure, and at such a time it may be that some, even of the seemingly insignificant things, said or done may make a lasting impress upon the mind, influence thought, or cast new light upon some problem which confronts them. In this hope I shall presently address myself particularly to these newcomers who eagerly, perhaps anxiously and very seriously, anticipate the experience which coming years have in store, but first of all it is proper that, as a representative of the faculty, I should extend to you all a most cordial welcome. Those who are coming back again feel, we hope, at home in their surroundings, and need not to be assured that they are welcome, but to him who is as yet a stranger within our gates we extend most cordial greeting. It is our hope that he may be one with us in all the aims and interests which we have in common, and that no seeming indifference on our part, or aloofness on his, may hinder him from taking the place to which he is entitled and obtaining every advantage and benefit which comes to those who are engaged in a common pursuit if so be they will ally themselves with their fellow-workers and thus secure their share of the inspiration to be derived by those who are bound together by a common tie and are striving to reach the same goal. To this community of interests I shall later on allude, because I am convinced by long experience that no little evil and loss comes to some from lack of proper apprehension of this matter, and while it may be that those who are continuing and not entering upon their studies here, and whose student habits are in some measure established, will be little influenced by anything said, I am encouraged to hope that some of those who find themselves in new surroundings may be ready to receive some new truth, or view some old one in a new light, so that it may impress itself upon the mind and influence in some degree their conduct. And this, as already intimated, is one of the advantages which such occasions as the present possess—that there are certain days in life and periods in the history of every individual when even the little things make their mark and find a lodgment in the memory. Which fact affords, as we have seen, some reason, or at least excuse, for such observances as this, which however perfunctory they may seem to some are yet by no means devoid of interest to others and may be made in some degree profitable to those who are disposed to view them aright.

This occasion has for me no ordinary interest. I stand to-day where on a similar occasion and for a like purpose I stood thirty-two years ago, and again twelve years ago, and as the duty which has for this third time been delegated to me is assigned in rotation to the members of our faculty it is in the highest degree improbable that I shall ever discharge it again. For many years as student and instructor, and for twenty-five years just closing as registrar, I have been connected with this school, and I can not look about me without recalling the faces of those under whose instruction I sat, whom personally I have known, or with whom as teacher I have been associated, many of them long gone, who from this place have addressed successive classes occupying the seats which you are filling to-day. Two of these were founders of the school—the brilliant surgeon March, and the versatile and accomplished anatomist Armsby, whose faces look down upon us from the canvases before you, and among those who at a later period became connected with the school were Dean and Harris in medical jurisprudence, and the dignified Scotchman of the old school, McNaughton, and the elder Vander Poel in the department of practise; Quackenbush and Seymour in obstetrics; Pomfret and Webster in physiology; Haskins in anatomy; Lansing in materia medica, and Porter, J. S. Mosher and Perkins in chemistry. Coming into the faculty later, and after its reorganization in 1876, were Swinburne in surgery, Gray and E. R. Hun in neurology, and F. Townsend in physiology. Dr. Thomas Hun had withdrawn from active participation in college affairs before my time, though he served as emeritus professor and dean of the faculty from 1876 until his death twenty years later, and Dr. Howard Townsend had just passed off the scene when I came on it as a student. These men and many others, for I have named only those whom personally I have known and none of the living, will be remembered so long as the history of this school shall endure, for they labored zealously in creating, upbuilding and successfully maintaining it. We do not recall the fact to find warrant for our present existence, nor can we claim lenient judgment for present performance by reason of distinguished services rendered by our predecessors, but we may find both incentive and encouragement in the contemplation of their work, and I take it that it is as true of institutions as of individuals that a line of reputable ancestors is something to be thankful for and on the whole no unimportant asset.

The place in which we meet compares but indifferently perhaps with the showy buildings in which many schools are housed. To the newcomer it may not be impressive, but since mind is more than matter, individuals more than piles of brick and mortar, and an elegant material environment in itself no evidence of intellectual profundity or productivity in its tenants, you need find in this fact no reason for discouragement. Plato in the groves, Socrates in the streets of Athens and Christ in the market-place, remain types of the true scholar and real teachers of mankind, and while conditions have changed essential truths are in no way altered. Our academies need a better housing than groves afford, and our teachers a more elaborate apparatus than sufficed for ancient philosophers, but in our thinking we should take care to estimate things at their real and not at fictitious worth or we shall place too high a value upon material things in the sphere of education and science. Here the real values are incorporeal, intellectual and spiritual, not material and directly convertible into dollars, nor are they directly producible by wealth. We stand in a great library, perhaps under the dome of the British Museum. Here are a million books collected at great labor and cost from all parts of the world and containing much of its best wisdom, but they are powerless to impart their knowledge to those who merely stand and gaze. And even he who longs to learn that which they hold in store is powerless to employ with real advantage more than the smallest fractional part of their great wealth. This wealth is like the energy potential in the coal deep buried in the earth, which must be mined with great toil, and burned to advantage, to convert it into impelling force and operating energy. Great fortunes, wisely employed, may render incalculable service to mankind, but it is an idle dream to suppose that dollars are directly convertible into brains, and that great gifts to education necessarily produce results proportional to their extent. Education, which is mental culture and implies a training of the faculties and development of the senses, is not on tap to be obtained by the turning of a faucet. When I survey the bewilderingly complex curriculums presented in the announcements of some of our universities I am reminded of the elaborate *menu* which is placed before the guest at a great hostelry. Everything is offered and one may choose this, and reject that, as his desires are simple or his greed consuming, but only that which is digested and assimilated serves the purposes of food and becomes a part of the body. Physical gain is not to be measured by the extent of the repast, nor is intellectual gain to be estimated by courses pursued, hours spent, experiments performed, books read, or even examinations passed. To hold otherwise is to entertain a very material conception and place too high an estimate on the value of the mechanical and material, the objective and external things which may be used to train and develop, but which can not create, the subjective faculties which are the real entities because they are the springs of action.

Let us look at this matter a little more closely, observing at the outset that for the carrying on of original investigation in most departments of science, and more especially in the physical sciences, money, and much of it, may be required. But I am not considering the needs of the investigator, nor the cost of carrying on his work, which may be great, ought to be met, and generally is, in one way or another, provided for. I have more particularly in mind the needs of institutions like our own, in which the work is mainly educational, not creative, and in which pupils are seeking to acquire some small part of the sum total of the world's accumulated and classified knowledge. Such pupils form the vast majority of those who attend our common schools and academies, our colleges and so-called universities, and our technical and professional schools as well. The average teacher in these institutions is himself not a genius, for the world's supply of such would scarce suffice to fill the places, but if he be competent and conscientious he is fulfilling a true mission, and the great work of education is carried on by teachers of this class. If he be deficient in those qualities which enable the born teacher to uplift his pupils, develop latent capacities, stimulate lagging energies, and broaden their mental outlook, so much the worse for him and his pupils, but his work is not to be condemned because much of it is but the repetition to successive classes of the rudiments of knowledge. He is dealing with the average intellect and with ordinary needs, and his work may be humble but it is not contemptible. It is honorable and all-important, and lies at the very root of our civilization and the intellectual progress of the race. Geniuses are born, not made. They soon outrun their instructors, and have indeed little need of them, being generally their own best teachers and the teachers of others. No complex apparatus, nor educational system, can create or even do much to develop them, and the chief function of the teacher, and main aim of education, must ever be to classify, preserve, render available and transmit the world's knowledge to the largest number of people who will receive it.

Now to carry on much of this work of education extraordinary facilities are not necessarily required. Ordinary results are secured by the employment of ordinary means. Unless we establish a standard of ideal and absolute excellence and perfection, and demand that the teacher shall conform to such standard or cease his teaching, we must needs be patient and tolerant of present, though imperfect, conditions. To abolish schools whatever their grade, because the teaching force is not of the highest, the equipment not of the best, and the results obtained not entirely satisfactory, would be folly indeed. And yet this is essentially what some idealists would seem to advise. What shall be thought, for instance, of the sanity of a critic who has said at a conference of state medical examining boards recently held in Chicago, that of the one hundred and fifty medical schools in this country only six were what they ought to be. We may well inquire of this critical essayist—whose opinion as to what medical schools "ought to be" is to be taken? Are we to assume that the school with which the critic is connected is one of the six that are what they "ought to be"? If so, does it represent perfection? The absurdity of such utterances is the more clearly seen when we consider how far short of perfection are the results of all human endeavor. Churches, social organizations and philanthropies, legislative bodies, courts and political parties are not what they "ought to be," but are they to be indiscriminately condemned, and are we to be told that we should be better off without them! Aside from an abstract sense in which it may be said that only pure truth and absolute perfection are admirable, and all error, incompleteness and insufficiency is abhorrent, it can not be maintained that the existing machinery employed by men collectively in society serves no good purpose because of its imperfections. Such a view underlies much anarchistic philosophy, discourages the endeavor of those who are laboring to better existing conditions, and retards progress. In the discussion of educational problems the inferences and strictures of irrational critics are unproductive of good result, harmful in many ways, and their recommendations if carried into effect would work irreparable injury to our educational system.

In the sphere of education we have been, it seems to me, unduly impressed by mere size and extent of output. Having observed the advantages that in the industrial world accrue from combination and the annihilation of competition, and learned that profit depends upon increased output, diminished cost of production and control of the market, it has seemed to some fair to assume that the larger schools should be able to afford better educational facilities, and these at a lower cost, than the smaller ones, and that these therefore ought to be strengthened since they would seem to be destined in time to extinguish their weaker and less favored competitors. We are often told that the small college will have to go, and so convincing appear many of the arguments of those who hold this view that it is not surprising that they find ready acceptance among philanthropic millionaires who are seeking for channels into which they may turn some of their surplus wealth. But what are in reality the results of this concentration which produces in some cases a kind of monopoly, and what may we expect them to be in the future, are questions well worth raising. This rather startling fact I think is one of them, that our richest and most liberally endowed colleges and universities are the most expensive to the student, and that in proportion to their gain in wealth the cost of attendance upon them increases. In other words, large capital, extensive plants and increasing patronage do not seem to reduce the cost of the educational output. This is not in accordance with economic laws as we observe their operation in the industrial world, but the fact is one not difficult to explain. Increased attendance means larger buildings, with more lecture rooms and laboratories, and a larger teaching force, and the cost of providing these may greatly exceed the increased revenue from tuition fees, so that large patronage by no means implies diminished cost of maintenance *per capita,* but often the reverse, and for this reason some of our colleges are now seriously considering the advisability of limiting the size of the entering classes either arbitrarily or by raising their entrance requirements. Nor can it be said that the larger institutions give so much better a return that the greater cost to the student is simply proportional to its real value. This view might be urged with some show of reason, for while it is a simple matter to determine the value of the material output of a manufacturing concern it is by no means easy to estimate moral and intellectual values. All sorts of arguments might be advanced as to better teachers because of better salaries, and better teaching because of better equipment. I do not propose to debate the question, but I hardly suppose that any one would claim that there is any definite relation between the size or wealth of an educational institution and its real effectiveness, so that it might be said for example in the case of an institution having a million dollars invested in its plant and another million in endowments, that, if these were doubled the institution would be capable of doing doubly efficient work. I take it that no reasonable person would undertake to maintain such a proposition as this, and yet some such notion seems to be entertained by some people who are unreasonably impressed by large figures and discover a relation between bigness and excellence that is invisible to more judicious observers. If the money given to education was in all cases as wisely employed as that which has been applied to the establishment of free technical and trade schools, for example, it is doubtless true that greater and more beneficent results might be accomplished, but when much of it goes into unendowed and often unequipped buildings which can only be maintained by calling upon alumni and friends for aid, or by raising tuition and other fees, we can understand why many colleges are property poor and constantly begging. The building of great dormitories often makes sharper the lines of social cleavage in the student body, places a premium on wealth, encourages luxury and ostentation, and makes life the harder for the poor and self-respecting student, and money expended for building gorgeous chapels, great gymnasiums, magnificent dining-halls and the like is generally misapplied and productive of few good results. Even great library buildings and museums are often useless duplications, the maintaining of which makes large drafts upon income, and they may be of little direct benefit to the undergraduate student, and none at all to the advanced worker for whose needs they may be quite insufficient. These external and material things, often imposing, even magnificent in themselves, contribute little in any direct way to the legitimate educational work of an institution, and they often limit its activities and interfere with its real usefulness. Theirs is a fictitious value, largely sentimental, but the cost of maintaining them is great, and in this do we find further explanation of the fact that our largest and richest educational institutions are most expensive to their patrons. Nor can much satisfaction be obtained from a consideration of the claim that in many of our larger colleges opportunities in the way of scholarships are open to able and deserving students, because it is not so much the poor man of brilliant parts, able to secure these prizes, that needs aid and encouragement, as the man who is both poor and of average ability. He it is who most needs aid and for him more should be done. There is danger that the conditions in some of our endowed eastern universities may in the not far distant future come to resemble those existing at Oxford and Cambridge. Bishop Gore in the House of Lords has recently denied that these universities are training the "governing classes." "The working classes," he asserts, "are beginning to govern the kingdom, and they are excluded from universities which are playgrounds for the sons of the wealthy, the majority of them idlers." The influx of foreign students at Oxford, due to the establishment of the Rhodes scholarships, has shown the insufficiency of much of its machinery for latter-day needs, and in America we shall be losers and not gainers if through mistaken sentiment we copy the imperfections of English universities instead of aiming to develop a type natural to our soil, adapted to our needs and in keeping with our institutions and social system. Chancellor MacCracken, in an address to teachers and students of the summer school of the New York University last month, said:

> More than one university to-day is in great danger of being misunderstood. A few "trust magnates" are giving to certain universities millions of dollars. These universities are in danger of being reckoned the purchased servants of a narrow caste. The sure and efficient way to escape this suspicion is for the universities to rid themselves of idle undergraduates who make no end of trouble, and to devote their money and energy to giving instruction and inspiration to the public teachers throughout the land. In a word, let the university cease to serve so largely the unproductive few and rather serve the productive and industrious many.

In referring as I have to the misuse of moneys given to education, and in the few words that I shall add in taking leave of this topic, it has been far from my intention to imply that money is not needed in educational work. It is, and vastly more than has yet been given, or provided by any state, might be well applied, but my desire has been to emphasize the fact that large real estate holdings, costly buildings and even great collections in science, literature and art, are merely external things which may, or may not be, advantageously and economically employed, and should be regarded as means and not as ends in themselves, since they may be entirely unproductive unless wisely used, and even their possession may, by establishing false standards, restricting competition and in other ways, work harm rather than good. In a country like ours higher education should be in no way dependent upon the variable and perhaps ill-directed impulses of individuals, however generous and philanthropic they may be, but like our public school system, which is our pride and great privilege, makes valuable to us our political rights, and is the chief conservator of our national well-being, it should be, and doubtless in time will be, administered by the state for all the people. Following the lead of western states, we shall have great universities, of wider scope and greater size than any now existing, where instruction in all departments of learning will be given to all who are competent to avail themselves of the advantages offered and are desirous of embracing them. Can public funds be better expended than in the education of the people, and if the revenue of the state was largely increased by proper taxation as of incomes, increased graduated inheritance taxes, and larger taxes upon stock-transfers, public franchises and many luxuries, the cost of higher education for the people would not be felt. I shall not stop to answer the objections of those who entertain the time-dishonored notion that public education is a form of charity, and that it is no part of the duty of the state to bring higher education to the masses, since the principle, well enunciated by the late President Harper at one of our university convocations in this city not many years since, that a municipality has right to teach anything in its schools that its voters are willing to tax themselves to pay for, is seldom any longer denied. At its last session the Wisconsin legislature passed a law authorizing cities in that state to raise funds by tax for the establishment of trade schools, and similar and even more comprehensive action bids fair soon to be taken in other states. If the east does not follow the west in establishing, and liberally maintaining, state universities we have reason to fear that our smaller colleges and professional schools will be overshadowed and ultimately extinguished by the larger institutions which receive the great benefactions. Professor Lowell, of Harvard, in an address delivered at Yale last April, shows that "a young man can go to-day more cheaply to a state university in another state that charges a differential fee, than to one of the eastern colleges." If the cost of attending our private and endowed institutions is to go on increasing the result inevitably will be that the larger and richer these become the more inaccessible will they be to the poor student who has greatest need of such advantages as they offer. I return to and emphasize this point because it is not a theoretical criticism, but an obvious fact. Our smaller colleges deserve and should receive fuller recognition and better support. Unless this is accorded them they are sure to suffer and the people to be the losers, but the ills resulting from the increasing cost of higher education may doubtless best be relieved by the state and in the manner indicated. The old objection to all this that we have doctors and lawyers enough but need more working people and servants, has been answered too often to need notice now. The law of supply and demand will take care of all that and, in any event, no social order can be lasting which seeks to perpetuate itself by keeping a part of the people down.

But another reason aside from general expediency why the state should undertake the duty of providing technical and higher education for the people may conveniently be stated now. During recent years the state has assumed the right to regulate many industries and most of the professions in the public interest. In so doing it has incurred consequent responsibilities. Industrial independence is now held in check by state control, and at no time has the disposition to regulate trades and control corporations been so marked as at the present. And so with the professions also. The regulation of the practise of medicine amounts in most states to absolute control. The state sets the educational standard for the student entering the medical school, and it fixes the length and character of the course which he must pursue, and after his graduation requires him to give evidence of his competency by passing an examination before it confers upon him by license the right to practise medicine. Infractions or evasions of the medical laws are punishable by severe penalties and the control exercised by the state over the practitioner of medicine from the day of his entering into the ranks as a student is supreme. But, in raising the standard and regulating the practise of medicine the state has assumed new responsibilities and the time is not far distant when it will be recognized as its obvious duty to make adequate provision for the education of its people, not in medicine alone, but in all the professions and many other occupations which it regulates, or in which it has established standards. This need in no way interfere with private institutions any more than our public schools interfere with private academies at present. If the result of the establishment by the state of high standards in medicine, for instance, is to increase the cost of medical education so that the doors of the schools must be closed to many, then the duty of the state to make provision for the education of such is apparent. And this condition is approaching. That many schools of good standing and entire respectability continue to carry on their work, as in the past, through the income derived chiefly from tuition fees is true, but it will be found upon investigation that these schools are possessed of certain advantages, as of position, established reputation, or exemption from certain present restrictions, which account for their continued existence. We are told by some educational experts that it should cost the medical school three or four times as much to educate a student as it can reasonably demand from him in fees. In other words it amounts to this—that no body of men having secured a charter in this state, for example, could provide the money to erect and equip a medical school which should comply with the requirements of law, and carry on therein the work of medical education at a profit. Indeed a very large balance on the wrong side of the ledger must soon be shown if running expenses and interest on cost of plant is to be paid, and the school is to compete with other established schools. If this be true it must be evident that ordinary business enterprise can not be depended upon to establish and maintain medical schools, and that the work of medical education must sooner or later be done either by private institutions enriched by wealthy benefactors, or in universities established and maintained by the state. We are in a period of rapid change. For a time the old order will suffice, but it can not be for long. Some of us view these impending changes with anxious uncertainty; others with apathetic indifference, and others still see in the progressive movement that is taking place the promise of the satisfactory solution of a perplexing problem. For myself I can not for a moment doubt that when the time comes for the people to decide whether the avenues that lead to professions like ours are to be kept open and safe-guarded to all the people, or whether they are to be narrowed by private control, or maintained by the self-sacrifice or generosity of individuals, they will speak with no uncertain voice.

And now before we take leave of this subject may I indicate some present tendencies which to my thinking need to be restrained, and which if not checked may result in the evolution of such a cumbersome and mechanical system of medical education and licensure as may threaten its overthrow, and in what I shall say, as also in all that has been said, excepting only in the words of welcome with which as a representative of the faculty I have greeted you, I give expression to individual opinions and am not speaking for my associates, so that if there be error or fault in anything said the blame is mine alone and should be imputed in no degree to any other. It behooves us, I think, to remember that our licensing boards are creatures of the state and that our whole educational system is subject to the will of the people and is not controlled by educators, specialists and salaried officials. Those who favor reasonable state control will therefore not urge reform of too radical a nature lest what has been gained be placed in jeopardy. In the state of Minnesota last winter so insistent a demand was made in the legislature for the opening of the state university to all applicants without regard to preliminary training that the project, though subversive and ill-advised, had to be considered and a compromise effected. Conditions in the east are different, but if the policy of certain extremists, who are influential at present in our state and national associations, is adopted, opposition will be aroused which may precipitate a reaction. Those who favor higher standards and extreme state control base many of their arguments upon doubtful premises. I am sometimes inclined, for example, to disagree with those who hold that since the adoption of a preliminary education requirement by law in this state an improvement has been effected in the class of men entering the medical schools. Men who spell wretchedly and make bad work with simple arithmetical calculations still enter, armed with state credentials, and last year in this school more first-year men were conditioned than in any previous year within my recollection. Nor am I inclined to believe that the average reputable American physician to-day is in any recognizable degree superior to his predecessor of a quarter century ago *as a result* of state supervision. State control may eliminate ignoramuses and charlatans, although in many states the laws are so framed as to apply to physicians of established schools of practise while irregulars of many kinds and "healers" are exempted from their provisions, but however effectual they may be as restrictive measures laws are much less effective in elevating the people in any direction than many enthusiasts would have us believe. The educational systems in European countries where bureaucratic methods prevail do not always produce the most enlightened citizenship, and in a democracy institutions thrive best if the people are not governed too much. I think that our medical schools themselves may be trusted in greater measure to bring about needed reforms and advance medical interests than some noisy reformers who clamor for more and more stringent laws seem to suppose. It seems to me to be time that the medical profession asserted its dignity once more and resented the imputation that so large a number of its members are incompetent or unworthy that the public needs further protection by special legislation. Whatever others may think I shall not hesitate to raise my voice in opposition to such utterances as the following. Says the *Journal of the American Medical Association* in its issue of September 14, in the leading editorial:

> Stronger safeguards should be placed about admission to medical practise in many of the states. The examining boards should be given supervision of all medical colleges within their respective states, with authority to pass on the entrance requirements of prospective medical students and to issue or to have issued to medical students entrance certificates. They should have the right to inspect the medical colleges and to close such as are not sufficiently equipped or are not doing satisfactory work. . . . Without this right the boards are not in position to protect the public from incompetent physicians.

And this is the utterance of a journal which is supposed to represent the profession of the United States, but which, under its present management, is, in the opinion of some, representative of commercialism in medicine in a preeminent degree. It floods the mails with circulars urging graduates of the schools against whom it brings this general charge of incompetency to ally themselves with the association and to subscribe for the journal, and it solicits the advertisements of the colleges with unwearying persistence. In the issue in which this editorial appears I find the advertisements of no less than ten medical schools which, according to its own statistical tables published in its issue of May 25, ranked in the lowest class as judged by the percentage of failures of their graduates before state examining boards during the year 1906. Now I do not hesitate to say that in my opinion there is not an examining board in any state in the union which could safely be invested with such authority as the *Journal* recommends. In our own state, for example, this board is so constituted that although eighty-five per cent. of the physicians in the state are "regulars" they are represented by but four members upon a board of nine. In many of our states men of only average ability and capacity are drawing salaries and exercising a little brief authority under the laws in places often secured through political influence. What shall be thought of a proposal to place the medical schools of this country under their absolute control. We have been shamefaced too long, fearing perhaps that if we in the schools raised our voices in protest against these insistent demands it might be thought that we feared investigation or opposed reasonable and proper supervision. Such is not the fact, but silence may be construed at times into an admission of guilt and it is high time that we resented the implication that the medical schools of this country are, as a class, unmindful of their high responsibilities and are employing questionable methods in the conduct of their work. There are poor medical schools as there are poor schools of all kinds, but no general charge of incompetency or dishonesty can lie against them as a class, and we should no longer remain silent when such charges are either directly or impliedly made.

Now first of all it seems to me we must guard against anything that savors of trades-unionism in medicine. Physicians should be banded together that they may promote the interests of their profession in proper ways, but any action that looks like closing the doors, or putting up the bars, for the purpose of lessening the number of medical men, and restricting competition, ought not to be tolerated. We are often told that the number of physicians in the United States is out of all proportion to the population and greatly exceeds that in any other country, but this fact in itself has no particular significance and may be cause for thankfulness. Conditions are different. If these practitioners are competent, and can make a living, let us not complain but rather thank God that the American people are better supplied in this respect, as in so many others, than those of Russia, or even France, Germany or England. With those who start with the assumption that our social system needs to be conformed to the European or monarchical type I have no argument, but there is danger that well-disposed and entirely patriotic persons, who are possessed with a zeal for reform and advance which is not tempered by a wise discretion, will by much fussing and compiling of statistics and the everlasting iteration of certain ideas bring about changes which will not be betterments. Such are the people who would reduce everything to a strict numerical expression. They pursue their investigations with a foot-rule and hour-glass, place implicit faith in statistics, and would reduce all to a system. They would determine the competency of a student to enter upon the study of medicine by the special courses he has taken, and the hours devoted to each, and whether his work is to be counted or not is to be decided by a measurement of floor-spaces of the recitation rooms and laboratories in which he has been instructed, and the cash value of the apparatus employed. They would measure his subsequent progress by mathematical computations in which the factors are forty or fifty divisions of the medical curriculum, each subdivided into lectures, recitations, clinics, demonstrations and laboratory work, and the value of each determined by a laborious conversion of these into hours, which must be so apportioned as to preserve a certain ratio, and the sum total of which must not fall below a prescribed minimum. And whether this instruction which he has received has been good or bad is to be determined by a consideration of the population of the place in which the medical school is situated, the value of buildings and apparatus, the ratio of students to floor areas, the number of cases treated in affiliated hospitals and dispensaries, and other such data. This is not fanciful. No month goes by that we are not requested to supply such information as this to individuals who are preparing papers to read at society meetings and conferences, to committees and councils of societies, and to state examining and licensing boards. These tiresome statisticians, with their arbitrary standards and mathematical deductions, seem to be in the ascendancy at present, but their enthusiasm needs to be restrained and saner views will ultimately prevail. Their information is often inexact because it is voluntarily and often carelessly given; their methods of computation are faulty, and their conclusions therefore unreliable. Their method takes no account of the past record and acknowledged reputation of institutions, of the experience, devotion and ability of teachers, and other elements the value of which is not determinable by the quantitative methods in which they so much delight, and in the case of the student it has no way of measuring natural aptitude, quickness of perception and the zeal which is often born of necessity. For myself I do not believe that either institutions or individuals can be measured up in this mechanical manner, and I do not think that such methods will be tolerated if they ever come to be rigorously applied in determining the standing of colleges and passing upon their credentials. It is not denied that great differences exist in the quality of the work done in the medical schools of this country, but I am clearly of opinion that the present tendency is to attach altogether too much importance to the institutions in which a man's education has been obtained. Do we not need to change our thinking in many respects? Institutions do not make men. They only aid a little in their development and the things which we have taught ourselves are the most valuable to us in the real work of life. "They do most by books," says Sir Thomas Browne in his "Christian Morals," "who could do much without them, and he that chiefly owes himself unto himself is the substantial man," and Darwin has said with greater deliberation and more seriously, and I beg you well to weigh his carefully chosen words, "I am inclined to agree with Francis Galton in believing that education and environment produce only a small effect on the mind of any one and that most of our qualities are innate." Manners are the result of, and much of our behavior is influenced by, education and environment, but our qualities are born in us and training has little effect upon the mind. Hence the mistake in attaching too much importance to time spent, and courses pursued, in institutions, and there is great danger that our laws regulating the practise of medicine and other callings may be patterned after too narrow, inelastic and mechanical a model and serve to restrain rather than encourage the development of the vocations they control.

Another tendency needing restraint is exhibited by certain specialists and faddists who urge upon colleges the necessity for giving instruction in all sorts of special subjects more or less closely related to medicine. Lest I give offense to some of these enthusiastic propagandists who push their projects with energy worthy of more important causes, I will make no catalogue of them. These zealous advocates read papers at society meetings; interrogate the colleges in tones implying that they are guilty of wilful neglect in failing to include their fondly cherished fads in their curriculums; and they organize societies and write books on their specialties. Unfortunately they take no account of the demands now made upon medical students and the relatively small importance of their particular branches, and they overlook the fact that such subjects as they would have taught in systematic courses are either already included in other departments, or else are of such a nature that the physician who has need of special knowledge concerning them can easily secure it for himself when the want is felt. Unless the colleges resist this kind of pressure from without that is brought to bear upon them either their courses must be lengthened or essential subjects must be curtailed.

We may indeed go further than this and say that the disposition to add anything to the present medical course which will necessitate lengthening it is a tendency that needs to be restrained. Unless the schools are to adopt an impracticable standard for which certain idealists seem to be contending, we may well be satisfied with the present four-year course. No one can deny the great advances which have been made within recent years, but is it not idle to suppose that educational courses can ever be made theoretically perfect and complete? Let us abandon the notion that the whole field should be covered in the medical course, and recognize the fact that as knowledge advances, and specialization increases, the ability of the individual to master the whole diminishes, so that the first and evident duty of the medical school should be to teach essential fundamentals and well-established principles, and leave many specialties, and most of the subjects which are still debatable, to be treated in optional courses or in other institutions.

And to my thinking it is no less true that the time spent in preparatory work is often much too long. The favored pupil who leaves the high school or academy at eighteen, college at twenty-two, and the medical school at twenty-six, if he takes a year or two of hospital or other post-graduate work, or studies abroad, will hardly be able to begin his practise until he is approaching thirty. This is quite too long a preparation. The man who has nothing to do, and plenty to do it with, may spend his time thus if he so chooses and no one be the worse perhaps, but the average man can not afford it, few men need it, and many men are injured by it. Doubtless some men mature less rapidly than others and need to be kept under tutors and guardians longer, but no educational system should be planned to meet the needs of the weaklings or the demands of idlers. Montaigne in his essay on "Age" says:

> I esteem that our souls show at twenty years of age what they mean to be. No soul that has not by that time given evidence of its strength will give proof of it afterwards. The qualities and natural virtues produce in that time or never what they have of vigor and beauty. It is possible that with those who occupy their time well science and experience may increase with life, but vivacity, promptitude and firmness, and other more important essential faculties, will fade and deteriorate. Therefore I complain of our laws; not that they leave us too long to our work, but that they do not employ us earlier; for considering the frailty of our life and the many ordinary accidents to which it is exposed I complain that so large a portion should be given up to childhood, to idleness and to apprenticeship.

If that was sound doctrine in the sixteenth century it is even sounder in the twentieth and needs restatement. Too much time is wasted in preparatory schools and colleges, but if these things can not be remedied then, to my thinking, the prospective medical student will do well to go from the high school directly to the medical college, or spend at the most not more than two years in intermediate work, which he may well devote chiefly to physics, chemistry, biology and modern languages. The old-fashioned college course is of little service to the student of medicine, and the time spent in pursuing it is frequently worse than wasted. The habits and associations which are formed are too often distinctly detrimental, and that four of the most valuable years in a man's life should be given over, as often they are, to aimless study, boyish frivolity and the formation of ideals which must be abandoned, and of habits which must be corrected in after life, is indeed deplorable. The youth who at eighteen or nineteen is without plans for the future and is carried along by indulgent parents through a four-year course in college is little likely to be the better for it. If young men are to be sent to educational institutions for the purpose of increasing their social connections, winning laurels in athletics, touring the country in glee-clubs, or acquiring a superficial polish often referred to as culture, let the fact be admitted, but let us cease calling the experience thus obtained education. That a man should be at pains to learn much that later he ought to forget if he have due regard to his soul's health is disheartening indeed, but too often true of those who, without real disposition to learn, are yet engaged ostensibly in study.

But we must leave these general considerations and in so doing let me say that my object in discussing with you some of these educational problems has been neither to prejudice your minds nor to urge upon you the acceptance of my own views, but rather to incite you to investigate for yourselves and form your own conclusions. Do not accept standards and entertain opinions simply because they seem to be held by those about you. All real reforms have been brought about by discontented people —not by the conservatives and self-satisfied people, but by the radicals who go to the root of matters and do not judge by the stalk or even the flower alone. In every community a certain number of prominent people desire, from motives of self-interest, to maintain unchanged the present order, but the larger part are inert and take their opinions ready-made from others. These would not willingly injure their fellow-men but they are satisfied to drift with the current, and feel it to be no part of their duty to inquire whether the multitude are as fortunate and as well rewarded as themselves. Better far is it for us and for others if we think for ourselves, give expression to honest convictions, unrestrained by considerations of policy or temporary expediency, and when called upon to act, do so with the courage and decision which real convictions should impart.

And now will you allow me to add some words of advice and general counsel more particularly addressed to those who to-day make formal beginning of their medical study. You are entering, gentlemen, by different paths the portals which give you access to a noble profession. Do you recognize your responsibilities? If so the realization of them must of necessity affect your behavior and influence your lives. You are no longer boys, but men, associates and coworkers with your instructors, many of whom perhaps some of you will outrun in the race. Time will tell. See that you start aright. Do not think that your course is divided up into periods, some of which are preparatory or probationary, and admit of idleness and dissipation. You could not make a greater mistake, for it is not so. You are in the profession now. Claim all things to which you are entitled and act as befits men who have adopted a high calling. I beg you to listen to me when I say that you can make no greater mistake at the outset in your course than to attempt to inject into the medical school any of the boyish frivolities or foolish customs that obtain and may even be encouraged in high schools and colleges. Put all such things behind you, for they have no place here. If you have not "been to college" do not, I beg of you, suppose that the medical school in some way is to supply an imaginary lack. Don't call yourself a "freshman." We have no "freshmen" here. Don't do the foolish things that many college students do because you are in a "college." Many of these things are bad enough even in the places where usage has in a sense sanctioned them, but they are entirely out of place in a professional school, and actions which might be condoned on a college campus become, if transferred to a medical school, merely disorderly acts, the perpetrators of which render themselves not only nuisances but liable to arrest for breach of the peace. I can not put this matter too strongly, and yet I do not wish to lay down any particular rules to govern your future conduct here. The whole matter lies in a nutshell. You are men, and have come here to associate yourselves with men engaged in the pursuit of knowledge whose desire it is to assist you in your work. They assume that your habits are fairly well formed, and that you are competent to enter upon the work which you have undertaken. They are willing to counsel and aid you, as friend may aid friend, but they do not desire to take the place of parent or guardian, and do not think that they should be held in any way responsible for your deportment. They stand upon no exalted pedestals and are neither omniscient nor oracular in their deliverances, and they expect from you only the courtesy which they are ready to render to you. That you are medical students then imposes new responsibilities and confers new dignities, but gives no license to disregard the ordinary rules of behavior which need no formal statement among gentlemen. Should there be any one here who has not appreciated this fact before and who is beginning his course under a misapprehension I beg him to revise his thinking that he may see things in their right relations to-day. The medical school is no place for boys and boyishness, and the medical student of to-day should no more conform to the Bob Sawyer type than our trained nurses do to those of the Sarah Gamp pattern.

Now this does not mean that there should be no relaxation at proper times, nor that all manifestations of class feeling and college spirit are necessarily out of place. Men who are closely associated for considerable periods of time naturally form attachments and such association engenders a kind of *esprit de corps*, but among men this should not find expression in boyish acts, and when it is manifested in buffoonery, lawlessness and physical conflicts the perpetrators of such acts become troublesome and disturbing elements. Our colleges are responsible for much of this lawlessness, for they too frequently condone where they should condemn, and they have been slow to reprove much which they might well have repressed, but from the man who has entered the professional school better things are expected, and if he falls short in his behavior he will find no indulgent apologists to hold him blameless.

Now, it may not seem very gracious in me to take advantage of the opportunity which this occasion presents to utter either warnings or complaints in seeming advance of any need of them, but the sincerity of the interest which I feel in your welfare prompts me to this frank speaking. Too many men who began their course with us last year made utter failure and find themselves again at the starting point, and for this reason, I believe, that they entirely misunderstood their position here. If I can save any one man from such lamentable failure I shall feel well satisfied to have put plain speaking in place of pleasant phrases and meaningless generalities. I can hardly suppose any one of you to be so short-sighted, but if any one is here to please parents or friends, to pass the time, or to secure an ornamental degree, he will find himself out of his element in such a school as this. Assuming, however, that you are here with good reason and honest purpose, what can be more evident than that you should cooperate with your teachers in all ways that you may secure to yourselves the largest possible return for the time and the money which you are investing. If you slight your work, evade or seek to be excused from it, is it not evident that you are injuring only yourself? This would seem to be the merest commonplace, but it is far from being recognized by all. Men come here from schools and colleges, and they do not always realize that inherent conditions are different. In the college course the man whose only ambition is to get through and secure a degree can save himself trouble by selecting easy subjects where he has choice, by slighting his work to the point of maintaining a bare passing stand, or by dint of cramming, cribbing and faking he may secure his ends and, in a sense, get the better of his instructors. But in a medical school it is not so. There are, and can be, no equivalents and electives, no purely disciplinary or culture studies, and there should be no superfluities. Every subject is connected with some other and all are essential. Perfection is not expected, and it is not denied that some matters may be sacrificed or slighted and one's standing maintained, but none the less it is true that just in so far as work is neglected the delinquent is a loser, and if any one is cheated he is the sufferer.

Another thing I think ought to be said. You will find the work here harder probably than any you have done before. You will need to devote to it more hours a day than you have ever probably given to study in any other institution. Some advisers would therefore caution you as to the care of your health and the dangers resulting from a too strenuous application, but these are more imaginary than real, and I shall give you no such caution. I have known many men injured by too much exercise and harmed by too much recreation, but I can recall no instance, in my own personal experience, of injury resulting from too much study. I do not deny the possibility, but I consider the probability so remote that words of caution are uncalled for. Such exercise as you need you can secure in simple and inexpensive ways. Leave out-door sports for the present to those who have leisure for such diversions, for you have other things to do and will have little time to give to them. School teachers, clergymen, studiously disposed persons generally, who lead sedentary lives, ordinarily enjoy the best health, and the risks and dangers to which the medical man is exposed do not result from over-study or too close confinement, and even if they did, remember that the mere preservation of health and prolongation of life are not the highest conceivable aims, and that these considerations may be, and often are, disregarded with advantage. Intellectual growth and spiritual supremacy are more important than muscular development and physical superiority, and while the sound mind in the sound body may be the ideal toward which we should strive, if either must suffer let it not be the mind.

Gentlemen, you are prosecuting your medical studies at a propitious and in a momentous time. The science of medicine is making great, and is probably destined to make still greater, advances. The place you have chosen for your study is favorably situated and Albany is doing her part in the advance movement, to the progress of which you may have opportunity to contribute. Its importance and influence as a medical center is daily increasing. Its hospitals are of the best, its laboratories well manned and productive, and this old school is entirely in sympathy with the modern trend in the development of the medical sciences, and is employing modern methods in its work of teaching. Its graduates rank high in the profession, and occupy important and conspicuous places in the community. A high standard has here been established and it will be maintained. What more need I say than that we welcome you to our ranks, pledge you our aid and urge you to improve every opportunity offered you for gaining knowledge of the profession to which you have devoted your lives. May this day be an auspicious one to you all, full of encouragement to those who return after a season of rest to the prosecution of their studies, and presaging success to those who, with honest purpose and entire devotion claim entrance to the ranks. On behalf of the faculty I greet you once again and bid you cordial welcome to this place.

Willis G. Tucker
Albany Medical College

AMERICAN CHEMICAL RESEARCH[1]

It is no disparagement to say that there are few chemists whose research work, at any given time, is of vivid interest to all classes of their chemical colleagues. To address an assembly of this kind on the experimental results of another man, to which results one has nothing of one's own to contribute, is to lay oneself open to a cross-fire—one part of the audience will ask why the speaker did not select a subject of which he had an adequate knowledge, whereas the other part will enquire why he did not deal with something that was *really* interesting. I have protected myself against both lines of attack by choosing a very large topic. I am confident that, intrinsically, it is interesting to each of us, because we all read our own papers and occasionally the publications of our friends, especially if we believe them to be erroneous, or think that they are going to interfere with our particular results!

During the past three years I have had the sole active charge of the *American Chemical Journal*, and I propose to take its history as the basis of my remarks. I select it simply because of my familiarity with it; the subject could be equally well illustrated by our own *Journal* and, so far as its age permits, by the *Journal of Physical Chemistry*. The first number of the *American Chemical Journal* is dated April, 1879. Volume 1 (1879–80) contains 460 pages. Volumes 10 and 20 (1898) comprise 472 and 890 pages, respectively. After that year two volumes were issued annually, the last one, number 37 (January to June, 1907), includes about 650 pages. To put it in another way, at the end of ten years the quantity of published matter per annum was the same as at the end of the first year; at the end of the twentieth year it had doubled, and eight years later it was three times greater than during the tenth year. An inspection of the earlier volumes suggests many reflections concerning the almost complete change which has taken place in the names of contributors during the past twenty-eight years. I shall not indulge in these beyond saying that death accounts for only a few of them. I feel sure, however, that you would not wish me to pass in silence over the fact that of the earlier contributors, practically only three, Professors Arthur Michael, H. N. Morse and W. A. Noyes, continue to contribute, at the present time, as successfully and copiously as ever to the extension of scientific knowledge.

Returning now to the consideration of the enormous increase of published matter, especially during the past fifteen years, the question arises, To what is it due? Undoubtedly the amount of scientific research carried out in this country is greater, both relatively and absolutely, and a comparison of the papers published in American chemical journals with those appearing

[1] Address delivered before the American Chemical Society at the Toronto meeting, June 28, 1907.

in other countries will show, beyond question, that on the average the home product is fully equal in quality to the foreign output. Although we may be satisfied on this point, yet it is certain that very much more might be done if an extra effort were made by the many whose training has taught them something of the methods of research, and this extra effort would not fail of its speedy reward.

A second most potent factor in increasing the quantity of work published in this country is undoubtedly due to the fact that, until comparatively few years ago, much if not most of the results of the best work done here was published abroad. At present not more than two or three people of any importance in the chemical world habitually send their results to Europe, yet some who should know better often communicate preliminary papers, or short articles containing the cream of their results to foreign journals. When, as sometimes happens, this is done essentially to secure duplicate publication, it is, of course, inexcusable, and even when the motives are unexceptionable the practise is one that should be indulged in sparingly, because it simply encourages the highly conceited and very prevalent German habit of ignoring or belittling American chemistry. Further, we must remember that if *we,* without detriment, can *now* publish our results at home, it is because of the patriotism and self-sacrifice of men like Professors Edgar F. Smith and W. A. Noyes, who, in the darkest days of our society, deliberately published some of their most important papers in its *Journal,* and thus compelled serious foreign recognition of it. It is the results of their devotion which we are now enjoying.

Leaving this matter of publication, I wish to direct your attention to another phase of the subject. Many persons have the *name* of research on their lips, but the *thing* itself is far from their minds. This is true of the college president who "encourages research" by giving an unfortunate teacher a couple of free hours per week, loading him down with numerous courses of instruction and with faculty work, and then wondering why published results are not forthcoming! The greatest sinners in this respect are probably our technical brethren. All of us are familiar with the man who gives an address and, after telling us of the vast importance of his industry, proceeds to formulate a series of questions regarding the behavior of leather, coke, tar, paper, etc., or the materials from which they are made, winding up with the suggestion that *somebody* in search of a problem should attack the subject. The speaker then complacently wends his way home, evidently feeling that he has done his part towards the advancement of research. Of course, what he has done is to demonstrate, in the clearest manner possible, his own complete innocence of the slightest conception of what scientific research really is and under what conditions it is carried out. It is safe to say that everybody who is capable of independent investigation is overcrowded with problems of his own; what he requires is time and help to investigate them. Those who lack the problems also lack the ability to attack them successfully without detailed and continuous help. In this country probably not more than a score of men are paid directly for doing research in chemistry; the remainder carry out their investigations at very great personal sacrifices of time, energy and money and, consequently, their absolute right to select their subject with perfect freedom is beyond question. If I meet my technological friend on his way to the golf links and tell him of the large load of wood which I want split, pointing out that it will afford him admirable exercise besides being *useful* to *me,* I fear that he will suggest that I split it myself or pay somebody else to do so; he, for his part, preferring to spend his well-earned hour of liberty in his own way without reference to my desires or convenience. Frankly, technical men must follow the practise of the best firms and bear the cost of their own research.

As my editorial work is at an end, I shall conclude this address with a few remarks concerning the difficulties which are encountered in such a position. Some little time ago a friend who edits and partly owns a scientific (non-chemical) journal, urged upon me the view that, essentially, an editor's duties should be confined to proof reading. That manuscripts should be printed exactly as sent in and that an author should be allowed the utmost liberty to make any exhibition of himself that he might choose. The prospect to an overworked assistant editor was very tempting, but, of course, the answer is that most journals profess to be published for the readers rather than for the authors. It is strange that a man will spend months or years working hard at a problem and will then neglect the few minutes required to verify the spelling of proper names (and occasionally of others), to place punctuation marks, or give his references in accord with the system adopted by the journal to which he is contributing. Some authors appear to be incapable of checking up their empirical formulæ or their analytical results, others show a preference for quinquivalent carbon atoms, whereas some appear to bend their energies to the reproduction of the graphic formulæ of such complicated compounds as methane or carbon dioxide, which latter they may write as one word. All this, like blots and smudges, which of course the printer will try to set up, is due to carelessness. On the whole, the standard of English is fairly good, of necessity one meets with "shall" and "will" misplaced, with "gotten" and "proven," with "glas" and "gass," while some of those who have spent a few months in Germany naturally forget their native language for the remainder of their lives and spell hydriodic acid and quinone according to the Teutonic fashion. The facts that, in English, the names of alcohols end in *ol,* those of amines in *ine* and that amino acids and amides are *not* identical appear to be beyond the limits of knowledge of some contributors. In general the meaning of an author is fairly clear, but occasionally some very startling statements are made, as, for example, one by a chemist of considerable prominence, who said, of a liquid, that it "heaped up about 150°." Another man, almost equally well known, describes a number of solids, all of which "melt under decomposition," whatever that may mean. These remarkable materials should certainly find place in the National Museum!

The really important point about such errors is this: Scientific workers in general and, I am sorry to say, American scientific workers in particular, have a bad reputation for the form in which their results are presented. In the vast majority of cases this reputation is not deserved, nevertheless the many suffer for the sins of the few. Authors should remember that the simple act of publication constitutes, in itself, an invitation to the world to give due credit and honor for the work which is described in their papers. A chemist is, presumably, not likely to underrate the value of his own work; if *he* does not consider it worthy of clear and accurate description, he has no right to expect that busy people will take the time and trouble to acquaint themselves with his results, no matter how important they may be.

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MATHEMATICAL PRODIGIES[1]

When scarcely three years old Gauss, according to an anecdote told by himself, followed mentally a calculation of his father's relative in regard to the wages of some workmen, who were to be paid for overtime in proportion to their regular wages, and, detecting a mistake in the amount, he called out "Father, the reckoning is wrong, it makes so much," naming the exact amount. The calculations were repeated and it turned out that the child was correct, while all who witnessed the performance were greatly surprised. He retained an extraordinary ability for mental calculations throughout life and remembered the first few decimals of the logarithms of all numbers, so that he was able to use the data of a logarithmic table in his mental calculations, and hence he possessed a mental slide rule—a unique possession.

Gauss was not only one of the greatest mental calculators on record, but he excelled equally in all branches of pure and applied mathematics. At the age of twenty he discovered the first rigorous proof of the fundamental theorem of algebra, which affirms that every algebraic equation has as many roots as its degree, and at the age of twenty-four he published his great work on the theory of numbers under the title "Disquisitiones Arithmeticæ." Later in life he turned his attention principally to applied mathematics—especially to astronomy and geodesy—and he is generally regarded as the last of the great mathematicians who was preeminent in nearly all branches of mathematical knowledge of his day. He considered mathematics the queen of the sciences and number theory the queen of mathematics.

While Gauss was both a great mental calculator and a great mathematician, and was a real mathematical prodigy, we proceed to consider several who were merely arithmetical prodigies and seemed to have very little general mathematical ability. The greatest of these is Dase, who was born at Hamburg in 1824, and "seems to have been little more than a human calculating machine, able to carry on enormous calculations in his head, but nearly incapable of understanding the principles of mathematics, and of very limited ability outside his chosen field." His extraordinary ability in mental calculation is evidenced by the fact that he was able to multiply mentally two numbers, each of which contained one hundred figures. It took him eight and three quarter hours to perform this feat, which stands in a class by itself, as no other arithmetical prodigy is known to have been able to multiply mentally two numbers each consisting of more than thirty-nine figures. Two forty-figure numbers, Dase was able to multiply mentally in forty minutes, while he would multiply two eight-figure numbers in less than one minute.

What is most surprising about this greatest mental calculator on record is that he was stupid in mathematics. Petersen is said to have tried in vain for six weeks to get the first elements of mathematics into his head, and other eminent mathematicians found that he had very little mathematical ability. Fortunately he was advised by some of the leading mathematicians of his day to turn his extraordinary ability to scientific uses instead of going around the country giving public exhibitions, a career upon which he had entered at the age of fifteen. He calculated many useful tables and was engaged on an extensive factor table at the time of his death. The ease and speed with which he could count the number of books

[1] Read before the Summer School students, University of Illinois, August 5, 1907.

in a case, the number of sheep in a herd, etc., was almost more surprising than his ability as a mental calculator.

Another well-known mental calculator, having even less mathematical ability than Dase, is Buxton, who remained illiterate through life, although his father had some education. He had a wonderful memory for numbers and could call off long numbers from right to left or from left to right with equal facility. On one occasion he squared mentally a thirty-nine-figure number in *two and a half months.* He was extremely slow and in this respect resembled a negro by the name of Tom Fuller who is known as the Virginia calculator. Although entirely illiterate he was able to reduce mentally years and months to seconds and could multiply two nine-figure numbers.

Darboux has called attention to an infant prodigy, of interest both because it relates to a man who afterwards became a very prominent mathematician and also because it is not included in the lists of mathematical prodigies which have recently appeared in this country.[2] Joseph Bertrand was born in Paris in 1822 and was such a delicate child that his parents did not expect him to arrive at manhood, and hence his early education was partly neglected. At the age of four he was sick for a long time and overheard the lessons which were given his brother in the same room. He knew the letters of the alphabet, but nothing more. When he was convalescent his parents brought him a book to look at the pictures, and he relates, in his account of his childhood, that he remembers distinctly how he shocked his parents by reading the text fluently. His frightened father snatched the book from him and commanded that under no pretext should he be allowed to do any work.

The manner in which he learnt elementary algebra and elementary geometry is still more extraordinary. We reproduce his own account:

> At the age of nine I had the great misfortune to lose my father, who, during the last part of his life, resided with my uncle who directed then a school preparing for l'École Polytechnique. The students, the youngest of whom was twice my age, loved me very much and I was very happy in their midst. I was assiduous at their recreations and often followed them to their classes. The teachers regarded me with astonishment but paid little attention to me. The students observed that I understood the work and when a demonstration appeared difficult, the first one who noticed me would run after me, take me up in his arms, and, placing me on a chair so that I could reach the blackboard, made me repeat the demonstration.

At the age of sixteen he entered l'École Polytechnique, and, as the examiner knew that he had already passed the examination for the doctor's degree in science, he gave him some very difficult questions. From one of the answers it appeared that Bertrand had never opened a table of logarithms. The examiner considered this answer an impertinence but gave him the highest grade. At l'École Polytechnique Bertrand says that he was a problem for his companions. He always received the highest grades but he was ignorant of some of the simplest things. For instance, he did not know what words were called adverbs, as he had never prepared a lesson in literature or in science and no teacher had ever asked him to make any calculation of any kind.

Bertrand's extraordinary youth gave rise to many marvelous stories. Fortunately, he wrote a brief account of his early life when he was elected in 1884 to

[2] Scripture, "Arithmetical Prodigies," *American Journal of Psychology*, Vol. IV. (1891), p. 1; Mitchell, "Mathematical Prodigies," *ibid.*, Vol. XVIII. (1907), p. 61. Bertrand was a mathematical prodigy, but he can not be classed among the arithmetical prodigies.

the French Academy. Hence we have a more reliable sketch of this infant prodigy than is possible to obtain in most other cases; for instance, in the case of his countryman, Pascal. The facts that Bertrand was permanent secretary of the Academy of Sciences for more than a quarter of a century, that he is the author of many theorems relating to modern mathematical subjects, and that he lived so recently, add interest to the account of his marvelous early aducation.

In the article already cited, which comes from the Psychological Seminary of Cornell University, Mitchell gives an interesting study of arithmetical prodigies and devotes considerable space to his own case. We add some of his conclusions.[3] "Mathematical precocity, then, stands in a class by itself, as a natural result of the simplicity and isolation of mental arithmetic. There is nothing wonderful or incredible about it. The all-round prodigy like Ampère or Sir William Rowan Hamilton or Macaulay is possible only in a well-to-do and cultured family, where books are at hand and general conditions are favorable, and he must possess genuine mental ability. The musical prodigy, again—Mozart is the stock instance—must come of a musical family, hear music, and have at least some chance to practise, and hence can not long hide his light under a bushel. But the mathematical prodigy requires neither the mental ability and cultured surroundings of the one nor the external aids of the other. He may be an all-round prodigy as were Gauss, Ampère and Safford, but he may also come of the humblest family, and be unable, even under the most favorable conditions, to develop average intelligence."

G. A. Miller

University of Illinois

[3] Page 39.

SCIENTIFIC BOOKS

THE HARVEY LECTURES FOR 1905–6

This volume consists of thirteen lectures given during the year to the Harvey Society of New York. This organization was founded in the spring of 1905, largely through the initiative of Professor Graham Lusk, for the diffusion of knowledge of the medical sciences by means of lectures given by authoritative research workers. The first volume constitutes a most valuable collection of first-hand information given by some of the most prominent investigators in this country and Europe and the reviewer finds before him an embarrassment of riches from which it is difficult to make a selection since all is good.

The first lecture by Professor Hans Meyer, of Vienna, is devoted to "The Theory of Narcosis" upon which subject no one is more competent to speak than this distinguished exponent of pharmacological research. So soon as scientific medicine began to break away from, or at least to seek, other support than blind empiricism, inquiry into the relation between the physiologic action of a drug and the physical and chemical properties began. One of the first investigations of this kind was carried out by Crum-Brown and Fraser, who discovered that practically all the organic bases in which the pentavalent nitrogen is connected by four of these valences with carbon have the same physiologic action notwithstanding other differences in their constitution and nature. The strong basic properties of these substances seem to be the determining factor in their effects upon the animal cell. Hofmeister and others pointed out that the laxative and diuretic effects of the neutral salts of the alkaline bases are due to their diffusibility and osmotic strength. The anesthetics include many substances that differ from one another chemically, while all depress the central nervous system. Meyer has made a careful study of the distribution coefficient of the narcotics between fatty and watery solutions and arrives at the following explanation of narcosis:

> The narcotizing substance enters into a loose physico-chemical combination with the vitally im-

portant lipoids of the cell, perhaps with the lecithin, and in so doing changes their normal relationship to the other cell constituents, through which an inhibition of the entire cell chemism results. It also becomes evident that the narcosis immediately disappears as soon as the loose, reversible combination, which is dependent on the solution of the tension, breaks up. It follows further that substances chemically absolutely indifferent, as the volatile saturated hydrocarbons, can act as narcotics.

In the second lecture, Professor von Noorden states "the modern problems of metabolism" in his usually interesting style. Some of the statements in this lecture might be criticized, but the reviewer has no desire to be captious, and when he notices that nearly two years have passed since the lecture was given and probably all of that since it was prepared he is ready to admit that it is only just not to be too critical. The confusion of erepsin with the cellular proteolytic ferments would not be made now, and the fact that the circulating proteins are strictly specific for every species of animal seems to be abundantly demonstrated by biologic tests, which are much more delicate than chemical analyses in distinguishing between proteins. Professor von Noorden points out clearly that the greatest interest and importance are now attached to the study of the intermediary products of metabolism. If the protein molecule is wholly disrupted into amino-groups in the alimentary canal, are these all or in great part synthesized into body proteins or are they treated as waste, converted into urea and thrown into the sewer? Is the man who follows Voit's average and eats 118 grams of protein a day simply wasting his energy in the manufacture of amino-acids which serve neither bone, muscle nor brain, but only tax the liver and fatigue the kidney? These are some of the questions that are now puzzling the physiological chemist, but he is a lusty young fellow and will solve the riddle by and by.

Professor Novy speaks interestingly and somewhat at length "on trypanosomes." Probably no other branch of microbiology has been developed so rapidly as that of protozoology and no other promises more benefit to mankind. While the bacterial diseases predominate in temperate regions, the question of the development and the civilization of the tropics depends largely upon man's ability to destroy the protozoal parasites and the scientist must be the pioneer in this work. Novy's discovery of the methods of growing the trypanosomes in artificial cultures is a long step in the right direction. In 1841 Valentin reported the first of this large class of parasites in the blood of the salmon and a year later Gruby found a first cousin in the frog and proposed the generic name, *Trypanosoma.* During the sixth decade of the last century similar parasites were found in moles, rats and mice, but these findings were practically ignored until Lewis in 1877 made his classical contribution to the subject. Three years later Evans found a trypanosome in the blood of animals suffering from a disease afflicting horses and camels in India and known as surra. In 1894 Bruce began his studies of the tsetse-fly disease known in Zululand as nagana and demonstrated that it was due to a trypanosome which is transmitted from infected to healthy animals by the fly. This disease was observed by Livingstone and is widely distributed over middle and southern Africa, extending up the west coast to Senegambia and on the east to the Red Sea. It affects the horse, mule, donkey, dog, ox, cat and many wild animals. Indeed, the chief occupation of the tsetse-fly seems to be to transmit the trypanosome from wild to domesticated animals and in the horse, donkey and dog the disease is said to be invariably fatal. Moreover, the tsetse-fly seems to have a monopoly in this business, since it has been shown that infected animals may be kept in the midst of uninfected ones in regions where this fly does not exist. Two Togo ponies were found in the Berlin zoological gardens to be infected and notwithstanding the presence of other biting insects the disease was not transmitted to other animals in the gardens. In the wild animals of Africa this parasite is either wholly harmless or kills so slowly that the supply does not run out. Since the rinderpest has found its way among the game animals the fly disease has become less prevalent and in some localities has been reduced to a negligible quantity. This seems to be an instance of driving out the Devil with Beelzebub. The trypanosome of dourine was discovered by Rouget, a French army surgeon, in 1894, the same year that Bruce began his work on the tsetse-fly disease. Dourine is apparently transmitted only during the sexual act and for this reason the French know it as *mal du coit,* and in English it is sometimes designated as "horse syphilis." It is especially prevalent on the shores of the Mediterranean. Its presence in America has been frequently suspected and within the past few months it has apparently been demonstrated in the Canadian Northwest in imported stock. *Mal de caderas* is the only trypanosomatic disease known to be indigenous to the New World. It is prevalent in South America from the Amazon to Bolivia and is due to *T. equinum,* discovered in 1901 by Elmassian. It is most frequently found in horses, in which it causes a remittent fever leading to loss of weight and finally to paralysis of the hind quarters. It is to the last-mentioned symptom that the disease owes its name. The agent of transmission in this disease is not known. Gambian horse disease was first observed by Dutton and Todd in 1902 in the horses of Senegambia. It is not known to infect other animals and in the horse is much milder than nagana. The parasite exists in two forms, a short and a long, and is known as *T. dimorphon.* A trypanosomiasis, much milder in character than nagana, exists throughout southern Africa, is confined to cattle and is known as gall-sickness, or galziekte. Sleeping sickness has been known since Winterbottom wrote concerning it among the slaves in 1803. Hundreds of slaves with this disease were shipped to the western world, but there was no diffusion here because of the absence of the agent of transmission. It is now known that sleeping sickness is due to *T. gambiense* and that it is transmitted by a species of tsetse-fly different from that which disseminates nagana. It is said that hundreds of thousands of people have died in recent years in Uganda from this disease which is quite surely fatal.

In the fourth lecture Professor Levene discusses "Autolysis" in a most satisfactory way. It was once supposed that the disintegration of organic matter was wholly a process of oxidation and that in order to prevent decay it was necessary to exclude the air. On this erroneous principle a wise Frenchman taught the world how to can fruits and vegetables; so good came, as it often does, from reasoning founded on a false premise. Then Pasteur taught us that putrefaction is due to microorganisms and gave the true explanation of sterilization, but the generalization that the world drew from Pasteur's work was in part erroneous. We came to believe that absolutely no change takes place in organic matter if bacteria be excluded; but Hoppe-Seyler and Salkowski have demonstrated that animal tissue at least carries in itself ferments that under certain conditions disrupt its own protein molecules, breaking them down into smaller particles such as amino-acids. Moreover, the work of Schulze and his students has demonstrated that the seeds of plants contain three important substances, the embryo, a ferment and the stored food supply. In the presence of heat and moisture the ferment splits up the food material and the bodies resulting from this digestion begin to react on the constituents of the embryo and latent life is awakened into the active form. Levene has himself made important contributions to the problems of autolysis and consequently he speaks authoritatively and interestingly.

Professor Park tells of the "results of serum therapy in the diseases of man." The discovery of diphtheria antitoxin is one of the most brilliant and at the same time one of the most beneficent that the genius of man has accomplished. Your reviewer was fortunate enough to be present at a meeting of sanitarians in Budapest when Roux confirmed the observations of von Behring as to the curative value of diphtheria antitoxin and he well remembers the enthusiasm with which the announcement of Roux was greeted, and now after thirteen years it must be said that the hopes then awakened have been more than realized. Thousands of lives have been saved and the once dreaded scourge of diphtheria has been robbed of its horrors. However, the dream that an antitoxin for each and every one of the infectious diseases would be secured within a few years has not developed into a reality and is not likely to do so. Indeed, it is possible that the attempt to work out an antitoxin for typhoid fever has delayed the discovery of the true method of treating that disease.

Professor Barker discourses on "the neurons," the theory of which has aroused much discussion and some bitterness of expression among histologists and it is all about the exact relation between the nerve cells and the nerve fibers. However, this is by no means a matter of trifling importance, because upon it rests problems not only of structure, but of function as well. The theory, founded largely upon the work of His, Forel and Cajal, was evolved by the genius of Waldeyer and it supposes that there is no nerve fiber independent of nerve cell and that the cell with all its prolongations is a unit or a neuron; that these units are not united to one another anatomically, but act together physiologically by contact; that the entire nervous system consists of superimposed neurons; that the neurons are so arranged that an impulse can pass only in one direction and starting in the dendrites it is carried to the cell body and thence along the axis cylinder to the dendrites of another neuron; that every part of the neuron is dependent for its nutrition on the nucleus of the cell body, and that when a nerve fiber is injured or severed the regeneration of the axis cylinder is accomplished by an outgrowth from the central end and in no other way. This theory has met with wide acceptance, but also with some strong opposition. The most vigorous opponents being Apathy, Bethe and Nissl; and Professor Barker, while supporting the theory is generous in his estimate of the value of the work done by these men. The lecture is most instructive and brings the whole subject up to date (January, 1906). The important work, illuminating this subject, done by Harrison is mentioned and has been more fully developed since.

Professor Lee discusses the old, but always interesting, subject of "fatigue." Why do we tire, is it in the nerve or the muscle, and what are the fatigue-producing substances? The nerve-muscle machine is a great invention, the first used by man, and still there are many things about it and its action that we do not understand. The scientific study of fatigue has been carried out largely by Mosso and his students and the ergograph in its improved form gives accurate results. The weight of evidence at present is that the nerve is not fatigued and that the tired sensation is due to peripheral exhaustion. However, the question in all its details can hardly be considered as finally settled. Hodge and others have demonstrated microscopical changes in certain nerve cells after muscular exertion and the experiments of Sherrington seem to show that in fatigue there must be something at fault in the nervous connections. He takes a spinal center which has several afferent tracts and but one efferent to a given muscle, and he finds that when he has exhausted the muscle by stimulation through one afferent nerve, it acts with renewed vigor when the stimulation is sent through another. The muscle, the motor nerve and the center are the same and renewed vigor is secured by sending the stimulation through another afferent. Sherrington thinks that the trouble lies at the point of contact between the afferent and efferent neurons. The fatiguing metabolism products are believed to be potassium acid phosphate, sarcolactic acid and carbonic acid. The statement of Weichardt that he had not only found a toxin that is responsible for fatigue, but had produced an antitoxin with which weary people might be treated, seems to have met with but little appreciation.

Professor Mandel points out the "recent advances in our knowledge of the formation of uric acid." It was formerly believed that uric acid was a product of deficient oxidation and its presence in unusual amount in the urine led to the administration of oxidizing agents, such as nitrohydrochloric acid. Horbaczewski was the first to give us a start in the right direction in the study of uric acid metabolism, and we now know that, in a general way at least, the amount of uric acid formed is a measure of the metabolism of nucleoproteids, and since these are found in our daily food we have two sources of uric acid: the exogenous that comes from the nucleoproteids of the food, and the endogenous that result from the metabolism of the nucleoproteids of the body itself. Quite naturally the daily output from the first source is quite variable, depending upon the kind and amount of food, while that from the second source is fairly constant in the individual, but quite variable as between individuals. However, all the uric acid formed in the body is not eliminated as such and there is some doubt as to the form in which the lost part is eliminated. It may possibly be converted into urea, allantoin, glycocoll or oxalic acid, or into two or more of these. In this connection the recent suggestion of the etiological significance of glycocoll in gout is interesting.

Professor Morgan is not ready to satisfactorily explain why "the power to regenerate lost members" is so feeble in man and other high vertebrates compared with the ready regeneration observed in some of the lower animals; however, he thinks that it is due to the fact that the different tissues regenerate at different rates and consequently there is lack of cooperation and harmony in development. The skin regenerates; the muscle does so, though less well; nerves and blood-vessels regenerate, and the bones have a not inconsiderable power to mend. Hence, the failure to develop a new limb does not appear to be due to the failure of the individual elements to regenerate, but to their failure to regenerate concurrently.

Professor Minot offers an interesting scientific explanation of "the nature and cause of old age." He thinks that senescence is due to a relative increase of the protoplasmic to that of the nuclear content of the cell. "Growing old, in other words, consists primarily in an increase in the proportion of protoplasm. We thus have a cytological mark by which old age can be distinguished, and we are able to connect senescence with visible changes in cells: we are able to say there is a histological basis or cause of old age." He shows that the animal grows old most rapidly during intrauterine life and that after birth the rate of growing old decreases. However, what is ordinarily denominated as old age is, from the intellectual side at least, the reaching of a point where the accumulated losses result in comparative mental fixity. Changes in the nervous system diminish its adaptability and we are not able without ever-increasing difficulty to turn to new forms of mental activity. We may continue to do well the kind of thing which we have learned to do, but if we try to overstep the limits of our acquired expertness we find that we are held up by a sense of permanent mental fatigue.

Professor Webster discusses quite exhaustively "modern views regarding placentation" and the text is accompanied by explanatory figures.

Professor Smith discourses in a broad, scientific way upon "the parasitism of the tubercle bacillus and its bearing on infection and immunity." The thesis held is that the tendency of such a chronic disease as tuberculosis is towards a balanced parasitism with reduced mortality but probably with increased morbidity. The effect of immunization of man, if it ever can be attained, on the destiny of the tubercle bacillus is an open question. Trying to stamp out tuberculosis by increasing man's resistance should be secondary to efforts to destroy the bacillus. The former is a compromise and a recognition that the bacillus is here to stay, and if it be permitted to continue among us, as we increase our resistance, it will probably grow in its virulence. Increased resistance may save the individual, but to save the race we should destroy all tubercle bacilli, and knowing how they find access to the human body and how they leave it, this does not seem an impossible task. Certainly it is one in which every intelligent man and woman should take an active part.

Professor Howell in the last lecture treats of "the cause of the heart beat." After dwelling for some time upon the arguments for the two theories, the myogenic and the neurogenic, he concludes that the weight of evidence is in favor of the former. Then, he discusses the deeper and more fundamental question of the initial cause, whether acting through the nerve or directly on or in the muscle. He calls attention to the influence of the inorganic salts, especially those of calcium, first observed by Ringer and concludes as follows:

> The well-nourished heart contains a large supply of energy-yielding material, which is in stable form, so that it neither dissociates spontaneously, nor can be made to do so by the action of external stimuli. It is possible that this stable, non-dissociable form consists of a compound between it and the potassium or the potassium salts and that herein lies the functional importance of the large amount of potassium contained in the tissue. This compound reacts with the calcium and sodium salts, and a portion of the potassium is replaced and a compound is formed which is unstable. At the end of the diastolic period this compound reaches a condition of instability such that it dissociates spontaneously, giving rise to the chain of events that culminates in the normal systole. This dissociation may be made to take place prematurely by an external stimulus, such as a mechanical or electrical shock applied to the heart at any time after diastole has begun.

The first course of lectures before the Harvey Society forms a valuable contribution to medical science and the members are to be congratulated on their wise selection of lecturers.

Victor C. Vaughan

Deutsches Bäderbuch. Prepared with cooperation of the German Imperial Health Office. Quarto. Pp. civ + 536 and 13 colored plates. Leipzig, Weber. 1907. Price 15 M.

It is believed that this book will prove of interest to scientists engaged in various lines of work. It is the joint work of a number of distinguished chemists, clinicians, pharmacologists, geologists, meteorologists, etc., and is designed to give a complete, impartial account of the leading German baths and mineral springs from various points of view. The greater part of the volume is occupied by detailed chemical analyses, but with these is given much valuable information concerning the geology, climatology, etc., of the individual springs. Especially noteworthy and of very general interest are the introductory chapters on geology, chemistry, climatology, pharmacology, and general therapeutic uses of baths and mineral springs; there is also a short chapter on the radioactivity of mineral springs.

An examination of this volume will well repay any one whose work is connected in any way with this subject. The economic importance of this subject is indicated by the fact that nearly $100,000,000 are spent annually at the German baths and springs.

R. H.

Further Researches on North American Acridiidæ. Professor A. P. Morse. Publication No. 68 of the Carnegie Institution, Washington, 1907.

The second report on North American Acridiidæ by Professor A. P. Morse is an interesting pamphlet of 54 pages, a frontispiece and nine plates. This, like the first report, is a well-prepared paper and treats of the acridiian fauna of the central southern states. General notes on the regions traversed and the life zones of localities visited are followed by a discussion of locust coloration and variation. Habits and habitats are discussed in connection with various local lists and then follows a detailed list of localities at which collecting was done and an annotated list of the 124 species of Acridiidæ taken. The plates are from photographs taken by the author and represent typical habitats of some of the species taken.

A. N. Caudell

U. S. National Museum

Catalogue of Type and Figures, Specimens of Fossils, Minerals, Rocks and Ores. George P. Merrill. U. S. Nat. Mus., Bull. 53, Part II., Washington, 1907, pp. 370.

The second part of the "Catalogue of Type and Figured Specimens" in the Department of Geology of the United States National Museum consists of three sections in continuation of the Catalogue, Part I., dealing with the fossil invertebrates; section II. treats of the fossil vertebrates, section III. of fossil plants and section IV. of minerals, rocks and ores.

All working paleontologists will welcome this volume as one which will greatly facilitate their work, and botanists in general will find section III. of much value. This part, constituting the greater portion of the volume, has been compiled by Dr. A. C. Peale, with the cooperation of Dr. F. H. Knowlton and Mr. David White. The specimens are described under their catalogue numbers, and the description in each case includes the name, authority, locality and geological horizon, together with citation of publication giving the first description and figure.

The entire catalogue closes with January 1, 1905, and includes all changes to that date. It may, therefore, be regarded as substantially up to date.

D. P. Penhallow

N. H. Abel. Sa vie et son œuvre. Par Ch. Lucas de Pesloüan. Paris, Gauthier-Villars. 1906. Pp. xiii + 168.

The writing of popular or semi-popular biography of scientific men, like the sketch of Faraday by Tyndall, or of Clerk Maxwell by Glazebrook, is highly commendable. A popular biography of a mathematician like Abel, who, though he died at the age of twenty-seven, made, according to Hermite and Sylvester, several discoveries of such originality as probably to keep mathematicians busy for one hundred and fifty years in the fuller unfolding of his ideas, can not be without interest. Mr. de Pesloüan, the author of the present sketch, has done his work fairly well.

In the case of a few technical matters he did not exercise sufficient care in the reading of the proofs, but with that exception the work is creditable. This booklet does not pretend to offer new facts on the life of Abel, nor is it intended to supplant the larger biography, written in 1885 by C. A. Bjerknes. De Pesloüan exhibits great admiration and much sympathy for the subject of his sketch. The title-page is preceded by a good picture of Abel.

Florian Cajori

DISCUSSION AND CORRESPONDENCE

AN ADAMS JOURNAL CONDUCTED BY THE AMERICAN EXPERIMENT STATIONS

The interesting communication of Dr. H. J. Webber, in Science of October 18, touching the publication of research to be made under the Adams Act, is quite timely and, as to every point discussed, most commendable. Formerly connected with one of the stations and yet deeply interested in the work, a teacher in an agricultural college, and publisher of the *Journal of Mycology*—on one or all these grounds may I take the liberty of offering some suggestions.

The necessity of such a publication—distinct from the popular bulletins—could not for a moment be questioned. I believe the plan essentially as proposed could be carried out. A committee of three for each subject or division, elected for three years (election of one member each year) but eligible for re-election, to pass on the completed work submitted by the directors of the stations, would doubtless be acceptable to all. Here, of course, if anywhere, there would be friction—*censorship!* some one would be sure to say! —yet the arrangement would probably and almost universally encourage, not discourage, investigators.

The classification is on a generous scale, and could be taken up, one division after the other as occasion demands. But I would suggest that the name *Adams Journal* (conducted by the American experiment stations) be used; that series be established, as "Agronomy Series, No. 1" (No. 2 *et seq.*); "Horticulture Series, No. 1" (No. 2 *et seq.*); "Plant Pathology Series, No. 1" (No. 2 *et seq.*), etc. Each number should contain only an investigator's work on one subject; a full index should be appended to each number, and the numbers should be sold separately (at or below cost). The pagination should be continuous in each separate series, and a title page, table of contents, and complete index furnished when the accumulated numbers warrant the closing of a volume.

It would be rash to anticipate a large subscription list; it would be in the beginning at least quite insignificant. But the stations are under obligation (moral, if not legal) to publish and publish properly what they do. Publication is in fact the inspiration of the investigator—the most precious part of his reward. Whether station workers should receive copies of the published work in their own lines free (*and exchanges with scientific journals inaugurated!*) could be settled later, but let us hope that the decision would not be in the negative.

Would this scheme of publication interfere with the patronage of existing scientific journals? I can not for a moment think that such would be the unfortunate case. On the contrary, they are bound to gain with the greater advance of scientific investigation in this country. The work done by college professors, students and independent investigators will not, under the circumstances, grow less, but more—and they now furnish the existing journals with the large proportion of the copy. Even with the establishment of an *Adams Journal* there would be, as now, some things the station workers would wish to publish, and could properly publish, in the existing periodicals. My own journal, so intimately connected with one line of station work, has been enriched heretofore by valuable contributions on mycological taxonomy from station workers, and I do not anticipate that there will be any conflict or that loss of patronage need be predicted.

W. A. Kellerman

Ohio State University,
October 19, 1907

A "CENSUS OF FOUR SQUARE FEET"

To the Editor of Science: The article by Mr. W. L. McAtee in Science for October 4, 1907, "Census of Four Square Feet," is extremely interesting, but some of his deductions therefrom, as far as insect and arachnid life are concerned, are wide of the mark. He concludes that insects are more abundant in the meadows than in the woodlands. But he has failed to take account of the trees and their fauna in the woodland. In the meadow the insect fauna is mostly concentrated on or near the ground; in the woodlands, on the contrary, the bulk of insect life is on the trees. There are many families of insects which rarely or never occur in meadows or on the forest floor, but do occur abundantly in trees. Four square feet of some forest trees would produce a great many specimens of insects; for example, a tree infested by Scolytids or with Coccidæ. Four square feet of foliage infested with Tingitids would have hundreds of specimens; if infested with gall-mites, would have millions of specimens. Four square feet of dog-wood blossom in the spring, if shaken, would produce a thousand minute Coleoptera. Four square feet of tree bark sometimes has hundreds of specimens of Psocidæ. These are all groups of insects practically unrepresented in meadows or on the forest floor, and some of them are food for birds. Even four square feet of forest floor with a few decaying fungi would produce hundreds of beetles and in some cases thousands of mites.

His figures for the meadow are not at all large; there are many spots where the Thysanura are much more numerous and where the mites would swell the figures to many thousands.

Many samples of meadow taken at different seasons would doubtless give an approximate idea of the insect and arachnid fauna of meadows; but no amount of samples of forest floor can give an adequate idea of the sylvan insect and arachnid fauna. Insects are more easily discovered in meadows than in woodlands, but the two regions are so variable that a comparison from selected spots has little significance.

Nathan Banks

THE OCCURRENCE OF HEROS IN YUCATAN

In a recent paper by Mr. Thomas Barbour and myself,[1] which reported upon a collection

[1] Barbour, Thomas, and Leon J. Cole, "Vertebrata from Yucatan: Reptilia, Amphibia and

of fishes from Yucatan, we stated that *Heros affinis* and *Heros urophthalmus* had apparently been reported previously only from Lake Peten, Guatemala. In some unaccountable manner we overlooked, at the time of writing our paper, the report by Evermann and Goldsborough,[2] published in 1902, upon fishes collected in Mexico and Central America. Dr. Evermann has kindly called my attention to the fact that the species mentioned were both obtained in Yucatan by Mr. E. W. Nelson, as recorded in the paper referred to. It so happens that Mr. Nelson had specimens from exactly the same places that I obtained them, namely, *H. affinis* at Progreso and *H. urophthalmus* at Progreso and at Chichen-Itza. Some of my specimens apparently came even from the same watering trough at the latter place, but I was successful in obtaining them directly from both the Great and Sacred Cenotes as well.

In the same connection it is interesting to note that "Mr. Nelson heard that cat-fish occur in a well [cenote] at Chichen-Itza, but did not see any specimens" (*loc. cit.*, p. 138). From the Sacred Cenote I obtained two specimens of one species of catfish, and from another cenote, some three or four miles to the eastward, eleven examples of another. Both of these appeared to be new, and have been described and figured by Mr. Barbour and myself as *Rhamdia sacrificii* and *Rhamdia depressa*, respectively.

One would not have suspected the presence of these catfishes in the Sacred Cenote, as they were at no time seen swimming about. The two specimens described were obtained for me by the Indians, upon hooks baited and sunk to the bottom. At the other cenote mentioned, however, the catfish were much in evidence, swimming about in a large school near the surface. As Mr. Nelson probably did not visit this cenote, these facts may explain why he did not see catfish at Chichen-Itza. I do not understand, however, why he did not see the mojarras (*Heros urophthalmus*) in the cenotes when he was there in February, as I saw them commonly during the whole period of my stay from February 13 to April 9. Furthermore, I found that they were not especially difficult to catch, in spite of the fact that I had to resort to boyhood's method of using a bent pin for the purpose, not having suitable hooks at hand.

It would be interesting to know whether there is any basis for the belief of the natives that the fish disappear from these cenotes during certain seasons, as it would furnish evidence as to the existence of the supposed underground connection of these curious water-holes. On the one hand, unless there are such connections, it seems hard to account for the apparently general distribution of *Heros urophthalmus* throughout the peninsula (unless we take into account the possible assistance of human agency); while, on the other hand, the segregation of two species of catfish in two cenotes only three or four miles apart is difficult to explain if there do exist subterranean connections of any considerable size.

Leon J. Cole

Pisces," *Bull. Mus. Comp. Zool.*, Vol. 50, No. 5, pp. 146-159, pls. 1 and 2, 1906.

[2] Evermann, B. W., and E. L. Goldsborough, "A report on fishes collected in Mexico and Central America, with notes and descriptions of five new species," Bull. U. S. Fish Com. for 1901, pp. 137–159, 1902.

OCCURRENCE OF THE FRESH-WATER MEDUSA, LIMNOCODIUM, IN THE UNITED STATES

On August 17, the writer received at the laboratory of the Bureau of Fisheries, Woods Holl, a few medusæ with the request for their identification. They had been sent from Washington on the fifteenth in a small bottle and were living when received and continued to live for more than a week, though gradually declining.

A cursory examination showed them to be a species of the fresh water medusa, *Limnocodium*, the occurrence of which in considerable number in Regents Park, London, in 1880 marked our first accurate knowledge concerning a medusa of this habitat. It was described by both Allman and Lankester, and its characteristics and something of its life history critically observed.

Great interest was aroused at the time, chiefly by reason of the then regarded anomalousness of its habitat, but also by reason of certain other features more or less peculiar, such as the apparent absence of female medusæ, and yet the occurrence of young apparently arising directly from eggs.

It has since been observed in several other localities and under a similar set of conditions, namely, in artificial tanks, or aquaria used for the cultivation of the large water lily, *Victoria regia,* a native of South America. Records of such occurrence have been made at Lyons and at Munich, in 1901 and 1905 respectively. In all these cases it has appeared and behaved in very much the same way as in London, and the same anomalous disparity of sex has been noted.

The discovery of the medusa, apparently the same species, though on this point I am not yet prepared to state definitely, in this country is naturally, therefore, a matter of some interest to students of animal distribution, and it is the hope of the writer that additional facts bearing upon several of the problems as yet unsolved may be secured. It was a matter of pleasure, therefore, to undertake, with the cooperation of the Bureau of Fisheries, to secure all the data and material which could be had. Thus far only a beginning has been made, and this preliminary notice is only intended to announce the general facts, reserving for a later contribution a fuller and more detailed account of the history of its occurrence. It may be noted in closing that, as in former cases, only male medusæ have been observed. And, furthermore, that no foreign plants have been introduced in these aquaria for several years, and that the *Victoria regia* has never been grown here.

P. S.—A communication was received by the writer dated September 30, stating that the medusæ had suddenly "disappeared as mysteriously as they came," and that not a single specimen could be found where for weeks they had been abundant.

Chas. W. Hargitt
The Zoological Laboratory,
Syracuse University,
September 20, 1907

GAMBUSIA IN NEW JERSEY

Professor John B. Smith has called attention to the introduction of *Gambusia affinis* in New Jersey waters as a check to the development of the mosquito, as neither he nor his assistants have met with it in their investigations. It was, therefore, with considerable interest that quite recently Messrs. H. Walker Hand and O. H. Brown assisted me in finding this little minnow in large numbers in Teal's Branch of Pond Creek, a small tributary of Delaware Bay at Higbee's Beach. We also found it very abundant in New England Creek, another tributary of Delaware Bay just north. There it was associated with large numbers of mostly young or small *Fundulus heteroclitus macrolepidotus, Lucania parva, Cyprinodon variegatus, Menidia menidia notata, Eupomotis gibbosus* and *Palæmonetes vulgaris.* The streams mentioned are mainly brackish, though fresh near their headwaters, more or less shallow with muddy bottoms, though with even a clear and gentle current. The males of *Gambusia* were equally abundant with the females, though the latter were usually larger. The occurrence of *Plethodon erythronotus* at Higbee's Beach is also interesting.

Henry W. Fowler
Academy of Natural Sciences,
Philadelphia, Pa.

COLOR SPORTS AMONG THE INSECTS

In the August 16 number of Science Mr. A. Franklin Shull puts on record the occurrence of a pink katydid, *Amblycorypha oblongifolia* DeG., which was taken near Detroit, Mich., on August 12, and he invites others to place on record their captures of similarly colored insects. Professor J. B. Smith has, in years past, taken several pink katydids in the pine barrens of southern New Jersey, and on August 1 of the current year I took a male specimen of the above species at Lahaway, Ocean County, New Jersey. None of Professor Smith's specimens retained their delicate color more than a few weeks at most and the Lahaway example lost most of its pink color in about two weeks, though the head, pronotum, wing veins and parts of the legs are up to this date still a decided pink. The specimen, when fresh, agreed very well with the description given by Mr. Shull, but it has a third row of brown speckles on the tegmina between the radial and cubital veins. Mr. Scudder's figure in the *Entomological News* is undoubtedly overcolored, being more reddish than pink and the speckles are also probably more prominently shown than really exists in the living insects.

Dr. Wm. M. Wheeler in a recent number of the *Journal of the New York Entomological Society* says, that of the twenty records of these insects the only male known is that taken by Mr. Scudder. Mr. Shull's specimen and the one under present consideration, both being males, are therefore of unusual interest.

The theory that the pink coloring is due to the influence of cold on the developing nymph seems to be completely upset when we consider that August 1 is an early date for a full-grown specimen and that the species is found until frost.

These pink "sports" are not confined to the Orthoptera but occur in the Hemiptera also. I took a pink specimen of *Amphiscepa bivittata* Say, a normally green insect, at Lakehurst, August 23, a rarity with this species; but the tettigonid, *Gypona octolineata* Say is almost as often pink as green in my experience.

John A. Grossbeck

SPECIAL ARTICLES

PLEISTOCENE TERRACING IN THE NORTH CAROLINA COASTAL PLAIN[1]

Terraces of Pleistocene age occurring in the coastal plain of Maryland have been described by Professor G. B. Shattuck in several papers, including the recent report on the "Pliocene and Pleistocene Deposits of Maryland." In the fall of 1906 the writer, while engaged in the study of the underground waters of the coastal plain of North Carolina for the United States Geological Survey, noticed similar terracing in that area, and a series of terraces extending across the state from north to south, separated from each other by well-defined seaward facing scarps which extend approximately in a north-south line, rising one above the other from sea level to elevations of over 400 feet along the eastern edge of the Piedmont Plateau, were traced out.

[1] Published by permission of the director of the U. S. Geological Survey.

Reentrants, sometimes of great breadth, extend from the lower up into the higher and older terraces. In North Carolina the conditions existing during Pleistocene time were such that the terraces were formed over broad areas and each succeeding terrace was well developed and still preserves much of the level character which it had when first uplifted. The lowest lying and most receut terrace retains almost perfectly its original level surface, being but little dissected by stream erosion. Each succeeding higher and older terrace is more and more dissected until in the oldest and highest mere remnants of the former level surface remain and the separating scarps can only be traced with difficulty.

In general, the materials composing the terraces are thicker, more highly colored, more heterogeneous in composition, more highly cross-bedded, and contain a large per cent. of pebbles and boulders of the crystalline rocks near the Piedmont border than farther eastward. Seaward the material becomes finer, the deposits thinner and the coloring less brilliant, until in the lowest terrace the sandy loams are gray or mottled with a small amount of yellow, and grade down into interstratified bluish quartz sands and bluish to drab clays.

A noticeable feature in nearly all sections of the terrace materials is the gradation from a mottled sandy loam at the surface (the mottling at places showing evidences of being due to the disturbance of stratified material of slightly different colors) to stratified sands and clays or sands and gravels of different colors at the base.

The lowest lying and youngest of the terraces in the North Carolina coastal plain attains at its maximum development a width of over 60 miles in the northeastern part of the state. It includes the area enclosed by the present "banks" from Beaufort to the Virginia line and east of the meridian 76° 35′. In the southeastern part of the coastal plain this terrace is present only as a narrow strip fringing the shore and the larger rivers. Reentrants of this terrace penetrate the next higher terrace along the Chowan, Roanoke, Pamlico and Neuse rivers. The elevation of the surface of the terrace varies from sea level to from 20 to 25 feet at the foot of the scarp separating it from the next higher terrace. The uplift which formed this lowest terrace was so recent that the terrace is but poorly drained. Its surface is very level, and much of it is swampy. Within the area where this terrace attains its maximum development are the Hyde County and Great Dismal Swamps and Albemarle and Pamlico sounds. Both of the swamps include large lakes, resting in slight depressions in the terrace surface. Fossils have been found in the materials composing this terrace at several places.

Beginning at the Virginia line in Gates County, and extending southward to the coast in western Carteret County, then swerving southwest along the coast to the South Carolina line is a sandy ridge separating the two lower terraces. This ridge is well shown on the topographic maps of the Beckford and Edenton quadrangles of the United States Geological Survey. It is also well developed in western Pamlico and eastern Pender counties. The eastern side of this ridge is a well-defined scarp. The summit is sandy, with long, low, rolling sand hills extending north and south, their major axis parallel to the edge of the scarp. The elevations along this ridge vary from 40 to 60 feet. The land slopes off gradually on the western side of the ridge to a broad level plain, at an elevation of from 30 to 50 feet above sea level, the second terrace. This terrace extends as a narrow band across the coastal plain. About 10 miles in width near the Virginia line it gradually widens to the southward and in Pender County has a width of from 25 to 30 miles. The surface of this terrace while better drained than the lowest lying terrace still contains many large swamps, such as Angola Bay. Fossiliferous beds occur within the materials composing this terrace.

The next higher terrace lies at an elevation of 60 to 80 feet, with a width of from 20 to 25 miles. It is well developed in the vicinity of Williamston and Greenville and covers most of the Parmele and Falkland quadrangles. The scarp separating it from the 30- to 50-foot terrace is low and at many places the two terraces grade into each other in a manner similar to that in which the lowest lying terrace in some places passes gradually into the terrace at present being formed beneath the sounds. The eastern edge of this terrace is very irregular, although having an approximately north-south trend. Broad reentrants of the next lower-lying terrace extend far within its borders along the large rivers.

The fourth terrace has an elevation of 110 to 140 feet and is best developed in the Wilson, Tarboro and Rocky Mount quadrangles. It has a width of approximately 25 miles. The scarp separating this terrace from the 60- to 80-foot terrace extends approximately north and south and is steep and well defined. In the central and northern parts of the coastal plain the materials forming this terrace rest in many places directly upon the uneven surface of the rocks of the Piedmont Plateau. In this region, therefore, the higher terraces are but poorly preserved. The westward extension of the 110- to 140-foot terrace is limited by a long narrow ridge extending in a north-south direction through Nash, Wilson and Johnston counties. The elevation of the surface of this ridge varies from 220 to 260 feet. In appearance the ridge resembles that described as separating the two lower terraces.

On the western side of this ridge the land slopes gradually to the next higher terrace at an elevation of 180 to 200 feet. Because of the uneven surface of the Piedmont rocks this terrace is but poorly preserved north of Johnston County. Broad level stretches occur, however, in northern Sampson and eastern Cumberland counties.

Remnants of terraces at 220 to 260 feet and at 280 to 320 feet can be seen on the topographic maps of the Springhope and Kenly quadrangles. It seems probable, however, that accurate topographic mapping of the southwestern corner of the Coastal Plain in western Cumberland, Moore, Richmond and Scotland counties, where the coastal plain materials lie at greater elevations, would disclose well-developed terraces at these and greater elevations.

Conclusions.—In a short paper like the present it is impossible to go into details regarding the origin of these terraces. The present topography of the North Carolina coastal plain appears to be due to the successive formation, with the uplift of the coast, of the three sandy ridges described above, the latest of which is represented by the present banks or bars enclosing Pamlico, Albemarle and Currituck sounds, and the formation of the several terraces within the areas thus enclosed.

The marked difference in elevation of the coast in the northern and southern parts of the coastal plain of this state is due to the fact that the lowest lying terrace borders the coast from Bogue Inlet north while to the south the next higher terrace fronts on the shore.

Terraces at these same elevations appear on topographic maps in Virginia and Maryland.

B. L. Johnson

U. S. Geological Survey

PLANT ZONES IN THE ROCKY MOUNTAINS OF COLORADO

In order to see the true relations of the flora of a mountain region some sort of classification into zones is necessary. Humboldt and later other students have pointed out the zonation on mountain sides and the zones have been delimited with greater or less accuracy. In order to call attention of my students to the zonation in our own Rocky Mountains I have prepared a classification which is proving useful for teaching purposes. It emphasizes to the student the various climatic and edaphic influences which accompany changes in altitude.

Schimper's three regions of mountains,[1] the *basal*, the *montane* and the *alpine*, are not exactly represented in the Rocky Mountains. Thus the *basal* region of Schimper is "like that of moist stations in the lowlands." In the Rocky Mountains there is no such basal region. In fact there are no true lowlands near the mountains to be used for comparison and the foothill plants are not like those of gulch and stream-side in the plains region. Schimper's *montane* region has a flora "resembling that of the lowlands in higher latitudes." In northern Colorado this zone would extend from about 8,000 to 10,000 feet in altitude. Here the general character of the vegetation reminds one of the northern parts of New England, Michigan, Wisconsin and Minnesota. Above 10,000 feet I believe it more conducive to clearness to make two zones—an alpine and a sub-alpine—the former including everything above "timber line."

The following classification of the zones of plant life is suggested as pointing out what the limits of the zones seem to be. I am by no means sure that the names used are the best which might be selected. The zones here indicated are those recognized along the eastern slope of the Rocky Mountains, especially in northern Colorado. The names and characterizations are offered in the hope that they may call forth criticism from other students of Rocky Mountain vegetation.

1. *Plains Zone.*—Altitude up to about 5,800 feet. This is a grassland formation, the grasses interspersed with and sometimes displaced by coarse composites. Trees and shrubs occur only along water courses or on rock ridges and buttes.

2. *Foothill Zone.*—Altitude 5,800 to 8,000 feet. This is generally a rather open forest of rock pine (*Pinus scopulorum*) on hillsides with a few scattered cedars (*Sabina scopulorum*), while there is a mixture of Douglas spruce (*Pseudotsuga mucronata*) on north slopes with some deciduous trees in the canyons and draws.

3. *Montane Zone.*—Altitude 8,000 to 10,000 feet. This is a closer forest than that of the preceding zone. Lodgepole pine (*Pinus murrayana*) is the dominant forest tree, frequently forming dense, pure forests. Rock pine

[1] Schimper, "Plant Geography" (English translation), p. 702, 1903.

and limber pine (*Pinus flexilis*) occur at various places and Engelmann spruce (*Picea engelmanni*) comes in at the upper limit of the zone.

4. *Sub-alpine Zone*.—Altitude 10,000 to 11,500 feet. This zone is characterized by forests of Engelmann spruce with limber pine and balsam fir (*Abies lasiocarpa*) as secondary species. Huckleberries are abundant as shade plants on the forest floor. A considerable amount of grassland or steppe occurs in the form of mountain meadows in the upper part of the zone. "Wind timber" runs up in tongues to various altitudes and there are small patches of this scrub formation isolated from the main mass below. Numerous ponds and bogs occur along stream-courses.

5. *Alpine Zone*.—Altitude 11,500 to 14,000 feet and higher. This is a rock-desert and steppe zone. Mat-forming plants and deep-rooted perennials are common. Large areas, consisting of rock heaps and boulder fields, are practically destitute of all vegetation except lichens. Sedges and grasses are numerous in species but seldom form a dense sod, being mixed with various flowering herbs. Dwarf willows occur, often forming a dense scrub over large areas, but there are no other woody plants.

Francis Ramaley
University of Colorado,
Boulder, Colo.

THE INTERCOLLEGIATE GEOLOGICAL EXCURSION

The seventh annual New England Geological Excursion was held at Providence, Rhode Island, on Saturday, October 26, under the leadership of Professor Chas W. Brown, of Brown University.

Friday evening a short conference was held at which the route planned was explained. The purpose of the trip was to study the undisturbed Carboniferous shales and sandstones with their fossil contents that occur east of the city of Providence and the graphite mine and sheaved basal conglomerate to the west of the city. Professors B. K. Emerson, J. B. Woodworth and Chas. W. Brown explained the structural and metamorphic features of the sections visited. The attendance of professors and graduate students was rather larger than in previous years.

In addition to the advanced students and teachers from the high schools and normal schools the following institutions were represented in the party of seventy: Amherst, Professor B. K. Emerson; Brown, Professors Brown and Ward; Colby, Professor H. E. Simpson; Holyoke, Professor Mignon Talbot; Harvard, Professors Johnson, Wolff, Woodworth and Dr. Mansfield; Massachusetts Institute of Technology, Professors Jaggar and Daly and Dr. Shimer; Smith, Miss Aida A. Heine; Williams, Professor H. F. Cleland; Yale, Professors Barrell, Gregory and Schuchert; Worcester, Mr. J. H. Perry; Worcester Normal School, R. M. Brown.

The next meeting will probably be held in the northern Berkshires in the vicinity of Williams College.

Herdman F. Cleland,
Secretary

THE LAMARCK MEMORIAL

Mr. Alexander Agassiz, Professor Henry Fairfield Osborn and Professor Bashford Dean, members of the International Committee from the United States, have issued a statement to the effect that the International Committee entrusted to secure funds for the monument to Lamarck has up to the present time received subscriptions amounting to about 25,000 francs. And the prompt response to the notices sent out by the committee has been, in many cases, very gratifying—Montevideo, for example, sending in the names of seventy-seven subscribers. There remains to be raised, however, the sum of 5,000 francs. And it is with the hope of securing the final amount that the American members of the committee are sending out this second notice. It is earnestly wished that this sum be contributed from the United States, in view of the influence which Lamarck has had upon the evolutionary conceptions of many and prominent American naturalists.

Subscriptions should be sent, as soon as possible, to Bashford Dean (Columbia University, New York), who will duly acknowledge and transmit them to the headquarters of the committee in Paris.

AN ACADEMY OF SCIENCES FOR ILLINOIS

Dr. A. R. Crook, curator of the Museum of Natural History of the State of Illinois, has addressed the following letter to men of science in the state:

"There is a widespread belief that our state should proceed to establish an Academy of Sciences. Ours is one of the few states in the middle west which is without such an institution.

"I. Such an academy will furnish an efficient medium for reaching all the various scientific groups of the state when scientific matters of public interest and common welfare are to be presented.

"II. At its meetings men of science throughout the state may interchange ideas and make the personal acquaintance of men working perhaps in other lines or of men known hitherto only by their writings.

"III. Men of greater achievement and success will inevitably stimulate and encourage beginners and men of less attainments.

"IV. The important contributions to knowledge made by the scientific men of Illinois will be disseminated so that all of us may learn of the important researches, inventions, and applications which are being made by our fellow citizens.

"More than one hundred men in different universities, colleges, normal and high schools, and museums have expressed their interest.

"The Academy should comprise every worker in science in the state, its roll being an almost complete scientific directory for Illinois.

"You are invited to be present at a meeting which will be held for the organization of such an institution at Springfield, on Saturday the seventh of December, 1907.

"The meeting will be held in the Senate Chamber of the Capitol at 10 o'clock in the morning."

SECTION G, BOTANY, OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The coming meeting of the American Association for the Advancement of Science will take place at the University of Chicago from December 30, 1907, to January 4, 1908. The sessions of Section G will be held in the Hull Botanical Laboratory.

It is important for the satisfactory prosecution of the business of the secretary that the titles of papers, accompanied by brief abstracts of not more than 200 words, be in his hands a few days before the initial date of the convocation. Inasmuch as the office of the secretary is at too great a distance for quick mail service, members are particularly requested to forward titles and abstracts to the secretary in care of Dr. Henry C. Cowles, Hull Botanical Laboratory, University of Chicago, Chicago, Ill., in whose hands they should be not later than December 20.

F. E. Lloyd,
Secretary, Section G

Mazapil, Zac., Mex.,
November 1, 1907

THE CENTENARY OF THE GEOLOGICAL SOCIETY OF LONDON

One hundred years ago, a handful of men in England, convinced that speculation is not true science, organized the Geological Society of London. With the foundation of that society the era of speculation came to an end, that of investigation began and geology, as we now know it, was born. Throughout one hundren years, the society has adhered consistently to the original policy, discouraging mere speculation but encouraging comparative geology. In its voluminous publications one finds results of study in all parts of the world and its members have proved themselves in many cases veritable helpers to students in newly settled countries. The list of presidents tells of the society's influence, for the names of most of them, from Greenough to Geikie, are as household words among geologists of all lands.

The centenary of the society was celebrated in London on September 26, 27 and 28 of this year. More than one hundred delegates representing an equal number of societies came from other countries with greetings to the parent geological society, while representatives from nearly every important scientific association in Great Britain and Ireland were present. No doubt the number of foreign delegates would have been much greater had the date been somewhat earlier; but as it was, men came from all parts of the world, Japan, India, Australia, Africa and both Americas, while, of European nations, all except Spain, Turkey and Roumania, appear on the roll. This widespread interest proves the general appreciation of indebtedness to the old society.

In accordance with custom, the celebration was preceded by several excursions, which, considering the fact that field-work is no novelty to most geologists, were well attended and those sharing in them found profit as well as pleasure. The Highlands of Scotland attracted the petrographers; the Lake Region of England had much for geographers and South Wales was a magnet for those interested in applied geology.

The formal exercises began on Thursday, September 26. The president's reception of delegates and guests took place in the House of The Institution of Civil Engineers at 11 o'clock. The number to be received was so great that, in order to bring the session within reasonable limits, only one delegate from each country was asked to speak, the other delegates handing in their formal messages at the close of his address. Dr. Arnold Hague was chosen to present greetings in behalf of delegates from the United States and his graceful address proved that the choice was wise. In the afternoon, at the same place, the president of the society, Sir Archibald Geikie, delivered the presidential address, taking as his topic, the state of geology at the time of the foundation of the society. The speaker traced the development of geological thought, discussing the varying influences affecting it. There were many matters requiring delicate treatment before such an audience, but they were dealt with frankly, and at the close all recognized that the judicial attitude had been maintained throughout and that the address is an important contribution to the history of our science.

In the evening, the official dinner was given at the Hotel Metropole and every corner of that (the largest banquet hall in London) was filled. The dinner closed with the usual course of addresses, representatives of France, Germany, Switzerland and the United States being called upon to respond to toasts. One must not fail to note that speakers at both the reception and the dinner confined themselves with nearly mathematical accuracy to the time allotted—a condition almost without parallel on similar occasions, which led some to suggest that Sir Archibald Geikie had exerted hypnotic influence upon the orators. If that were the case, the long-suffering American community would be glad to import him to this country.

The twenty-seventh and twenty-eighth were devoted largely to making the visitors content with themselves and their hosts. The treasures in archeology, geology and related sciences, accumulated in the several museums of London, were opened up to groups of interested observers, and, under the guidance of the Canon of St. Paul's, that cathedral was examined historically as well as geologically—the latter relation possessing much economic interest. It may be remarked in passing that anxiety respecting the security of that structure seems to be superfluous. The cracks in the walls are not due to recent excavations for subways and deep cellars, but they are as old as the building itself, most of them having developed during construction, as foreseen by Sir Christopher Wren, who, as they appeared, made proper arrangement for redistribution of burden so as to prevent further trouble.

In the early evening of the twenty-seventh, a dinner to the delegates and invited guests was given by the Geological Club of London, which was a good example of "how to do it." Each member of the club was directed to annex some of the guests and to seat them with him at the table; the result being that groups of four or five with similar lines of study or with affinities of other sorts were brought together, making this a more than enjoyable meeting for many who were present. The formal exercises were brought to a close on that evening by a brilliant conversazione at the South Kensington museum, where many old acquaintanceships were renewed and some new ones converted into friendships.

On Monday, the thirtieth, many of the delegates went to Oxford and many others to Cambridge. At each place the hospitality was profuse and honorary degrees were conferred on several geologists from the continent.

Unlike geological congresses, this meeting was not one for the reading of formal papers. As the president said to one of the visitors, the object was to have geologists see and know each other. In this respect the meeting was eminently successful. The commodious rooms of the Society in Burlington House, open for two weeks prior to the celebration, afforded every opportunity for men to become acquainted and full advantage was taken of the opportunity. The effect for good will last for a generation. It would be well if some one with genius for organization would take the method for a pattern and remodel the congresses so as to reduce reading of papers to the minimum and to increase the opportunity for personal contact, punishing by fine those who may neglect to utilize the opportunity.

Where all labored to make the celebration a success, it would be invidious to select any for particular mention; one may only congratulate the committee of arrangements upon the smoothness with which everything moved. Geological John Bull's idea of hospitality embraces much of genial common sense. It may be, as reported, that the Briton is slow in starting, but certainly, once started, his momentum is tremendous, carrying both willing and unwilling alike on a high wave of good cheer.

John J. Stevenson

SCIENTIFIC NOTES AND NEWS

Professor Major Ronald Ross, who left Liverpool on October 22 for Mauritius for the purpose of research in tropical medicine, and Mr. W. M. Haffkine were entertained at dinner on October 21 by the Liverpool School of Tropical Medicine. Sir Alfred Jones presided, and presented Mr. Haffkine with the Mary Kingsley medal of the school.

The council of the Royal Meteorological Society, at their meeting on October 16, awarded the Symons gold medal for 1908 to M. L. Teisserenc de Bort, of Paris, in recognition of the services which he has rendered to the science of meteorology. The medal was established in memory of the late George James Symons, the founder of the British Rainfall Organization, and is awarded biennially.

The College of Physicians of Philadelphia announces that the Alvarenga prize for 1907 has been awarded to Dr. William Louis Chapman, Providence, R. I., for his essay, entitled "Postoperative phlebitis, thrombosis and embolism." The next award of the prize, amounting to about $180, will be made on July 14, 1908. Particulars may be obtained from Dr. Thomas R. Neilson, secretary of the College of Physicians of Philadelphia.

The honorary degree of Ph.D. has been conferred on Professor Ernest Rutherford, of Manchester University, by the University of Giessen.

The Yale corporation has conferred the honorary degree of master of arts on Professor E. W. Brown and on Professor Ross G. Harrison, who have this year become members of the faculty of the university.

Sir Patrick Manson, medical adviser of the British Colonial Office, has been chosen president of the International Society of Tropical Medicine, organized during the recent International Congress of Hygiene.

Professor Baelz, of Stuttgart, and Professor Noecht, of Hamburg, have been elected presidents of the recently established German Society of Tropical Medicine.

Dr. Frank H. Loud, professor of astronomy and mathematics in Colorado College since 1877, has retired with an allowance from the Carnegie Foundation.

By the trustees of Clemson College the office of state entomologist has been separated from the chair of zoology and entomology of the college and located at Columbia, S. C. On September 11, 1907, Professor Chas. E. Chambliss resigned his position of associate professor of zoology and entomology to accept the appointment of state entomologist.

Dr. Heinrich Hasselbring, assistant in botany in the University of Chicago, has been appointed assistant botanist at the Cuban

Agricultural Experiment Station, at Santiago de las Vegas.

Mr. A. K. Chittenden has been appointed assistant in the United States Forest Service to investigate the White Mountain and Appalachian Mountain forests with a view toward the proposed national park. Mr. Karl Woodward has charge, for the U. S. Forest Service, of a study of forest conditions in Montana, in cooperation with the Northern Pacific Railroad Company. Mr. Chittenden and Mr. Woodward are graduates of the Yale Forest School and are sons of distinguished American men of science.

Dr. J. Ashburton Thompson, M.D., permanent head of the department of public health of the government of New South Wales, has arrived in London.

At a meeting of the Physico-chemical Club of Boston and Cambridge, held on Wednesday evening, October 30, Professor T. W. Richards spoke on "Chemical Research and Instruction in Berlin," and Dr. H. T. Kalmus presented a paper on "Some Properties of Fused Salts." Profesor Richards was elected president, Dr. A. A. Noyes vice-president, Professor Sherrill secretary and Mr. Frevert treasurer.

Nature states that on October 12 the Clifton (Bristol) Scientific Club celebrated its twenty-first anniversary by entertaining Sir William Ramsay and other past members, when Sir William, who was one of the founders of the club, delivered an address on the recent history of chemical science and on the nature of matter. On the previous evening he visited Clifton College, where he gave an account of the experiments by which argon and other gases of the atmosphere were discovered.

Mr. Herman DeC. Stearns, associate professor of physics in Stanford University, died of tuberculosis on October 21. Professor Stearns has been absent from the university on sick leave for the past three years.

The death is announced of Dr. A. Fürtwangler, professor of classical archeology at Munich.

M. N. Vaschide, assistant director of the Laboratory of Pathological Psychology of the University of Paris, died on October 13, at the age of about thirty-three years.

The Civil Service Commission announces an examination on December 4 to fill such vacancies as may occur in the positions of laboratory assistant qualified as textile and paper analyst and laboratory assistant in polariscopic work in the Bureau of Standards, Department of Commerce and Labor, at $1,000 and $1,200 per annum.

Under the will of the late Dr. Nathaniel Rogers, the senate of the University of London offers a prize of £100 for the best original investigations made on any medical pathological subject during the preceding two years. Candidates will be permitted to present papers published during the preceding year.

Foreign journals announce that a large meeting was held at Rangoon on September 19 to consider the establishment of a Pasteur Institute in Burma. It was resolved that the institute should be established at Maymyo. A committee was formed with powers to undertake measures preliminary to the formation of the institute. The subscriptions already amount to 80,000 rupees, which secures the success of the movement. Other subscriptions have been promised, which will be sufficient to enable the institute to start on a wide basis.

A telegram has been received at the Harvard College Observatory from Professor W. W. Campbell, director of the Lick Observatory, stating that prominent bright knots have been visible during the past week in Saturn's rings, two east, two west, symmetrically placed.

UNIVERSITY AND EDUCATIONAL NEWS

The report of the treasurer of Yale University states that gifts and legacies to funds during the fiscal year have been $527,545, as compared with $629,705 the year before, corresponding figures for gifts to income being $112,238 and $250,602. The gifts, most of which have been already announced, include the Yale alumni fund, $52,692; the Belden bequest, $105,000; the Seely gift, $100,000; the G. S. Woodward lectureship gift of $5,000; a gift of $3,055 to the library by friends of the late J. Sumner Smith; to the academic department five loan funds of about $2,000 altogether; the Abernethy fellowship of $10,-000; the Milner fund of $45,125, and Witherbee scholarship of $10,000; the Ely professorship fund of $50,000 to the Medical School; and, to building funds, part of the Ross bequest to the library, $97,534, and the W. L. McLane bequest of $97,468. Gifts to income include $13,869 from the Carnegie foundation; $25,000 from the Yale Alumni Fund Association; $31,744 from William Kent; $8,-600 from E. S. Harkness, and $8,800 from William Sloane for Dwight Hall improvements; and $3,300 from the National Lumbermen's Association for the Forest School. The W. W. Farnam accumulating fund has now reached $50,000, and its income becomes available for university purposes.

Gifts of $363,000 have been made to New York University during the past fiscal year. The value of the university's property holdings was said to be $5,130,000, on which there is a mortgage of $1,230,000.

The family of the late Professor Angelo Heilprin has presented to the Sheffield Scientific School the collection of lantern slides, comprising about 1,000 views taken by him in all parts of the world and used by him in his course in physical geography.

According to the *Umschau* there were last summer 3,132 teachers in German universities, of whom 1,333 were ordinary or full professors, 729 extraordinary or associate professors, 116 honorary professors and 1,054 privatdocents or lecturers. There are at Berlin 477 teachers, at Munich 226 and at Leipzig 224. The smallest number of professors is found at Rostock, Erlangen and Münster.

A fellowship in industrial chemistry, yielding $500 a year for two years, has been established at the University of Kansas by the Parke-Davis Company, manufacturing chemists of Detroit, Mich. Ralph C. Shuey, University of Kansas '06, is the first holder of the fellowship.

J. Fred Baker, B.S. '02, Michigan Agricultural College; M.F. Yale '04, has been appointed professor of forestry in the Michigan Agricultural College, in place of E. E. Bogue, deceased. Mr. Baker was in the U. S. Forest Service for a portion of '04; assistant professor of forestry for the State Forestry Commission of Pennsylvania, '05–'06, and professor of forestry in Colorado College, '06–'07.

At Harvard University, Mr. R. B. Thomson has been appointed instructor in botany and Mr. F. C. Blanck research assistant in biological chemistry.

The following scientific appointments have recently been made in the State University of West Virginia: John A. Eiesland, professor of mathematics; John L. Sheldon, professor of botany and bacteriology; Albert M. Reese, professor of zoology; Henry M. Payne, professor of mining engineering; Daniel W. Working, superintendent of agricultural extension work; Frederick R. Whipple, veterinarian; Welton M. Munsen, horticulturist; Clarence Post, assistant in physics; Margaret Buchanan, assistant in mathematics and Greek.

Dr. J. H. Grindley, of Liverpool University, has been appointed principal of the Government School of Engineering at Ghizeh, Cairo.

Mr. A. H. Lees, of King's College, Cambridge, has been appointed to the studentship in medical entomology for the period of one year. The studentship was recently established on the basis of a grant from the "Tropical Diseases Research Fund," administered by the Colonial Office.

We learn from *Nature* that of the four fellowships awarded last month at Trinity College, two were for classics; one of the remaining two was awarded to Mr. A. S. Eddington, senior wrangler in 1904, and the other to Mr. V. H. Mottram, of the natural sciences tripos, 1903, and first class (physiology) in the same tripos, 1905. Mr. A. Wood, who took his degree in chemistry and physics in 1904 as an advanced student, has been elected to a fellowship at Emmanuel College.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, NOVEMBER 15, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

FACTS LIMITING THE THEORY OF HEREDITY[1]

MY first duty is to acknowledge the honor done me by the suggestion that I should deliver the address in this section. I need not say that I very highly appreciate the distinction thus conferred.

The fact that a heredity section has been constituted is surely a matter for congratulation. It is a sign that the study of zoology is passing into a maturer stage. For the past half century zoologists have been chiefly occupied with the accumulation of morphological facts of structure and development. The perfection of microscopical methods had revealed regions in which knowledge could be readily advanced by simple means. We became, therefore, students of Cœlenterata, insects, Vertebrata, or whatever it might be, according as fancy or opportunity had specially attracted us to one or other of these groups.

Such work was interim work. It was making up arrears. This task is now practically accomplished. Almost all that can be seen by these simple means has been seen. One more phase is over. The division of our subject matter according to the groups of the animal kingdom is no longer adequate.

We are trying for fresh points of attack. Our forces are disposing themselves in new formations, with fresh centers and a new front. In the organization of the present congress the change has been recognized,

[1] Address delivered at the International Zoological Congress, before the Section of Cytology and Heredity, August 23, 1907.

and the creation of this section and of sections for experimental zoology and cytology testifies to the existence of new methods and new hopes.

Limitations of the animal classes do not trouble us. We take facts wherever we can find them. We are botanists to-day, zoologists to-morrow. The widening of interest which the study of heredity is bringing into modern zoology must prove a great benefit to the science.

When morphology was a new idea, everything was sacrificed to its pursuit. Physiology, systematics, all were discarded as useless lumber. Let us not repeat that short-sighted mistake. In the wider survey which we are attempting we shall need all these things. If we are to understand rightly the phenomena of specific difference—to take that problem only—we shall be glad of anything that the systematist can tell us, and of many deductions of pure physiology.

The study of heredity and variation—of genetics, to use our modern term—is itself a purely physiological inquiry, and as such it must range itself among other physiological inquiries; standing next beside, and looking constantly for support to, physiological chemistry.

The accidents of development which dissociated zoology from physiology were, as we are beginning to perceive, a misfortune, though perhaps an inevitable one. The botanists are happy in that their smaller dimensions have prevented such disruption. But let us hope that the dynamics of the zoological system may admit of the retention of that part of physiology which still adheres. Genetics will grow to be a big sphere one day; but may it never break off from the parent body whether as satellite or as sun.

Let us now examine the task which lies before us as students of genetics. Various descriptions of our objects may be made, referring to the phenomena of heredity and variation; their bearing on the theory of evolution, or on the origin and destinies of races. Stripped of all that is superfluous and of all that is special to particular cases, genetics stand out as the study of the process of cell-division. For if we had any real knowledge of the actual nature of the processes by which a cell divides, the rest would be largely application and extension. It is in cell-division that almost all the phenomena of heredity and variation are accomplished. Nothing is more easy than to witness this process. We may behold its minutest visible details when we please and as often as we please, and still no one has even a plausible guess as to the essential nature of the process. Two centers form: the parts collect round each. The two halves withdraw; or, if we may commit ourselves so far, repel each other, and there are then two cells instead of one. The likeness of those two cells we call heredity; their difference we call variation. If the two cells remain constituent parts of one body, we may speak of their likeness as symmetry or repetition; and their points of unlikeness we then call differentiation. But *how* the two centers were formed, not to speak of *why,* and how they came to separate, we have no surmise. Still less can we conjecture what it was that decided the distribution of differences between the two halves. No phenomenon of common life is so obscure.

By suitable means many of the finer details can be watched, but the most meticulous observation has failed to disclose the essential truth which must yet be so near. I am speaking in a country where by the determination of vigorous observers a great school of cytologists has arisen who have greatly added to knowledge of the perceptible features. They will, I think, agree with me that were the powers of the microscope increased many times, it is unlikely that we should be very much wiser than we now are. Evidence of a different sort is needed.

Others by great ingenuity have tried to penetrate a little deeper by making models which in various ways can reproduce something of what is seen to occur, but the features thus represented are those which occur *after* the two centers are formed—the consequences, that is to say, of the division, not the division itself.

That remains a phenomenon unparalleled in the physical world, like consciousness, a distinctive property of living matter. By no confection of chemistry or mechanical contrivance can we yet fit together a system which will dichotomize and grow, dichotomize and grow, repeating the process again and again as long as certain materials are supplied to it.

The point on which I wish here to lay the emphasis is the failure to conceive or to represent the dichotomy. Heredity, as we commonly see it, is much more than that, but the dichotomy is the one feature common to all its manifestations. I have sometimes thought that in our investigations of the later and more special phenomena of inheritance there is a danger of forgetting that this is the essential fact. In the visible rearrangement of the chromosomes, for example, in mitoses, occurrences so tangible and striking are witnessed that the observer can hardly avoid exclaiming, "This is the essential process of heredity," or "Those chromosomes which I can watch and count must be the physical basis of hereditary likeness." Attractive and stimulating as those wonders are to behold, the essential is still beyond. Heredity began in the explosion which impelled the chromosomes on their courses. If it were possible to identify the chromosomes ever so clearly as the physical bearers of hereditary characters, the problem of the division would remain, and I am strongly led to expect that it must be in some new light on the causation of the division that the way to attack the essential problem will be found. In this expectation I am glad to find myself in agreement with Dr. Loeb, whose stimulating address we heard yesterday. The researches which he has so successfully inaugurated have brought the problem of cell division at last within the range of experiment; and if the nature of the explosion remains still inscrutable, Loeb's work has shown how the charge may be fired.

In our deliberations I anticipate that the more immediate question, whether the chromosomes are or are not the bearers of hereditary characters, will be fully debated. Without presuming to a definite opinion on this question, I venture to state what seem to me formidable difficulties in the way of this expectation. If the chromosomes were directly responsible as chief agents in the production of the physical characteristics, surely we should expect to find some degree of correspondence between the differences distinguishing the types, and the visible differences of number or shape distinguishing the chromosomes. So far as I can learn, no indication whatever of such a correspondence has ever been found. Besides this, although no very thorough investigation of the chromosomes of somatic structures has yet been made on an extensive scale, I believe that definite cytological distinctions between the nuclei of the various tissues *of the same body* have not been detected. If chromosomes were the chief governors of structure, surely we should find great differences between the chromosomes of the various epithelia, which differ greatly in their structure and properties. As these cytological differences have not been found consistently there, the prospect of successfully tracing them among the specific types does not look very hopeful.

Again, no correspondence between the chromosome numbers and complexity of structure has ever been asserted to exist. Low forms may have many; highly complex types may have few.

Then, on the contrary, very closely allied types may show great differences in these respects. As you are aware, Rosenberg has shown that one species of *Drosera* has 20, while another has 10.[2] Again, Miss Lutz has found a similar state of things in *Œnothera gigas,* which has 28, while *Œnothera lata* has 14. Obviously this doubling means something definite, but it is not suggestive of the determination of specific difference. In *Aphis* Miss Stevens, on the other hand, has shown how wide a diversity may be presented by the chromosomes of forms so alike as to have passed for one species. These differences prove both too little and too much. I can not but believe that all this evidence points to the conclusion that we are about to find among the chromosomes one more illustration of the paradoxical incidence of specific difference, not the fundamental phenomena on which that difference depends. Among coleopterists punctulation is sometimes a feature of great systematic importance. To dipterists neuration and chætotaxy sometimes give useful critical data. In certain orders of Lepidoptera, the Hesperidæ, for example, the structure of the gonapophyses sharply distinguishes the species where all outward tests fail. But proceeding farther with each of these criteria, we are sure to come upon other groups where for a long series of diverse types the critical feature, so important elsewhere, may show no differences, or, on the contrary, may show hardly any stability. I have digressed outside my province in these remarks. My excuse must be that I have a rare opportunity of speaking to a great school of cytologists, who must, sooner or later, become the colleagues of us breeders in the attack on genetic problems, and I can not resist saying how the facts strike an observer who is highly interested, and I may truly say unprejudiced. I suspect, then, that the specificity of the chromosomes may conform in general to these other phenomena of specificity.

There remains the suggestive fact that all that has been witnessed regarding the behavior of the chromosomes is in fair harmony with the expectations which our Mendelian experience would lead us to form respecting the hypothetical "bearers" of varietal differences. On the other hand, with one striking exception, nobody has been able to connect a cytological difference with a character-difference in any instance. The exception, of course, is the case of the accessory chromosome which Professor Wilson so admirably demonstrated to us yesterday. Of that I shall speak again hereafter.

But though, in regard to these profounder questions, our knowledge is so defective, the results of experimental breeding are beginning to limit the problem in very definite ways. We know first the fact deduced from Mendel's original experiments with peas, that the bodily characters may result from the transmission of distinct unit-factors. According to Mendel's own conception these factors existed in alternative or allelomorphic pairs, of such a nature that only one member of any one pair can be carried by a gamete. Now though we can not quite prove this first account to be wrong, it is nevertheless possible to express all Mendelian phenomena in terms of a simpler system, according to which the allelomorphism may be represented as con-

[2] Important evidence as to these chromosome numbers has been published by R. R. Gates, *Botanical Gazette,* February and July, 1907.

sisting essentially not in the presence of separate factors for the dominant and for the recessive characters, but in the *presence* of something constituting the dominant character which is *absent* from the recessive gametes. So satisfactory, indeed, are the results of this mode of representation that the probabilities are greatly in favor of its truth. Indeed, when the interrelations of a complicated series of varietal types have to be dealt with, the presence-and-absence system, as we may call it, applies so readily that its correctness is scarcely doubtful.

In simple cases, for instance, in that of the rat, we may regard the color gray and black as due to the operations of gray and black determiners acting upon a distinct factor for color. According to the scheme promulgated by Cuénot, the two determiners, gray and black, are regarded as allelomorphic to each other.

Such a system, however, fails when, as in the case of mice, a third color-type (in addition to the albino) viz., chocolate, has to be expressed. If, on the contrary, each determiner is regarded as allelomorphic to its own absence, a workable system is provided, which can deal with almost all the observed facts. The gray—or technically, agouti—mouse, then, contains all the factors. The black is black because it is minus the determiner for agouti, and the chocolate is wanting in the determiners both for agouti and for black. The relations of all the color types to each other are thus clear except in so far as the relation of yellow to the other colors is not quite satisfactorily accounted for on either system.

It is at present beyond my purpose to examine the suggestions made to deal with that particular difficulty, but leaving this special question on one side, we can draw the clear deduction that each of these varieties owes its existence to the absence or removal of some factor, from the gamete of the type.

Conversely in other cases we perceive with equal certainty that the variety is due to the addition of such a factor.

To deal with this series of interactions, the simple conception of dominant and recessive is inadequate. We now need a term to denote the relation between dominant factors belonging to distinct pairs of allelomorphs.

Till lately we spoke of the relations between the gray color of the mouse to the black color in terms of dominance. Those terms, strictly speaking, should only be applied to members of the same allelomorphic pair. We can perhaps best express the relation between the gray and the black by the use of the metaphor "higher and lower," and I therefore suggest the term *epistatic* as applicable to characters which have to be, as it were, lifted off in order to permit the lower or *hypostatic* character to appear. The same method of representation is, of course, applicable to the series of factors for pattern and for intensity of color.

The case of patterns is in a special way instructive. Symbolically we can represent pattern as due to determining factors, like those which cause the tint or the intensity of color.

Though justifiable as a symbolic representation, it is evident that the "factor" for pattern may really be a quantitative difference in the amount of one of the elements, presumably the chromogen. We may imagine that the color appears on special parts, just as color takes on the prepared surface of a lithographer's stone, always remembering that though the distinction between, for example, self-pattern, the Dutch-pattern and the English-pattern rabbit may thus be quantitative, the quantitative stages are fairly well defined.

The point is of interest inasmuch as

when we come to estimate the minimum number of transmitting elements, it is superfluous to postulate additional elements as instruments in effecting these alterations in pattern, seeing that the change may very readily be imagined as due to a series of quantitative subtractions from the qualitative elements. If then we can thus regard the distribution of color as dependent on subtraction-stages of some one element, say the chromogen, we are naturally led to refer the various intensities to another similar but also definite series of subtraction-stages in which the subtraction is spread over the whole field, and so on for the other qualities.

Two fairly distinct classes of difference may thus be presumed to exist, those depending on the qualitative elements and those due to quantitative subtractions from them. The latter may be again subdivided.

It is scarcely necessary at this time to repeat that almost all the subtraction-stages fully studied are fairly definite, and their existence implies no suggestion of general failure of segregation. Interesting experiments have recently been made by Castle and McCurdy, exhibiting positive results of selection inside the limits of one of these stages, viz., the so-called hooded type in the rat. Nevertheless, the maximum result attributable to selection in such cases is a modification within the limits of one particular varietal type.

Such evidence provides no escape from the conclusion that each genetic variety comes into existence by a special addition to or subtraction from the genetic equipment.

Of all the results to which experimental work has led us, that which to me is the most astonishing is the fact that the same systems of transmission should be followed by characters which, by whatever test they are judged, must be supposed to be most diverse in physiological causation. Naturally when we are dealing with changes in color, for instance, or in the reserve materials of a seed, we surmise that the critical factor is a certain ferment, or rather, the power to produce that certain ferment. It is perhaps not too wide a stretch of imagination to regard susceptibility to fungoid disease as caused by some similar body. The diversity of these ferments must anyhow be very great, and it seems very strange that all these multifarious potentialities should exhibit gametic allelomorphism. Let us take an illustration. Color, as we can prove in regard to several plants, and in regard to the plumage of fowls, is due to the meeting of two complementary factors. One is presumably a ferment. Recent research strongly suggests that it is a tyrosinase. The other is referred to as a chromogen. But whatever they are, the two bodies, or rather the factors which produce them, must be of utterly different nature, and yet, genetically, the two potentialities are treated similarly. Each is allelomorphic to the absence of such a power.

How much more astounding is it, that when we pass to qualities such as length of stalk and shape of flower, or of a cock's comb, the quality of the hair in rabbit, we still find the same rules in strict and undeviating operation. Any scheme of heredity on a scale comprehensive enough to deserve the title of theory must deal with this surprising fact.

There is another extraordinary feature in the behavior of allelomorphs which, though known clearly in a few cases only, must certainly play a great part in the fuller elucidation of heredity. This is *partial gametic coupling.*

Mr. Punnett and I have for some time been engaged in studying this phenomenon in the sweet pea (*Lathyrus odoratus*) and we have recognized indications of the same thing elsewhere. The section will perhaps forgive me for taking a botanical illustration. I have no doubt it will not be long before cases in animals are found.

In the sweet pea, then, we know experimentally about eleven distinct allelomorphic pairs. The actual number is, of course, much greater, but eleven have been critically demonstrated.

Of these characters some are concerned with the production of color, others with the determination of form. The composition of the F_2 families shows that several of these allelomorphs are not distributed independently among the gametes, but that certain combinations of characters occur with greater frequency than others. The first of these couplings to be made out was that between the normal or *long* pollen shape and the factor which determines *blue* color. In the absence of the long pollen factor, the pollen is round. In the absence of the factor for blue, the flower color is red. The coupling here is such that the F_2 numbers instead of being 9 blue-long + 3 blue-round + 3 red-long + 1 red-round, are 41 : 7 : 7 : 9, or very nearly so.

This system would be produced by the following gametic series: 7 blue-long + 1 blue-round + 1 red-long + 7 red-round.

It is not possible to decide strictly whether the series is 7, 1, 1, 7, or 8, 1, 1, 8, and, of course, the dichotomies which produce the one or the other of these systems must be entirely different, but the total of the series is either 16 or 16 + 2.

Now the other two instances of partial coupling show that the association is there in groups of either 32 or 32 + 2. In the first case the blue factor and the pollen shape are again concerned, but their proper system of coupling is disturbed by the presence of another element, that which governs the shape of the flower.

The three pairs of characters are then:

Dominant	*Recessive*
1. Blue.	No blue, viz., red.
2. Pollen long.	Pollen round.
3. Standard upright, having central notch.	Standard hooded, without a central notch.

Now, experiment has shown two things. First, that in these families there is a total and complete coupling of *blue* and *hood*. In other words, all gametes destitute of the upright standard factor have the blue factor, while all gametes bearing the upright standard are destitute of the blue factor. Consequently, there are in such families three types of plants, distinguishable by the shape and color of their flowers:

1. Blue—hooded standard.
2. Blue—erect standard.
3. Red—erect standard.

Classes 1 and 3 are homozygous, but 2, which in this curious instance happens to be the wild type of sweet pea, is here always heterozygous, like the blue Andalusian fowl. Consequently we meet the paradoxical result that of the three types produced in such a family the original wild form is the one which does not breed true, but continues to throw off the other two types.

It is only by a stretch of language that we can speak of the blue factor as coupled with the hooded shape; for the hooded shape is recessive, and thus may be regarded as the shape due to the removal of the factor for upright standard. A more strict way of describing the facts would be to speak of erect standard and blue factor as gametically alternative to each other. It is thus possible that we may have eventually to extend the conception of allelomorphism to cases like this where two characters, both dominant, due, that is to say, to the presence of some factor, are alternative to each other in the constitution of the gametes.

To return now to the distribution of the pollen characters in these families: the F_2

numbers prove that the coupling between the blue factor and the long pollen character is altered and becomes far more complete. When the hood standard is segregating from the upright standard at the same time as the blue is segregating from the red (viz., non-blue), and the long pollen from the round pollen, the gametic series is no longer 7 blue; long + 1 blue; round + 1 red; long + 7 red; round, but is evidently 15 + 1 + 1 + 15, unless, as is still possible, the actual numbers are 16 + 1 + 1 + 16.

A second case of this peculiar distribution exists in regard to the two characters, sterility of anthers and absence of colors in the axil; there the association is 15 (or 16) fertile ♂; colored axil + 1 fertile ♂; green axil + 1 sterile ♂; colored axil + 15 (or 16) sterile ♂; green axil.

The F_2 numbers resulting from the recombinations of two pairs of allelomorphs distributed independently, and according to various simple systems of partial gametic coupling may be tabulated as follows. In each pair one of the factors is taken to be dominant over the other.

	AB	*aB*	*Ab*	*ab*	Total
No coupling.	9	3	3	1	16
3 . 1 . 1 . 3	41	7	7	9	64
7 . 1 . 1 . 7	177	15	15	49	256
15 . 1 . 1 . 15	737	31	31	225	1024

and so forth.

Curiously enough, we have as yet no certain case of the coupling in a series of 8, viz., 3 + 1 + 1 + 3, though we can scarcely doubt that the system exists. There are, however, clear indications that couplings of a still closer order exist and we may reasonably expect them to fall into systems corresponding with the series of powers of 2. This evidence will, in all probability, be of great assistance in the attempt to close in on the question of the moment at which the segregation of characters is effected and must be taken into account in any discussion of the nature of the dichotomies themselves. It becomes very difficult to suppose in these cases of close though still incomplete coupling that all the segregations occur at the reduction division—or indeed at any single division—and we await with some interest the result of cytological studies of the antecedent stages in maturation. The difficulty reaches its maximum when we attempt to conceive the process of character distribution among the egg cells of plants. The male cells in plants and animals are so numerous that their numbers supply sufficient scope for the formation even of very long series of couplings. The egg cells, on the contrary, are few, and very often definitely grouped in special organs which again are arranged on a definite geometrical plan relatively to the gross anatomy of the plant. Even if the various accessory cells of the plant ovary are reckoned as belonging to the gametic series, the number seems still insufficient to allow for the development of a coupling which demands a long series for its expression. Is there, then, any organized system of differentiation connecting the several ovaries into a common plan? In maize and peas, where indications of this system might be expected to be found if they existed, the evidence is entirely negative, and that is all which can be positively asserted.

Turning now to another aspect of the problem, we have to look for facts which may help us to limit our search for causes of variation. We may, as I have said, assume that a vast number of variations are due to the addition or removal of definite factors. We begin, therefore, to have some dim conception of the nature of this class of variations, and at all events to appreciate that they must occur as definite and specific events. As to the causation of these events, there is almost no light. A few months ago, I think it would have been scarcely an exaggeration to have said there was none. It is, however, impossible not to recognize that the striking experiments lately published by Tower may be a positive contribution to this part of the inquiry. We can scarcely imagine that changes in temperature or in moisture are the great or chief efficient causes of natural variation; still the fact that in Tower's experiments such artificial changes in conditions appear to have effected a modification in the germ cells of the potato beetle (*Leptinotarsa decem-lineata*) and to have permanently deflected the offspring into a recessive line, must be allowed weight in future discussions of these phenomena. Many points in that fine piece of work still remain to be cleared up, but a very remarkable beginning has been thus made. It is, perhaps, scarcely necessary to add a warning that though the response to change of conditions may have been direct, it must not be hastily concluded that the response is adaptive. The appeal to direct responses so common in evolutionary discussions of thirty years ago, was made to account for the complex adaptations of organism to environment. It is the total want of any evidence supporting that appeal which has driven most of us to disbelieve in the reality of any such claims, and there is nothing in the new evidence, I think, which should shake the attitude of resolute agnosticism which we have thus been led to adopt.

Similar reflections apply to another very curious instance of genetic change induced by more violent means. MacDougal states that by injecting zinc sulphate into the ovary of *Raimannia* he caused the plant to produce seeds which became small and depauperated plants, destitute of the ciliation characteristic of the parent species. These, in their turn, transmitted the new character to their descendants.

The facts which I have referred to as helping to limit our view have been drawn from the behavior of a considerable range of characters and, as I have said, there are strange elements of similarity common to all. Respecting two very important classes of characters we still remain in almost total ignorance. Some years ago in attempting a provisional survey of variations I distinguished a special group of phenomena as *meristic,* that is to say, belonging to those occurrences by which division and repetition are effected in animals and plants. Obvious as the meristic differences are, we know very little as to the system followed in their inheritance. Only one case is clear, I believe. Farabee has shown that the peculiar condition of the human digits in which the fingers and toes have only two phalanges each, behaves as a simple dominant. Dr. Drinkwater has very kindly sent me lately a table which he will shortly publish, showing exactly the same thing in an English family. In his family, as in Farabee's, the affected members were of very short stature. I can not at all readily conceive how any ferment or other transmissible substance can be supposed to be responsible for such a variation as this. It is true that the attacks of gall-flies or of fungi may excite branching, or proliferating cell division in plants, and we may have to suppose that a poison can have this effect. Perhaps we may also imagine that the fine division of the hair follicles in Angora rabbits or Merino sheep may be due to the want of some substance which in the normal type inhibits or checks this excessive subdivision, but if we are to bring the two-phalanged digits into line with the rest of these observations we shall have to make an extreme demand upon the specific powers of chemical substances.

Polydactylism has thus far failed to give clear indications. Sometimes the inheritance is Mendelian, while in other strains or individuals dominance is so irregular that the descent becomes untraceable. Such irregularities of dominance here, as elsewhere, may be referred with some probability to the disturbing influences of other undetected factors. It is much to be hoped that cases of difference in the ground-plan numbers of some radial type will be found amenable to experimental tests. Here the problem may be found in a somewhat simplified form on account of the elimination of serial differentiation.

One most interesting class of characters remains untouched. I refer to right- and left-handedness. I can form no surmise as to the laws which will govern the descent of these characters. From Mayer's observations on *Partula* we learn that parents of either twist may bear young of either twist. The numbers in the uteri were so small that the absolute numbers were insignificant, and it may be an accident that no mixture of types was found in any one uterus. Direction of twist is a fundamental meristic phenomenon, being, as Crampton and Conklin have proved, determined as early as the first cleavage plane; and great light on the problem of cell division might perhaps be obtained if the inheritances of these differences could be determined. The only case we have studied, that of *Medicago*, in which the fruits are right- or left-spirals according to species, proved unworkable, perhaps on account of the minute size of the flower and the roughness of the manipulations.

I must now refer to the one positive case alluded to above, in which a chromosome difference has been proved to be associated with a somatic difference. McClung, studying the accessory chromosome first observed by Henking was the first to insist on its importance. He showed that in certain insects half the sperms have it and half are without it. This fact led him to make the natural suggestion that the structure might be concerned in the differentiation of sex. This suggestion has been shown by Wilson to be correct, but the accessory body proves to be the peculiarity of the sperms which are destined to form *females*, not of those which will form males, as had been previously supposed. It was with no ordinary feelings of pleasure that in the past week many of us in Woods Holl, and again the large audience assembled in this room, beheld the fine series of photographs which so amply demonstrate Wilson's far-reaching discovery.

The definiteness of the facts is evident beyond all question, and whether the accessory body is in these types the "cause" of femaleness or only associated with that cause, we have at last the long-expected proof that sex is determined in the germ cells, so far as these specific cases are concerned. In those cases we may even go farther and declare that the female is homozygous in femaleness, while the male is heterozygous in sex. Such a result accords well, I think, with the general conclusions to which breeding experiments, on the whole, point. For though great disparities between the proportion of the sexes occur in certain matings, these disparities seem to be obliterated in succeeding generations. If the one sex were homozygous and the other heterozygous, such impermanence of the divergences is what we might naturally expect.[3]

[3] In these remarks I have of course in view the case where the actual number of the two sexes show strange departures from equality. The phenomena recorded by Doncaster in *Abraxas grossulariata* and by Standfuss in *Aglia tau*, where the proportions of the sexes belonging to two varietal

Of course, the association of sex-distinction with an accessory chromosome is admittedly a peculiarity of certain types, but science proceeds by the discovery of prerogative instances, of which surely this notable illustration will long be remembered.

While knowledge has of late progressed so rapidly in regard to many genetic phenomena, we still know next to nothing of the facts relating to the incidence of partial sterility among heterozygous forms. Guyer found that the abnormality of which the sterility of hybrid pigeons is the expression, begins in the reduction-division and is apparent as an entanglement of the chromosomes which fail to divide. In many cases sterility is partial; and for example, a proportion of good pollen-grains occurs mixed with the aborted grains. Fuller examination of these cases would probably lead to interesting results.

In selecting facts which tend to limit our outlook on the phenomena of heredity I have naturally chosen to speak rather of features which are positive and mutually consistent than of the many negative and thus far conflicting items of evidence which must perhaps one day be allowed their weight. The real value of these negative and frequent doubtful observations is as yet so uncertain that they must be regarded rather as hints to be followed in the pursuit of facts than as facts already ascertained.

Allelomorphism, as we are becoming more and more disposed to believe, consists in the separation of a positive something from the absence of that something: More correctly, perhaps, we should say that the thing which conveys a certain power segregates, leaving in that cell division no representative of that power behind. This allelomorphism is the one fact of which we have the clearest proof. It may govern, as we have seen, features of the utmost diversity. What then is that allelomorphism? An essential phenomenon of cell division, it is not: for in homozygous organisms the products of division are alike. Any theory of heredity must include and recognize both these two kinds of division in its purview. We seek vainly as yet for a scheme by which these two sorts of division may be represented.

types followed peculiar but consistent systems, are evidently to be referred to the effects of coupling, as Doncaster has shown.

I do not know that analogy is helpful in these cases, but in my own mind I sometimes remember in this connection that the somatic divisions themselves are also of two types. There are segmentations which, as in radial animals or bilateral animals, divide similar parts from each other, and there are also the serial divisions by which series of differentiated segments are produced. It seems to me just possible that the heterogeneity among the differentiated segments may have some point of real resemblance to the heterogeneity of allelomorphs. I suggest this comparison with only a faint hope that it may prove sound.

Lastly, any scheme of heredity must be able to recognize the possibility of gametic coupling between allelomorphs belonging to distinct pairs, and though few such couplings have yet been proved, we have good reason to believe that yet other systems of couplings of much higher complexity exist.

Dr. Loeb encourages us to look to chemistry for the fulfilment of our hopes, and often, as in the case of the sweet peas, of which I have spoken, we come very near indeed to something like simple chemical phenomena. Of chemistry I know little, but I would ask those who are experts in chemistry whether it is in harmony with chemical conceptions that, in all the range of characters with which we, breeders, have dealt, no phenomenon suggestive of valency between characters has been observed. Everywhere we meet the fact that on an average the number of germ cells in which our allelomorphs are present is the same as the number in which these allelomorphs are absent. Whatever the kind of characters concerned, equality of number is the rule. While, therefore, we see very readily that the operations of the allelomorphs are due to chemical action, allelomorphism itself can not be expected to prove a chemical phenomenon in any simple sense. Allelomorphism is rather to be compared to the separation of substances which will not mix, and it is not impossible then in some of our more complex cases we are concerned with various phenomena of imperfect mixture. The elucidation of this part of the subject must be left to the physicist.

I can not conclude without expressing something of the delight which I feel that biologists are at length devoting themselves in good earnest to genetic problems.

To those whose memories go back even to the International Congress of 1898 in Cambridge the change is indeed amazing. Then we spoke little of genetics—little, that is to say aloud, or in official programs, though under our breath some of us were murmuring of these things. In this congress the voices that we dared not raise in 1898 are rather in danger of hoarseness from too much speaking. But, seriously, we students of genetics may look forward to the future with great confidence and hope. Those who next week will see Professor Davenport's magnificent institution at Cold Spring Harbor will appreciate that a wonderful and most hopeful beginning has been made. The work of Professor Davenport and his staff, of Professor Castle, at Harvard, of Professor Tower, at Chicago, and of others I might name, are all evidences that a great and combined advance has begun. We in Europe will bear our part also, and if we have not any very fine equipment we must console ourselves with the thought that light-armed troops may move the faster for a while. With their base on Cold Spring Harbor, or Woods Hole and the Biologische Versuchsanstalt in Vienna, the allied armies of genetics, cytology and experimental zoology they start for the grand attack; and I think when we meet at the end of another period of ten years, there will be victories to record.

William Bateson
Cambridge University

SCIENTIFIC BOOKS

Résultats du Voyage du S. Y. Belgica en 1897–9, sous the commandement de A. de Gerlache de Gomery. Rapports Scientifiques. Zoologie. *Insects* par G. Sévérin (and twenty others), 92 pp., 4°, V. pl., 1906; *Ostracoden* von G. W. Müller, 8 pp., I. pl., 1906; *Holothuries* par E. Hérouard, 17 pp., II. pl., 1906; *Medusen* von Otto Maas, 32 pp., III. pl., 1906.

A fresh batch of the valuable reports of the Belgian Antarctic Expedition have come to hand, the printing and illustrations of the elegance which has characterized the series.

The number of insects which have been brought back from the Antarctic remains pitiably small, and in marked contrast with the richness of the Arctic regions. Besides the Collembola taken in the Gerlache channel, a *Podurella* and pedicularian obtained by the *Southern Cross*, no insect is known except a Chironomid fly of the new genus *Belgica*, and the larva of perhaps another species of the same family. These minute creatures, whose wings are so reduced that they are incapable of flight, are found in the vicinity of small pools of water where the seabirds roost on the rare bits of bare ground or rock which are exposed along Gerlache Channel.

A number of interesting insects were obtained in the Magellanic region and at the Falkland Islands. These are also treated of in the present publication.

A few ostracods, mostly belonging to the genus *Conchœcia* or *Paradoxostoma*, were obtained from the plankton between 69° 48′ and 71° 15′ S. Lat.

The Holothurians comprise nine species, of which five are new, including the new genus *Rhipidothuria;* and which were procured chiefly between S. Lat. 69° and 71° 18′ in deep water, or in the plankton collections.

The Medusæ are also rare, only two of strictly Antarctic habitat having been taken, *Homœonema racovitzœ* and *Isonema amplum.* The second generic name, it may be noted, is preoccupied for a Mollusk since 1866 by Meek and Worthen, and might be replaced by *Arctapodema.* The other forms discussed are mostly from the subantarctic plankton, none of them identical with Arctic species, though one of them is supposed to be Mediterranean in distribution.

WM. H. DALL

National Antarctic Expedition, 1901–1904, S. S. Discovery, commanded by Capt. Scott R. N. Natural History. Vol. I., Geology. London, the British Museum (Natural History). 1907. 160 pp., 4°, pl. X. Field Geology, by H. T. FERRAR, Geologist to the expedition (100 pp.). Rock Specimens, by G. T. PRIOR, Asst. Brit. Mus. (40 pp.).

We have already reviewed the second and third volumes of this excellent report, and now are able to notice volume I., which has recently appeared.

The part of South Victoria Land studied by the members of the expedition consists of a great range, or series of mountain ranges, stretching in a line almost direct from latitude 71° to latitude 82° south, a distance of some 800 miles. Some of the peaks rise to a height of 13,000 feet, and it is remarkable that there is no extensive area of land lower than 4,000 feet. Off this bold coast line is the shallow Ross Sea, with occasional islands close in and in a series roughly parallel to the coast.

In the vicinity of the winter quarters the Ross Archipelago, including the large Ross Island which bears Mts. Erebus and Terror, is composed of recent volcanic rocks. Mt. Erebus emits steam, but during the stay of the expedition no ejection of dust, lava or other solid matter was observed.

On the opposite side of the gulf, westward from Ross Island the rocks are quite different, having for a basal platform a gneissic series with which a pure white coarsely crystalline limestone in places is associated. Above this lie granites with interstratified sheets of dolerite, occasionally thin seams of micaceous schist, and narrow basaltic dykes. The granites are capped by a yellowish sandstone which reaches a thickness, of 2,000 feet or more, and at certain localities retains carbonized traces of vegetable remains. These rocks were horizontal or inclined only at comparatively small angles. The carbonaceous matter occurs in sufficient quantity to form blackish bands in the strata, which also show at times cross-bedding, pebble bands, and yellowish argillaceous mudstones or concretions up to two inches in length. Some calcareous layers were also noted.

Above the sandstones the uppermost horizon consists of intrusive dolerites, sometimes columnar.

Full notes are given on the inland and sea ice. The former covers and obliterates the inequalities of the interior land surface, leaving coastal land fringes, comparatively free from ice. The floe or sea-ice rarely exceeds eight feet in thickness, and, if depressed by a deposit of snow above, the lower surface of the floe is removed by the action of the sea to an equivalent extent, so that, according to Ferrar, it seems impossible that the thickness of the floe can be increased to any very marked extent by the addition of snow to the upper surface. The rise of the inland ice from the coast inland is very gentle and almost imperceptible, so that it seems as if, should an elevated hinterland occur at all, it must be at a considerable distance inland.

Denudation in this region seems largely due to wind action, the temperature being so low that erosion by water flow is hardly possible. Exposed surfaces of rock rapidly disintegrate into dust, but at a small distance below the surface, where solidly frozen, practically no erosion of rock surfaces takes place.

The wind carries away the dust of disintegration; loose stones are often smoothed and pitted by the sand blast, as in desert regions; and some of the harder surfaces receive a superficial glaze. Wind carries away the smaller rock fragments, and, on rare occasions, the sudden outbursts of short-lived glacial torrents spreads mud and sand over the surface of floating glacier ice.

Sulphate and chloride of sodium occur on the floating ice, partly as concentrates or exudates from freezing sea water, sometimes in mounds several feet across and as much as two feet thick.

In a general way the ice must be regarded as at present retreating, though the amount of retreat is moderate. The rocks in their petrologic aspect are thoroughly discussed by Dr. Prior.

The text of the volume is replete with excellent half-tone cuts from photographs, and to the plates are added two well-executed charts.
Wm. H. Dall

Clean Water and How to Get It. By Allen Hazen. New York, John Wiley & Sons.

Nothing could be more timely than a book dealing with the subject of water supply, for all over the country there is a remarkable awakening of interest in improvements along this line. High death rates from typhoid fever in American cities have too long been a reproach to our civilization and the inaction which has permitted them is rapidly giving way to a wholesome spirit of reform. No one is better fitted to meet the need for popular treatment of this subject than Mr. Allen Hazen, whose own engineering skill has contributed so largely to develop the newer methods of water purification. This book is, therefore, a doubly welcome one.

The popularization of the results of scientific investigation is a difficult task. On the one hand is a mass of fresh information which needs only popular education to make it effective in practise; on the other hand is a large and intelligent public waiting for the information which it would gladly apply. The intermediary is still too often lacking because the qualities of scientific grasp and popular exposition are so rarely joined. On one side lies the pitfall of patronizing over-simplicity into which certain well-known authorities have recently so notably fallen. On the other side is the danger of being too technical, lacking in the clear analysis and telling exposition necessary to appeal to the untrained mind; this, if anything, is Mr. Hazen's error. His book is designed, as he states, especially for public officials who have been drawn from walks of life in which they have had no water-works experience and who wish to serve their cities well and can perhaps be aided in doing so by very simple statements as to certain matters. He modestly disclaims any intention of helping members of water boards and water-works superintendents, whom he believes to be familiar with the information which he gives. If the reviewer is not mistaken, however, the book will prove of very great value to the latter class of readers and will reach only exceptional individuals among the former. In a new edition, which is sure to be called for soon, the path to the solid knowledge the book contains might be made easier by a more logical arrangement of its contents and by the addition of two elementary chapters, one outlining, at the beginning of the book, the general characteristics of a good water-supply, and one, in the middle of the book, on the general plan and principles of water filtration.

In the present work the author begins with a detailed description of certain surface supplies. Then follows, in the next succeeding chapters, an admirable review of various sources of water supply, in which the grasp of trans-Atlantic conditions made possible by the writer's wide experience is tellingly evident. He discusses the use of large lakes for water supply and shows why Milwaukee and Duluth are comparatively free from water-borne typhoid, while Chicago and Cleveland have suffered so heavily. River waters are next discussed, and the ground is wisely taken that a certain amount of bacterial pollution is a necessary characteristic of surface waters and that the responsibility for the removal of bacteria rests on the town drawing water from streams rather than on the community which discharges a reasonable purified sewage into them. In chapter five he points out the difficulty of securing good ground water supplies in America and contrasts this condition with that which obtains in northern Europe, particularly in Germany. It is evident that the water supplies of the United States must be drawn mainly from rivers and in this connection the author might well have emphasized somewhat more distinctly than he has done the modern dictum of sanitary science that no surface supply can be considered entirely safe for drinking without preliminary treatment. Filtered river and lake supplies must in the end offer the well-nigh universal solution of the water problem.

The question of tastes and odors in water is particularly well treated. Their origin is discussed in chapter one, a clear distinction being made between the odors of putrefaction produced at the bottom of reservoirs and the odors caused by the growths of organisms at their surface. The merits of stripping and of the copper sulphate treatment are conservatively handled and in chapter nine the removal of tastes and odors by filtration and aeration is discussed.

The subject of water filtration in general suffers a little, as pointed out above, by the lack of preliminary general statements, but the account of recent progress is excellent and the discussion of the possibility of securing a higher percentage purification than is obtained by sand filters to-day is eminently suggestive. Here, as elsewhere, the engineer can furnish any results for which it is worth while to pay.

The last six chapters of the book must be particularly commended; here, Mr. Hazen succeeds admirably in making complicated problems stand out clearly in their main outlines. In chapter eleven the fundamental engineering principles underlying construction, with its necessary allowance for excessive demands, and in chapter twelve the problem of securing adequate pressure, are excellently treated.

Chapter thirteen contains a good statement of the importance of metering water with a table which shows in a striking way the excessive consumption, in the neighborhood of 200 gallons per capita per day, in the large cities which have no meters, a wanton waste of water which is cut down more than three quarters by the installation of a considerable proportion of metered services.

Chapters fourteen and fifteen deal with the financial aspects of the water-works problem. Mr. Hazen estimates that the amount of money spent on construction and maintenance of water-works is no less than thirty millions per year and that, of this, something like one quarter is wasted by careless and inexpert methods. The problem of securing pure and wholesome water supply is a difficult one and requires technical expert service of a high grade.

It might be shown how in some lines of work the development is so rapid that even the most recent text-books are hopelessly out of date; how the subjects are becoming so complex that only the principles and not the important details can be treated in them; how the most efficient works are designed by groups of men, each attending to the parts which he best understands, and all under the general direction of a chief who has a clear idea of the end to be reached and the way of reaching it, though he may know less of many of the details than his subordinates; how the only way to learn a business is to be brought up in it; and how it can not be learned by a casual inspection from the outside.

Mr. Hazen rightly pays a tribute to the faithful, devoted and inadequately remunerated work of water boards and water superintendents at the present day, but his presentation makes it increasingly clear that the water supply problem is one of the many municipal questions which must be treated as technical engineering problems demanding expert service, properly rewarded, and unfettered by any demands other than those of economy and efficiency. The attainment of these ends will be furthered appreciably by a book so excellent, in the main, as Mr. Hazen's.

C.-E. A. WINSLOW

Die Ausgleichungsrechnung nach der Methode der Kleinsten Quadrate. By F. R. HELMERT, Director of the Royal Prussian Geodetic Institute. Leipzig and Berlin, B. G. Teubner. 1907. Second edition. Pp. xviii + 578.

In preparing the well-known first edition of this work Professor Helmert had in view the needs of the physicist, the astronomer and the geodesist rather than those of the mathematician; and, though the treatment of the subject was of necessity mathematical, the emphasis was not placed upon the more intricate parts of the mathematical theory. As a result the book gave a clear presentation of the *method* of least squares and supplemented it by a mathematical discussion which was ample for all ordinary purposes and which in some particulars went beyond the range of the ordinary texts on the subject. Numerous well-chosen problems furnished illustrations of the details of the use of the method in the chief cases.

The plan of the earlier part of the new edition is substantially that of the former one, though minor changes have been made. Nor does this adherence to the plan of a book thirty-five years old necessarily imply a defect in the new work. For the method of least squares is one of the few advanced branches of mathematical science in which such a proceeding is not inappropriate.

Certain features common to both editions deserve notice, and of these one is the treatment of the law of error. No conclusive argument in favor of this law has been given and the author has chosen to base it upon its accord with the results of observation. This is commendable, for it tends to clear a state of affairs which some one has characterized by saying of the law of error that both mathematicians and physicists accept it, the former because they believe the latter have obtained sufficient experimental evidence and the latter because they believe that it has been mathematically demonstrated. It is true that in the second edition one of the numerous mathematical arguments in favor of the law is included, but it is given a secondary place. Moreover, the author expressly considers several possible laws of error.

Clear explanations of the most important ideas of the subject are given early in the work and accompanying them are illustrations of their practical use. Then follows the development of the subject along standard lines from the discussion of direct observations of equal weight to that of indirect determinations of the values of quantities which are not independent.

Of the improvements made in preparing the new edition, one notes an increase in the amount of space devoted to pure theory, particularly in regard to the relations to each other of various kinds of errors of observation and in regard to the application of the method to interpolation. The size of the volume has been increased from 348 to 578 pages, and a large part of this increase is made up of the last three chapters, which deal with technical problems of physical, astronomical and geodetic work.

Pleasing are the frequent references to original sources and the excellence of the examples by means of which the theory is illustrated. A detailed table of contents and an index make all of the matter in the book accessible to the reader, and the publishers have made the book attractive in appearance. An occasional sacrifice of mathematical rigor for the sake of brevity will not prevent even an exacting reader from regarding the text as an excellent treatise on the subject.

George H. Ling.
Columbia University

SCIENTIFIC JOURNALS AND ARTICLES

The opening (October) number of volume 14 of the *Bulletin of the American Mathematical Society* contains the following articles: "Application of a Definite Integral involving Bessel's Functions to the Self-Inductance of Solenoids," by A. G. Webster; "On the Apsidal Angle in Central Orbits," by F. L. Griffin; "The Maximum Value of a Determinant," by E. W. Davis; "The Invariant Substitutions under a Substitution Group," by G. A. Miller; Shorter Notices (Tannery's Leçons d'Algèbre et d'Analyse à l'Usage des Elèves des Classes de Mathématiques spéciales, Tome Premier, by F. Cajori; Tannery's Leçons d'Algèbre et d'Analyse, Tome Second, by G. W. Myers; Pionchon's Mathématiques.

Principes et Formules de Trigonométrie Rectiligne et Sphérique, by G. W. Myers; Schubert's Beispiel-Sammlung zur Arithmetik und Algebra, by G. W. Myers; Russell's Elementary Treatise on Pure Geometry, by O. Veblen; Bruns's Wahrscheinlichkeitsrechnung and Kollektivmasslehre, by H. L. Rietz; Engel's Hermann Grassmanns gesammelte mathematische und physikalische Werke, Band 2, by E. B. Wilson; Jaumann's Grundlagen der Bewegungslehre, von einem modernen Standpunkte aus, by G. W. Myers; Slocum's Text-Book on the Strength of Materials, by G. W. Myers); Notes; New Publications.

The November number (volume 14, number 2) of the *Bulletin* contains: Report of the Fourteenth Summer Meeting of the American Mathematical Society, by F. N. Cole; "On a Special Algebraic Curve having a Net of Minimum Adjoint Curves," by Virgil Snyder; "Note on Certain Inverse Problems in the Simplex Theory of Numbers," by R. D. Carmichael; "Third Report on Recent Progress in the Theory of Groups of Finite Order," by G. A. Miller; Notes; New Publications.

SOCIETIES AND ACADEMIES

THE TORREY BOTANICAL CLUB

THE first fall meeting for the year 1907 was held on October 8, 1907, at the American Museum of Natural History. The meeting was called to order at 8:30 by the secretary, and Dr. E. B. Southwick was elected chairman. Eleven persons were present.

The announced program consisted of informal reports upon the summer's work and observations. In response to calls by the chairman the following members made remarks:

Remarks on the Absence of Undergrowth in a Hemlock Forest: C. STUART GAGER.

Hemlock seeds germinate freely under the parent trees, but seldom attain a height of more than three or four inches. It was suggested that there may be present in the soil a substance or substances secreted by the hemlock roots, and deleterious to the germination and growth of hemlock seedlings. This, as well as poor insolation, must be considered in attempting to explain why the seedlings fail to develop.

Botanical Observations made in Pownal, Vt.: M. A. HOWE.

Dr. Howe reported his attendance at the annual summer field meeting of the Vermont Botanical Club, which was held in Pownal, the extreme southwestern township of Vermont. In this town are the only known Vermont stations for *Liriodendron tulipifera, Morus rubra, Aster sagittifolius* and several other species of interest.

Plant Studies on the Northern Coast of the Gulf of St. Lawrence: C. B. ROBINSON.

Dr. Robinson had spent the first two or three weeks of August at Seven Islands, on the northern coast of the Gulf of St. Lawrence, about 325 miles below the city of Quebec. The coast to the east of the bay of Seven Islands is a nearly level sandy plain, but the western side, and the islands across the mouth, are formed of steep crystalline rock, a kind of feldspar. A rauge of hills attaining 1,700 feet in height runs parallel with the coast about ten miles inland. With the exception of a few plants like *Sibbaldiopsis tridentata, Empetrum nigrum* and *Achillea millefolium* the rocks and the sand bore strikingly different floras. There was a tendency in some cases for the species of the woods to invade the sand, bringing there species like *Linnœa americana, Moneses uniflora* and *Peramium ophioides.* Three species of *Botrychium* grew in still more open places on the sand. The flora, at best a scanty one, is particularly poor in trees. The shores are lined by black spruce, and the white spruce is less common. Beginning a short distance from the shore, the sand plain becomes a pine barren, with *Pinus Banksiana* as practically the only tree. Two species of paper birch, the fir, larch, aspen and mountain maple are the only other real trees. It had been hoped that the higher latitude would sufficiently compensate for altitudes lower than those of the hills of Gaspé, and thus give a flora comparable with that of the latter. A few such species were found, among them *Diapensia lapponica, Vaccinium ovalifolium, V. uliginosum, Comandra livida, Euphrasia Ran-*

dii and *Selaginella rupestris*, but the general results in this respect were distinctly disappointing.

Experiences at the Biological Laboratory of the U. S. Bureau of Fisheries at Beaufort, N. C.: W. D. Hoyt.

An account was given of the excellent equipment of the station, and the facilities for research. The richness of the local fauna and the varied flora was noted. The locality abounds in epiphytic plants of numerous species. The speaker's investigations indicate a local algal flora that compares favorably with that of the New England and the Florida coast. Over 100 species have been found. The latitude of Beaufort appears to be the northern limit of certain southern species and the southern limit of some northern ones. The predominant flora varies greatly, according to the season, southern forms predominating in summer and northern forms in winter.

A coral reef about twenty-three miles off the coast and under a depth of 13 to 14 fathoms, extends about one mile in length and one half a mile in width. This is probably the most northern of the coral reefs. It supports a rich algal flora, consisting almost entirely of southern forms, and some of them new to North America.

Remarks on the Unusual Habitats of Certain Ferns in New Jersey: Miss Pauline Kaufmann.

Several species have been observed growing in habitats somewhat unusual for the species.

Observations in Western South Carolina, and on the Isle of Palms: Homer D. House.

On this island, which is off the coast of South Carolina, several species new to South Carolina, and a probably new species of *Helianthus*, were found.

Account of a Visit to the Experimental Garden of President Brainerd, at Middlebury, Vt.: Tracy E. Hazen.

A description was given of President Brainerd's experimental pedigreed cultures of violets. In addition to remarks concerning the Mendelian studies in *Viola*, attention was called to the fact that, contrary to the general notion, viable seeds were commonly found in the petaliferous flowers of the violet.

Discussion followed the remarks of each speaker.

C. Stuart Gager,
Secretary

DISCUSSION AND CORRESPONDENCE

SOME OBSERVATIONS ON MUSEUM ADMINISTRATION

The two articles which recently appeared in Science[1] by Drs. Dorsey and Boaz on museum administration have been of more than passing interest to those engaged in the collection and exhibition of natural history material. While Dr. Dorsey's article discussed the matter from a purely ethnological standpoint, that of Dr. Boaz is of such a scope as to include broadly all branches of museum installation. The following observations are based upon an experience of thirteen years in one of the smaller museums, where the attendance averages about 350,000 per year.

Dr. Boaz states that museums may serve three purposes, viz., healthy entertainment, instruction and the promotion of research. That a museum is for the purpose of providing instruction and of promoting research all museum men will agree, but there is great danger of dwelling too much upon the idea of entertainment. All museum men desire unquestionably that their museums should afford healthy entertainment, but the installations must not be prepared for this purpose. In the writer's opinion every exhibit should be prepared with some definite purpose in view; it must, indeed, be the embodiment of an idea which may be apprehended by the visitor.

It has not been the writer's experience that the public resents to any large degree an attempt at systematic instruction, or that it dislikes to give serious consideration to the exhibits. It has been frequently noted in the Chicago museums that visitors will study or look over every case in a given hall or gallery; the more commonplace exhibits will perhaps be passed over, but where it is apparent that some idea or fact of nature has been embodied in an exhibit, this exhibit will be carefully

[1] No. 641, April 12, 1907, and No. 650, June 14, 1907.

looked over and criticized. The writer does not believe that the majority of visitors to a museum are actuated by a mere search for entertainment. The public knows what the museum contains and it visits the institution because it desires to see the different kinds of animals, plants and minerals. If the visit was for the sake of mere entertainment, then surely the same people would scarcely visit the institution repeatedly.

Dr. Boaz asks the question, "What can be done for this class of visitors?" In answer to this I would call attention to the terse definition of Professor William H. Flower, who defines a museum as a place for the inculcation of ideas. We must not descend to the plane of the public's point of view and try to please it; we must, on the contrary, try to lift it up to higher planes of thought. Nature presents countless facts for our use and we have but to utilize them to find an inexhaustible mine of "healthy entertainment" at our command. The idea of making exhibits "popular" is receiving more attention of late than the subject demands. In the writer's opinion the popularity of an exhibit should not be the motive governing its construction. Each exhibit should crystallize about some central thought or fact, so presented, in either label or preparation, as to fix the thought in the mind of the visitor. There will be, unquestionably, a number of people who will fail to perceive this central idea, but I am positive that the majority of visitors will apprehend the lesson which the exhibit seeks to teach. The writer's experience has been that the museum visitors minutely inspect a group exhibit, searching for those little artistic touches which make the modern groups so interesting. To cite an example; we have in the Chicago Academy of Sciences a large group of Virginia deer, showing this species in a Wisconsin forest. It is called a "woodland courtship" on the label and presents two bucks fighting for the possession of the female. In the same exhibit are several chickadees, a red squirrel, a woodpecker and a porcupine, besides some snail shells near a pool of water. Several of these animals are hidden by foliage, but the sharp eyes of some visitor invariably spies them and such exclamations are heard as "Oh, see the squirrel!" "Look at the little bird hanging by his feet!" (referring to one of the chickadees) or, "See the woodpecker behind the tree!"

The public comes to the museum with several definite questions which it seeks to have answered. These are, what is the object? where did it come from? What is it good for? All of these questions may be answered by specially prepared exhibits and labels. It is astonishing to note with what avidity the museum visitor studies a group which has been prepared to illustrate some common aspect of nature. A year or more ago the Chicago Academy of Sciences began the preparation of a collection of Illinois birds mounted in small groups to show their nesting habits as well as their young. With each group a map was placed, showing the breeding, the winter and the migration range of each species. These cases are emphatically popular, although they were not prepared for entertainment but for study.

As a rule the large museum makes the very serious mistake of exhibiting too much material and the visitor is bewildered, tries to "do" the whole museum in one visit and leaves it with an aggravated case of brain fag. The writer has always contended that a natural-history museum should divide its collections into two parts, one of which is specially arranged for the museum visitor, while the other is especially prepared for the convenience of the serious student, who will be, as Dr. Boaz remarks, in the minority. The endless exhibition of species and genera is very tiresome to the museum visitor, to whom they all look alike. If, however, a selection be made to bring together a few of each family to show their interrelationship and their contrasts, then the visitor is interested. Such exhibits as the typical inhabitants of different countries, those peculiar to certain regions or those which have an economic value are always interesting to even the most casual visitor.

It is doubtless true, as Dr. Boaz states, that the label is quite secondary to the specimen, which is the essential thing. The visitor looks for the specimen first and then looks for the label, and if the latter is not there, then the visitor, if he is from Chicago, will hunt up the first available attendant and ask what the name of the specimen is. This experience has been repeated a thousand times in the museum under the charge of the writer. This shows clearly that a good label is an important item. It has been stated by some museum men that the public will not read labels, but here again the writer's experience, both in his own institution and while visiting the museums in New York and Washington, is at variance with this statement, for of the visitors actually seen fully seventy per cent. read some of the labels. This presupposes, of course, that the labels are printed or are written in a legible manner.

For purposes of instruction it is obviously impossible to arrange large collections from all points of view, nor is this necessary, because the teacher will select from the exhibit material those sections which best illustrate the problem at hand. The possibilities of variation in systematic exhibition are endless and it requires an administrator with positive genius to successfully travel the middle road. The large museums, however, should aim to have systematic collections in all branches, sufficiently exhaustive to clearly indicate our present knowledge of the science. This does not mean, of course, that every known species and variety shall be exhibited, but that enough shall be available to the public to indicate the advance in each particular branch of science. The public expects this and should not meet with disappointment.

It is a mistake to prepare large exhibits primarily for the schools, because each school will use the collections for a different purpose and in a different manner and the selection of material must be left to the teacher. It is becoming apparent to some museum men that each school must possess its own small and selected museum with which to teach the principles of science, and the larger museum will be ultimately used as an adjunct to the school museum when the pupil is able to more easily grasp the significance of the larger exhibits. This plan is now being successfully carried out by several Chicago schools and these schools have also successfully demonstrated that concentration of thought can be secured in a large hall which is used by the public and which is as systematically arranged as it is possible to make a collection.[2]

It is probably true that the smaller museums are in closer touch with the schools and with the public than the larger museums are. This may be due to the fact that the collections are more concentrated and hence more available for systematic study. It has seemed to the writer that an expansion of the systems in use by the smaller museums would make the larger museums much more useful to the schools as well as to the general public. The writer can by no means agree with the statement made by Dr. Boaz that a thorough systematization of the large museum is impossible or that systematic museums must of necessity be small. A museum, large or small, without a thorough systematization would be an absolute failure and of little value for scientific study. There seems also, to the writer at least, too much concern about the seeming conflict between the interests of the public and of the scientist. There should be no conflict if once we divorce ourselves from the idea that we must of necessity try to please the public. Visitors will crowd the museum halls no matter what is exhibited or its manner of exhibition, and it lies with the museum administrator to arrange and install his collections for the best interests and for the advancement of science, for which reason alone the museum is in existence. The principal function of museums, large and small, is the acquisition and preservation for future study of such material as will throw light upon the great problems of life which confront us and which are engaging our attention. The exhibition of material is secondary to this great work. In the near future more of the larger museums will doubtless follow in the footsteps of the National Museum and select broad-minded men as curators of exhibits, leaving the specialists free to carry on their studies.

In conclusion the writer wishes to state as

[2] See the *Museums Journal* for August, 1905, p. 50.

his opinion that the public should be rigidly excluded from the study collections. These should, if possible, be kept away from the exhibition halls, but if this can not be done they should at least be kept from the public view. Drawers with glass tops, placed beneath the cases and accessible to the public are an abomination to the curators and a menace to the safety of the collections, besides serving no good purpose to the public, which is only bewildered by the multitude of similar forms.

The paper by Dr. Boaz opens up some perplexing but also interesting questions of museum administration and it would be of value to hear from others who are working along this line. Many of the problems touched upon will probably be discussed by the American Association of Museums at some of its future meetings, and the writer would suggest that the Chicago meeting in 1908 will be an opportune time to offer some of these problems for debate.

Frank C. Baker,
Curator

The Chicago Academy of Sciences

THE PUBLICATION OF AGRICULTURAL RESEARCH

Professor Webber in a recent issue of Science[1] has crystallized a problem which has been prominent in the minds of experiment-station workers of the United States for the last decade or more, and which has been particularly accentuated by the recent expansion of technical work in the stations by virtue of the Adams Act.

Most active station workers feel the need of additional and better facilities for publication.

As Professor Webber indicates, the issuance of special technical series of bulletins has been a failure and has been almost entirely or altogether abandoned. The publication of a technical bulletin with another edition of the same number in popular abstract, tends to confusion. Some stations issue the more technical, less practical, bulletins in small editions and withhold them from general distribution. This course is objectionable, since the farmer feels slighted when he finds that certain bulletins have not been sent to him. To take the other horn of the dilemma and send all of this technical matter to the farmer, placing before him matter which will ultimately and in the hands of the proper persons be highly valuable, but which it is entirely impossible for him to use or even to judge properly, is certainly not a proper course.

[1] Science, Vol. XXVI., p. 509.

Nor do any of these methods of bulletin publication of technical matter attain the desired end, viz., *to reach the largest number of interested people and to place the matter in permanent and easily accessible form.*

In general, the plan of Professor Webber must meet approval in that it provides a central unified publication center. Personally I believe that there should be one publication which might be known as the *Journal of American Agricultural Research,* a title which commends itself as being definitive and concise, and which is easily abbreviated to *J. A. A. R.* or *Jour. Amer. Agric. Res.,* an abbreviation which is not preempted in the large list used by the *Experiment Station Record.* While primarily intended for publication of the research of experiment-station workers, who should have the first right to immediate publication, the privileges might be extended to all other research concerning American agriculture.

This journal should be issued in numbers consecutively, as they come from the press and be paged consecutively as high at least as the ten-thousandth page. All citations by page will then be exact. The numbers should be of variable size to conform to the dimensions of the single articles contained therein, and such editorial staff and press facilities should be at command as to insure practically immediate publication of matter submitted to the editorial board by various station directors.

Frequent index numbers with extensive cross reference should be issued in order to keep the journal of ready reference utility. Such a journal used in conjunction with the *Experiment Station Record,* as at present conducted, would render all American agricultural research readily accessible.

I see no need, and indeed it seems to me a great disadvantage, to divide the publication into separate series. Each experiment station and each other large research institution, many libraries and many individuals, will desire the whole publication. Citation should be to the journal as a whole and not to separate series. If division into series be attempted their boundaries will be artificial and their number will be constantly changing and no stability will be secured.

Issuance in series will also inevitably lead to delay. The only advantage of such a series will be that each investigator may receive only the series concerning his particular field. This end may be attained with even greater accuracy by issuing each article as a special number of the journal, and sending to subscribers only such numbers as contain articles pertinent to the subscriber's interest. In this I incline to the view expressed by Bailey[2] and avoid the difficulties raised by Gilmore[3] and by Webber himself.

If there be no separate series of the journal the editorial board would need to be enlarged to include one or more men in each special field of research. These editors should be paid sufficient compensation to make it their duty to give *immediate attention* to each article submitted to them, and thus to facilitate publication.

Numbers upon designated subjects should be sold to station workers at a price sufficient to control actual waste, but low enough to be without burden to the subscriber, as, say, 25 per cent. of actual cost.

F. L. Stevens
Vegetable Pathologist
N. C. Experiment Station

HOLOTHURIAN NAMES

To the Editor of Science: In reference to the letters by Dr. Theo. Gill and Dr. W. K. Fisher in Science for August 7 and September 20, respectively, I would ask whether Dr. Fisher's conclusion that "we can no longer speak of sea-cucumbers as 'holothurians,' nor of the class as *Holothurioidea*" is really justified.

Even if the name *Holothuria* be taken up by the writers on Cœlentera, is there any reason why we should not continue the use of what has now become an ordinary English word? And as regards the name of the class, I would protest against the assumption that this must necessarily be based on the name of one of the families or one of the genera included in the class.

It is generally held that the word ὁλοθούριον, used by Aristotle ("Historia Animalium," I., i., 19, and "Partes Animalium," IV., v., 43), as well as the word *Holothurium*, used by Pliny ("Naturalis Historiæ," Liber I., Cap. xlvii.), refer to a sea-cucumber. This is surely enough to justify the continued use of the class name Holothurioidea.

Since in these days the genus *Holothuria* has become so much split up that it would in any case be difficult to decide for which of its sections the name *Holothuria* should be retained, the disappearance of the name from systematic usage is by no means to be regretted. As for the possible transference of the name *Holothuria* to either a pelagic hydroid or a tunicate, this appears to be eminently one of those cases which should be disposed of by an international committee, such as it was proposed should be established by the International Zoological Congress. I am not aware whether such a committee was actually appointed.

Both your correspondents seem to have overlooked the fact that the absurdities following a rigid adherence to rule in this matter were well put by my colleague Mr. F. Jeffrey Bell in his note "A Test Case for the Law of Priority" (*Annals and Magazine of Natural History*, pp. 108–109; July, 1891).

F. A. Bather
London

SPECIAL ARTICLES

A SUGGESTION FOR A NEW UNIT OF ENERGY[1]

The study of the food of man and of animals as a source of energy to the organism has made rapid progress within recent years. It is, of course, easy to overestimate the value

[2] Science, Vol. XXVI., p. 512.

[3] Science, Vol. XXVI., p. 511.

[1] Read before the Society for the Promotion of Agricultural Science at its annual meeting, May 27, 1907.

of a new method or a new point of view, and we must beware of assuming that a study of food energy will solve all the problems of nutrition. At the same time, the new method, while not a panacea, has proved a most useful instrument which seems likely to be employed to an increasing extent.

The unit of energy commonly employed in such studies is either the large or small calorie. This arises naturally from the fact that in order to measure the quantities of energy involved we ordinarily convert them into heat. The use of the calorie as a unit is, therefore, convenient in avoiding a recalculation of results, in spite of its unfortunate suggestion that we are dealing with energy in the animal body in the form of heat only.

In practical use in connection with the feeding of domestic animals and the computation of their rations, however, the calorie is an inconveniently small unit. To express the energy values of feeding stuffs per pound in kilogram calories requires rarely less than three integers and usually four, while the energy values of rations computed per 1,000 pounds live weight, as is the usual custom, practically never require less than five integers. Taking, for example, the maintenance requirement, which is about the smallest quantity of energy which we need to express in practise, the average of Kellner's determinations for cattle is 13,469 calories of metabolizable energy per head, or 21,312 calories per 1,000 kgs. A ration for productive purposes, of course, would require the use of still larger numbers. These large numbers are inconvenient in computation, and differ so much in appearance from those which have previously been used that it is likely to be difficult to bring them into common use.

To meet this difficulty Kellner has proposed the use of "starch values" to express the production values of feeding stuffs as determined according to his method. The starch value of a feeding stuff means, in brief, the amount of pure starch which would produce the same energy effect as a unit weight of the feed in question. Computed per 100 units, the starch values give figures comparable with the percentages of total digestible matter heretofore used, commonly requiring two integers for their expression.

There are, however, certain objections to this method of expression, and to the writer it seems preferable, if we are to attempt to deal with energy values at all, to do so boldly and to employ a unit of energy rather than a unit of matter. To do so conveniently, as already indicated, it is desirable to have a larger unit, and the object of this paper is to suggest such a unit for discussion and to indicate by one or two examples how it could be used.

The unit which I suggest is 1,000 kilogram calories, for which I propose the designation *Therm.* The word therm has already been proposed as the equivalent of the small or gram calorie, but does not appear to have come into general use. Following the analogy of the calorie, we may write the unit here proposed with a capital and use the capital or full-face **T** as a convenient abbreviation. The relation of the units would then be

1 therm (t)	=	1 gram-calorie (cal.).
1,000 cals.	=	1 kilogram-calorie (Cal.).
1,000 Cals.	=	1 Therm (**T**).

While a sense of strangeness and awkwardness of course attaches to the proposed as to any new term, it seems better, if a new unit is to be used at all, to give it a new name rather than to employ any modification of the word calorie, which would be likely to produce confusion. It may be objected that the suggested unit is not a C.G.S. unit, but while this is true, a thermal unit is practically more convenient, partly because, as already pointed out, our determinations of energy are usually made in thermal units and in part because any available C.G.S. units are rather small.

As an example of the use of the suggested new unit, I have taken three samples of feeding stuffs whose energy values have been determined at the Pennsylvania Experiment Station, namely, timothy hay, clover hay and corn meal. The composition and digestibility of these feeding stuffs per 100 pounds as expressed by the ordinary method, and also the energy values of the same quantity, are shown in the following table:

In 100 Pounds

	Timothy Hay. Pounds	Clover Hay. Pounds	Corn meal. Pounds
Composition			
Water	15.00	15.00	15.00
Ash	3.94	5.58	1.23
Proteids	4.34	9.50	8.67
Non-proteids	0.20	0.76	0.25
Crude fiber	33.08	24.46	1.86
Nitrogen-free extract	41.67	42.21	69.40
Ether extract	1.77	2.49	3.59
	100.00	100.00	100.00
Digestible nutrients			
Proteids	1.57	5.13	5.76
Carbohydrates	44.06	42.24	68.44
Fat	0.63	1.59	3.44
	46.28	48.96	77.64
Energy			
Fuel values	77.70 **T**	80.17 **T**	132.68 **T**
Maintenance values	48.89 "	58.54 "	103.30 '
Production values	25.87 "		70.72 '

The maintenance values of feeding stuffs will seldom require more than two integers for their expression in the new unit and the production values, I think, never. Expressed in this way, these values have quite the appearance and effect of percentages. It is true that if expressed per 100 kgs. instead of per 100 pounds the numbers would be somewhat unwieldy, but the actual adoption of the metric system in this country still seems distant. The reason for expressing the values per 100 pounds instead of per pound will appear if we consider the use of these figures in the computation of rations.

As a simple case let us suppose we have a ration consisting of 12 pounds of timothy hay and 18 pounds of corn meal, and that we desire to compute its production value on the basis of these tables.

The ordinary method of computing the digestible nutrients is illustrated in the first half of the subjoined table. The calculation is identical with the one with which we are already familiar, with the single exception that the number of pounds of the feeding stuff is expressed as a fraction of 100 pounds. In other words, the transposition of the decimal point is made in this number and not in the figures for the percentages.

The second portion of the table shows the computation of the ration on the basis of its energy value. But a glance is needed to show that the two are precisely similar and that the units of energy can be handled in this way in a manner precisely analogous to the manner in which protein, carbohydrates and fat are handled.

The total ration, therefore, would be as tabulated in the second table.

	Timothy Hay. Pounds	Corn meal Pounds
Digestible nutrients		
Dry matter	85.00 x 0.12 = 10.20	85.00 x 0.18 = 15.30
Digestible		
Proteids	1.57 x 0.12 = 0.19	5.76 x 0.18 = 1.04
Carbohydrates	44.08 x 0.12 = 5.29	68.44 x 0.18 = 12.32
Fat	0.63 x 0.12 = 0.08	3.44 x 0.18 = 0.62
Total	46.26 5.56	77.64 13.98
Production values		
Dry matter	85 00 x 0.12 = 10.20	85.00 x 0.18 = 15.30
Digestible		
Proteids	1.57 x 0.12 = 0.19	5.76 x 0.18 = 1.04
	Therms	Therms
Production value	25 87 x 0.12 = 3.10	70.72 x 0.18 = 12.73

Computed Ration

	Dry Matter	Digestible Proteids	Production Value
12 lbs. timothy hay	10.20 lbs.	0.19 lb.	3.10 **T**
18 " corn meal	15.30 "	1.04 lbs.	12.73 "
	25.50 "	1.23 "	15.83 "

Finally it should be noted that it is not the relative value of these two methods of expressing the content of feeding stuffs or rations which is here in question. Assuming the desirability of the use of units of energy, the purpose is to show that the manner of using them according to this scheme is quite similar to the familiar methods of computing rations, so that the transition from one system to the other should be comparatively easy, while the use of large figures is avoided. The writer would be grateful to receive the fullest criticism, both in general as regards the utility of such a unit and specifically as to the suitability of the one proposed and the propriety of the name suggested.

Henry Prentiss Armsby
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THE FLYING MACHINE

The fact that a machine of the aeroplane type built entirely of metal and canvas may be made to fly by the power of an ordinary steam engine judiciously constructed, was practically demonstrated some time ago by S. P. Langley. More would, therefore, be expected from the gas engine, if constructed with equal forethought. I have always had some misgivings, however, as to whether these experiments, into which so much devoted labor was put, actually met the real issue involved. It seemed to me that they proved that the power available in case of the ordinary engine is just about sufficient to maintain flight and no more; whereas a really practical machine should be provided with a motor whose output of work per second and per kilogram of weight, could be made enormously to exceed the demands upon it, under conditions of smooth soaring.

If one is in search of a maximum of power combined with a minimum of weight, one involuntarily looks to some form of modern explosive and in particular to those which can be worked up into wicks or ribbons. These could be adapted for use in connection with the rocket principle which has so frequently stimulated the imagination of inventors, in a way to require the least amount of subsidiary mechanism. In fact, such expansion is virtually its own propellor. The only question is, how can this quite prohibitively excessive power be controlled. In other words, how may the enormous per second expenditure of energy be reduced in any desirable amount at will, and compatibly with safety and the need of the operator?

Now it occurred to me that in case of the nitrogen explosives there may be a method of obtaining a continuity of power values within safe limits from insignificant amounts up to the highest admissible, by using some appropriate method of very cold storage. It is well known that at sufficiently low temperatures phosphorus and oxygen cease to react on each other, that fluorine is indifferent to hydrogen, etc. Is it not, therefore, probable that an explosive tendency will be toned down as temperature decreases; or that a molecular grouping which is all but unstable at ordinary temperatures will become stable at a temperature sufficiently low, and proportionately stable at intermediate temperatures. This is then the experiment which I would like to see tried, the endeavor to get a gradation of power values ending in prohibitively large maximum, by the cold storage of explosives. If it succeeds, it seems to me that a motor yielding per pound weight not only all the power needed in the flying machine under any emergency will be forthcoming, but that large amounts of the inevitably dangerous source of such power may be taken aboard for use en route. The lower temperature of the upper air would here itself be an assistance.

Carl Barus

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ABSTRACTS FOR EVOLUTIONISTS

ANTARCTIC APTERA

Professor George H. Carpenter has recently published[1] a report on the Collembola of the South Orkney Islands, obtained by the Scottish national Antarctic expedition. In describing *Isotoma brucei* n. sp. he remarks that it is closely related to the Arctic and subarctic *I. beselsii* Packard: "In the general build of the body and the structure of the spring—particularly the form of the mucro, with its three prominent claw-like teeth—these two species of *Isotoma* stand apart from all other members of the genus." After discussing the distribution of the Antarctic Collembola, Professor Carpenter arrives at the conclusion that the ancestor of *I. brucei* must have reached the Antarctic lands during the secondary period, and that during all the time that has since elapsed, it has undergone no more modification than is expressed by the difference between *I. brucei* of the south and *I. beselsii* of the extreme north—a difference of much less than generic value.

UNIONIDÆ OF THE LARAMIE CLAYS

It is well known to naturalists that the eastern United States are the home of numerous remarkable groups of fresh-water mussels, which are absent from the western part of the continent, and to all appearances orig-

[1] *Proc. Roy. Soc. Edinburgh*, XXVI., Part VI. (1906).

inated in the same general region as that in which they now occur. Dr. R. P. Whitfield has published[2] accounts of a number of species of *Unio,* in the old broad sense, which have been obtained in the Laramie beds of Montana, and has called attention to their great resemblances to some of the more characteristic forms of the Mississippi and Ohio valleys. Placing these in their modern genera we find:

Unio gibbosoides Whitf. resembles *gibbosus* Barnes.

Pleurobema æsopiformis (Whitf.) resembles *æsopus* Green.

Obliquaria letsoni (Whitf.) resembles *cornuta* Barnes.

Quadrula cylindricoides (Whitf.) resembles *cylindrica* Say.

Quadrula pyramidatoides (Whitf.) resembles *pyramidata* Lea.

Quadrula verrucosiformis (Whitf.) resembles *verrucosa* Barnes.

Obovaria retusoides (Whitf.) resembles *retusa* Lam.

Thus several genera are represented, and as to the species, Dr. Whitfield says "some of them are so nearly like the living species, that it would do but little violence to specific features to state that they were the same." In view of these facts he adds: "I venture to state that these further western waters of the Laramie times were the original home of much of the *Unio* fauna of these [Mississippi and Ohio valleys] more eastern recent localities."

AN ANCIENT TYPE OF TREE

The *Ginkgo,* now commonly planted in the states along the Atlantic coast, is of interest to all botanists on account of its curious foliage, and especially because it is the last surviving member of a very ancient and at one time widespread genus. Miss M. C. Stopes, in a description of the flora of the Inferior Oolite of Brora, Scotland,[3] points out that the *Ginkgo digitata* (Brongn.) of those beds is so like some examples of the living *G. biloba* that at first sight no difference can be observed. However, by great good fortune the epidermis of some of the specimens of *G. digitata* is well preserved, and shows cells with even outlines, whereas in *biloba* the outlines of the cells are mostly wavy, the difference being considered of specific value.

HYBRID HUMMING BIRDS

Messrs. John E. Thayer and Outram Bangs have lately published[4] a short paper on hybrid humming birds, of which four are now known from California alone. These, occurring, of course, in the wild state, are all between different genera; but the genera in this group are many of them very closely allied. The fact and character of the hybridization in each case is determined wholly from a study of the skin, but the authors seem confident of their results. The presumed hybrids are:

Selasphorus alleni × *Calypte anna.*
Trochilus alexandri × *Calypte anna.*
Trochilus alexandri × *Calypte costæ.*
Selasphorus rufus × *Atthis calliope.*

CRESTED TITMOUSE HYBRIDS

Bæolophus bicolor, the tufted titmouse, ranges from the Atlantic coast to the Great Plains. *B. atricristatus,* the black-crested titmouse, ranges from the highlands of Vera Cruz to central Texas. At the line of junction of the humid and arid divisions of Texas these birds meet one another, and all sorts of intergrades occur. Dr. J. A. Allen has made an elaborate study[5] of these Texas forms, based on more than 200 skins, and arrives at the conclusion that it is a case of hybridization, not of geographical gradation. "The same localities furnish, at several known and quite widely separated points, birds of pure blood of both species, and intergrades having almost every possible combination of the strikingly dissimilar features of the two species." There is a genuine geographical variation in size observable in both species; the larger northern race of *B. atricristatus* is

[2] *Bull. Amer. Mus. Nat. Hist.*, XIX., and especially XXVI. (1907).

[3] *Quart. Journ. Geol. Soc.*, August 14, 1907.

[4] *The Auk*, July, 1907, p. 312.

[5] *Bull. Amer. Mus. Nat. Hist.*, XXIII., separates dated June 12, 1907.

separated as *B. atricristatus sennetti* Ridgway; the small Floridian form of *B. bicolor* has been named *B. bicolor floridanus* Bangs; while the maximum of the same species, found in eastern Kansas, could be called *B. bicolor missouriensis* (*Parus missouriensis* Baird) if it were worthy of a name, which Dr. Allen thinks doubtful. These differences are clearly geographic and are apparently dependent upon climate, directly or indirectly. It is quite possible that in part, at least, they represent what Tower calls "place-variation." In both species there is some difference in color accompanying that of size, and in the case of the black-crested titmouse this is quite marked. If the birds can be readily bred in captivity, they afford a fine opportunity for experimental work.

AFRICAN ISOPODS

In a descriptive account[6] of the terrestrial Isopod Crustacea collected in Liberia by Dr. O. F. Cook, Miss Harriet Richardson describes four species of the genus *Ethelum* Budde-Lund, stating that "all the species of this genus hitherto described are from the West Indies." It is interesting, as showing how little we know about tropical Isopods, to find that all the species of Eubelidæ collected by Dr. Cook, twelve in number, were new to science.

T. D. A. C.

[6] *Smithsonian Misc. Coll.*, September, 1907.

BOTANICAL NOTES

SUNDRY BOTANICAL PAPERS

Elmer D. Merrill, of the Biological Laboratory of the Bureau of Science, at Manila, has published in a recent number of the *Philippine Journal of Science* an interesting account of the flora of Mount Halcon on the island of Mindoro. He confines his paper to the spermatophytes, the vascular cryptogams having been catalogued by Copeland in an earlier number of the same journal. One species of *Agathis* (*Pinaceae*), three of *Dacrydium*, eight of *Podocarpus*, and one of *Phyllocladus* (*Taxaceae*) make up the list of gymnosperms. But nine species of grasses are recorded, including one *Bambusa*. The sedges are scarcely better represented, having but ten species in the list, only one of which is a *Carex*. Of the palms there are but two species. The families *Juglandaceae, Fagaceae* and *Ulmaceae* are represented respectively by single species of *Engelhardtia, Quercus* and *Gironniera*. Of the *Rosaceae* and *Leguminosae* there are but three species each, while there is but one umbellifer. Even the great family *Compositae* is represented by only nine species. The largest family is the *Rubiaceae* with 27 species, followed with *Melastomaceae* (18), *Taxaceae* (12), *Myrsinaceae* (12), and curiously enough, the *Ericaceae* also with 12 species. In the latter there are two species of *Rhododendron*, one of *Gaultheria* (subscandent!) and eight of *Vaccinium* (mostly epiphytic!).

In the September *Botanical Gazette* Mary S. Young publishes an interesting short paper on the germination of the pollen of *Dacrydium*, one of the *Taxaceae*. The material was obtained in New Zealand.

Mr. Ellsworth Bethel, of Denver, and Dr. W. C. Sturgis, of Colorado Springs, have projected a series of papers to be published under the general title of "The Myxomycetes and Fungi of Colorado." The first number has appeared in the "Colorado College Publication" for September, and is entitled "The Myxomycetes of Colorado." It was prepared by Dr. Sturgis. He does not attempt to determine whether these organisms are plants or animals, "nevertheless," he says, "the study of these organisms is, and always has been mainly in the hands of botanists." After a few paragraphs on their structure, collection and preservation, microscopic examination, and literature, he gives a key to the genera known to occur in Colorado. This is followed by a fully annotated list of the species arranged under their genera. No attempt is made to characterize the genera otherwise than is done in the key, and only new and hitherto unreported species or varieties are described. About one hundred species and varieties are included.

"Linné and the Love for Nature" is the title of a pretty and appreciative paper by

Edward K. Putnam read at the Augustana College celebration of the two hundredth anniversary of the birth of the great Swedish botanist. It has now been published in *The Popular Science Monthly* (October, 1907).

Dr. C. L. Shear publishes a valuable bulletin (No. 110 of the Bureau of Plant Industry, U. S. Department of Agriculture) on "Cranberry Diseases." In it he brings together what he has hitherto published in smaller papers, and thus makes the first full account of the diseases of the cranberry due to fungi. It is illustrated by seven full-page plates, two of which are colored. The diseases discussed at length are "scald" (due to *Guignardia vaccinii*), "rot" (due to *Acanthorhynchus vaccinii*), "anthracnose" (due to *Glomerella rufomaculans vaccinii*) and "hypertrophy" (caused by *Exobasidium oxycocci*). Thirteen additional species of fungi attacking the fruit and producing diseases of less importance receive briefer treatment, while seventeen more occurring on leaves or stems are noticed and still more briefly discussed. Several pages are devoted to preventive and remedial measures. A bibliography of cranberry diseases including sixty titles closes this important paper.

Dr. H. L. Shantz's "Biological Study of the Lakes of the Pike's Peak Region" in the *Transactions of the American Microscopical Society* (Vol. XXVII.), although largely given to a description of the zoological phase of the matter is a valuable paper for the botanist who is interested in plankton studies. Dr. Shantz brings out many interesting facts in regard to the vegetation of a dozen or more lakes ranging from 1,800 to over 3,300 meters above sea level.

Professor Stanley Coulter and Herman B. Dorner, of Purdue University, have issued a handy "Key to the Genera of the Native Forest Trees and Shrubs of Indiana" which must prove very helpful to pupils and teachers in the public schools, as well as to some college students. The key is of the strictly dichotomous kind, and so while quite "artificial" is very easily used. Two plates and a two-page glossary complete the duodecimo, 24-page pamphlet. It is supplied to schools for twenty cents.

A useful 80-page bulletin (No. 107), prepared by Alice Henkel, has just been issued by the Bureau of Plant Industry (U. S. Department of Agriculture) under the name of "American Root Drugs." From it we learn that "more than half of the root drugs in the Eighth Decennial Revision of the United States Pharmacopoeia occur in this country, some native and not growing elsewhere, and others introduced." In all fifty such drugs are described, and with the description of the drug there are given botanical and common names, habitat and range, description of the plant, with notes as to cultivation, collection, prices, and uses of the drug. Twenty-five text figures and twenty-eight reproductions of photographs of as many plants serve to make this paper still more useful.

Under the title of "The Roots of *Lycopodium pithyoides*" Alma G. Stokey describes in the July *Botanical Gazette* the curious phenomenon of the formation of "inner roots" which run down *inside* of the stem, boring their way through the cortical tissues, and finally emerging at or near the base of the stem.

In a recent paper Dr. R. P. Hibbard gives (*Botanical Gazette*, June, 1907) the results of his experiments made to determine the effect of prolonged tension upon the formation of mechanical tissue in plants. By ingenious devices he subjected stems and roots to tension and compression. The results showed that the response of the plant was generally not great, although usually noticeable.

From his investigations of pollen formation in Cucurbitaceae (*Bulletin Torrey Botanical Club*, Vol. 34, pp. 221–242) J. E. Kirkwood is able to confirm the conclusions of other observers, and to add somewhat to our knowledge of the karyokinetic stages.

One of the best attempts to formulate the work in botany for the high schools is that of Professor R. Kent Beattie, of the Washington State College. It is issued by the State Superintendent of Public Instruction as High

School Bulletin No. 1, and is intended to serve as a guide for the high schools of the state. The work as outlined includes the cell, the blue-green algae, the green algae, the lower fungi, brown seaweeds, higher green algae, red algae, higher fungi, liverworts, mosses, ferns and their allies. This is followed with sixteen lessons on the structure and activities of the seed plants and suggestive paragraphs on how to make a botanical museum and herbarium, how and what apparatus to buy, a list of text- and reference-books, etc., etc. It must prove very helpful to high school principals and those who are teaching botany in these schools.

ANOTHER TREE BOOK

Mr. Romeyn B. Hough, well and favorably known in connection with his publication of sections of American woods, has issued a stout volume of 464 pages under the title of "Hand-book of the Trees of the Northern States and Canada east of the Rocky Mountains." In this book one finds for each of the more than two hundred species included, on one page a reproduction of a photograph of the leaves, twigs and fruit, and on the page opposite, a similar photograph of the trunk, a map showing distribution, a careful description, and in many cases an enlarged photograph of a cross-section of the wood. The photographs are admirably selected, and have been reproduced very successfully. Those showing leaves and fruits are upon a background marked into squares which originally were square inches, and so while the pictures have been reproduced with different degrees of reduction, the lines enable one at once to make out the actual dimensions of the objects. This device is very ingenious, and should be more generally adopted by book-makers. The little maps are admirable, and tell more exactly the distribution of each species than is possible by any amount of mere description.

At the beginning of the volume is a key to the families, based mainly upon the flowers, and in the back portion is given a synopsis of the families and genera, with keys to the species. Here occur also the descriptions of a considerable number of species not found in the illustrated part of the volume. The book closes with a full glossary, and a well-arranged index. It will be indispensable to the botanist, and the student of forestry.

Charles E. Bessey

The University of Nebraska

APPOINTMENTS AT TULANE UNIVERSITY

The following changes are noted in the faculty of the Tulane University of Louisiana for 1907–8:

Dr. Robert Sharp, head of the department of English, has been granted a year's leave of absence, and has selected as his substitute Mr. Armour Caldwell, of Columbia and Harvard, who with Assistant Professor Brown, of the department of English, will carry on Dr. Sharp's work for the present session.

Dr. Ulrich B. Phillips, assistant professor of American history in the University of Wisconsin, who has been granted a year's leave of absence by that university, has been selected to fill the chair of history, made vacant by the death of Professor John R. Ficklen.

Professor J. M. Gwinn, professor of pedagogy in the Missouri State Normal School, at Warrensburg, has been appointed to the newly-established chair of education.

Dr. John C. Ransmeier, who recently returned from Europe, where he has been traveling on the John Harvard fellowship, has been appointed assistant professor of German, vice Professor John Hanno Deiler, who retired last June on a Carnegie pension.

Dr. William B. Smith, former professor of mathematics, who spent the most of last year in Europe, will fill the chair of philosophy. Dr. Joseph N. Ivey, associate professor of mathematics, has been appointed head of that department.

Professor Douglas S. Anderson, who was granted a year's leave of absence in 1906–7, and who spent the greater part of his time at the Polytechnic School at Zurich, Switzerland, has returned to take up his work as head of the department of electrical engineering.

Professor William B. Gregory will pursue studies at Cornell University for the session of 1907–8. Mr. James M. Robert will act as his substitute.

Professor B. Palmer Caldwell will take charge of the work in chemistry, Professor John W. Caldwell having retired from this position last June on a Carnegie pension. He will be assisted by Messrs. Scott C. Lyon and H. B. Reese.

Mr. G. Byron Waldrop has been appointed to the teaching fellowship in Greek.

Mr. George J. Theriot and Mr. Sidney Crespo have been appointed instructors of mechanical drawing and mechanic arts, respectively.

Mr. Andre Dreux, graduate of L'Ecole des Chartes, Paris, noted lecturer and critic, has been elected to the vacancy in the department of French in Newcomb College, Miss Marie Augustin having retired from this position last June on a Carnegie pension.

Dr. J. A. C. Mason, former fellow in Columbia University, has been appointed to the chair of history in Newcomb College. Professor Pierce Butler, who formerly held this chair, has been promoted to the chair of English, Mrs. Jane C. Nixon having retired last June on a Carnegie pension.

Miss Margaret E. Cross, head of the department of Latin and psychology in the State Normal School, at Natchitoches, Louisiana, will take charge of the department of education in Newcomb College.

Dr. Edmond Souchon, who taught for twenty-eight years in the medical department of the university, retired last June on a Carnegie pension.

The following promotions and appointments have been made in the medical department since the close of last session:

Dr. Isadore Dyer, associate dean and professor of diseases of the skin; Dr. Paul E. Archinard, professor of diseases of the nervous system; Dr. J. B. Elliott, professor of clinical medicine; Dr. E. D. Fenner, professor of orthopedics and surgical diseases of children; Dr. Henry Bayon, acting professor and demonstrator of anatomy; Dr. Marcus Feingold, professor of ophthalmology; Dr. Charles J. Landfried, professor of otology, laryngology and rhinology; Dr. Herman B. Gessner, associate professor of operative surgery and instructor of clinical surgery; Dr. W. W. Butterworth, associate professor of diseases of children; Dr. S. M. D. Clark, associate professor of gynecology; Dr. George S. Bel, associate professor of clinical medicine; Dr. Marion S. Souchon, assistant demonstrator of anatomy and instructor of clinical surgery; Dr. William M. Perkins, demonstrator of operative surgery and instructor of clinical surgery; Dr. Ralph Hopkins, lecturer and instructor in physiology, hygiene and diseases of the skin; Dr. John Smyth, lecturer and demonstrator in the laboratory of minor surgery and instructor of clinical surgery; Dr. Urban Maes, junior assistant demonstrator of operative surgery and instructor of clinical surgery; Dr. Joseph D. Weis, lecturer and instructor in clinical medicine; Dr. I. I. Lemann, lecturer and instructor in clinical medicine; Dr. J. L. C. Perrilliat, clinical instructor of obstetrics; Dr. Charles C. Bass, instructor of clinical microscopy and clinical medicine; Dr. Edward O. Trahan, assistant demonstrator in the microscopical laboratory; Dr. George J. Tusson, assistant demonstator in the microscopical laboratory; Dr. Sidney K. Simon, instructor of clinical medicine; Dr. Eugene deBellard, assistant demonstrator in the microscopical laboratory; Dr. Carroll W. Allen, instructor of clinical surgery; Dr. J. B. Crawford; junior assistant demonstrator of operative surgery; Drs. C. J. Miller, L. R. DeBuys and P. B. Salatich, chiefs of clinics of obstetrics and gynecology; Drs. P. A. McIlhenny and E. S. Hatch, chiefs of clinics of orthopedics and surgical diseases of children; Dr. Henry Daspit, Jr., chief of clinic for practise of medicine.

The university will erect at once on the campus, opposite Audubon Park, buildings for its medical department at a cost, including laboratories, of $260,000. The first two years' work of the medical department will hereafter be given upon the university campus; the work will be rigidly scientific. The last two years' work will be given in the present downtown building, which is near the Charity Hospital, with which the medical department of the university is affiliated. During the year, three professors will be added to the medical faculty—a professor of anatomy, a professor of physiology and a professor of pathology. The maximum salary for these positions is fixed at $5,000.

ARCHEOLOGICAL WORK IN ARIZONA

DURING the past season the Committee on American Archeology of the Archeological Institute of America offered properly qualified students the privilege of joining the field expeditions of the Institute in Colorado, Utah and New Mexico. A number of students availed themselves of the opportunity to participate in the practical work of exploration, mapping and excavation of ruins in the San Juan and Rio Grande basins. These expeditions closed on October 1.

Through the courtesy of the Secretary of the Smithsonian Institution the committee is authorized to announce that the government excavations at Casa Grande, in the Gila Valley, Arizona, will be resumed about November 1, under the direction of Dr. J. Walter Fewkes, to continue during the fall and winter, and that students may arrange through the Archeological Institute to participate in the work at this site. As government institutions are not permitted to accept volunteer services, Dr. Fewkes is authorized to pay a limited number of students (not to exceed ten) for their services in connection with the work a nominal salary of ten dollars per month, it being understood that they provide for their own traveling expenses and subsistence. This nominal salary will about cover field subsistence at Casa Grande.

Students desiring to avail themselves of this opportunity should correspond with the undersigned as early as convenient. Applications should be accompanied by the recommendation of the professor under whom the applicant has studied.

EDGAR L. HEWETT,
Director of American Archeology
ARCHEOLOGICAL INSTITUTE OF AMERICA,
1333 F STREET, WASHINGTON, D. C.,
October 21, 1907

BRITISH MUSEUM MODEL OF EURYPTERUS

IN the Upper Silurian rocks of the island of Oesel, in the Baltic, are found the fossil remains of an arthropod called *Eurypterus Fischeri.* This animal is of interest as one of an extinct group of arthropods that appear to have been allied to the modern Limulus or king-crab, as well as to the scorpions. These particular fossils have a further interest in that the chitinous substance of the outer coat of the animal has been preserved unaltered in chemical and physical composition. Thus Professor G. Holm, of Stockholm, has been able to dissolve the remains out from the rock by means of acid, and to mount them on glass slides in Canada balsam. On the preparations thus obtained, he based an elaborate description, published in the *Memoirs of the Academy of Science,* St. Petersburg (Ser. 8, Vol. VIII., No. 2, 1898). It can now be said that the structure of this species is known better than that of any other extinct arthropod. Several of Professor Holm's preparations preserved in the geological department of the British Museum are quite marvelous, and it is difficult to believe that one is looking at a fossil at all, still more one dating from the Silurian Epoch.

The perfection of these specimens and the interest of the animal suggested to members of the staff of the British Museum (Natural History) the advisability of preparing a complete model of it, and such a model in colored wax, of about twice the natural size, has now been made under the direction of Dr. W. T. Calman and Dr. F. A. Bather by Mrs. Vernon Blackman, whose beautiful models of plants, of the parasite of malaria, and of the tsetse fly are well known to all visitors to the Natural History Museum in the Cromwell Road.

The model was first placed on exhibition on the occasion of the visit of foreign geologists to the Centenary of the Geological Society of London and evoked their enthusiastic admiration. It measures 23 x 15 cm. The wax of which it is made will stand any extremes of temperature likely to be met with in a museum, and the colors are believed to be quite permanent; they are based upon those of the recent *Limulus,* and Sir Ray Lankester has shown great interest in their selection. The model which, it may be mentioned, has been subjected to the careful scrutiny of Professor

Holm himself, certainly looks quite as natural and life-like as any specimen of a recent arthropod exhibited in the museum.

The geological department hopes to have a limited number of copies of this model, which it is prepared to exchange with other museums. Naturally a model of this nature, which has taken a very long time to make, demands an exchange of considerable value, but for information on this matter inquiries should be addressed to the keeper of the geological department, Natural History Museum, Cromwell Road, London, S. W., England.

THE RESEARCH LABORATORY OF PHYSICAL CHEMISTRY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

This laboratory opened on September 1 for its fifth year. Professor G. N. Lewis has been appointed acting director of the laboratory, in place of Professor A. A. Noyes, who is temporarily acting as president of the institute. Investigations are being carried on in the laboratory by sixteen men of whom ten are devoting their whole time to research work. The new members of the research staff are Professor Carl von Ende (Ph.D., Göttingen), Mr. John Johnston (B.Sc., St. Andrews) and Mr. Roger D. Gale (S.B., Massachusetts Institute of Technology). Mr. R. B. Arnold (S.B., Rose Polytechnic Institute) enters as a candidate for the degree of doctor of philosophy. This degree was conferred last June on three of the research workers in the laboratory, Messrs. Raymond Haskell, R. B. Sosman and M. A. Stewart.

As in the past, a considerable part of the research work bears upon the problems of conductivity in aqueous solutions at high temperatures. The results of the numerous investigations in this field, which have already been completed in this laboratory, have recently appeared in a comprehensive memoir published by the Carnegie Institution. A new form of conductivity bomb, capable of withstanding very high pressures, has recently been constructed. In this bomb the vapor-pressure, density and compressibility of water up to the critical point are being studied, as well as the influence of pressure upon the electrical conductivity of solutions. Closely allied investigations are being made upon electrical transference in mixed salt solutions, the solubility of salts in water at high temperatures, and the dielectric constant of water up to its critical point.

In another field of investigation which is receiving special attention in this laboratory several investigations are under way. These are directed towards the determination of the common electrode potentials, and of the free energy of important chemical reactions. Indirectly but vitally connected with these researches is an investigation of the specific heat of gases at very high temperatures, which is now being undertaken by Professor H. M. Goodwin and Dr. H. T. Kalmus.

The general scheme of qualitative analysis, developed by Professor A. A. Noyes and Dr. W. C. Bray, is being extended to include the detection of the acids. Other investigations begun in previous years on the hydration and the true transference numbers of the ions, on the electromotive force produced in a solution by rotating it at a very high rate of speed, and on the properties of the solutions of metals in liquid ammonia, are being brought to a successful conclusion. Mr. C. A. Kraus, who is carrying on the last-named investigation, has succeeded in finding the missing link between the metallic and the electrolytic conductor, and has thus obtained a new point of attack for the problem of the electron.

During the past year a gift of $500 has been received from the William E. Hale Research Fund and one of $3,000 from a private source in support of the work of the laboratory. In addition, Professor A. A. Noyes has received a grant of $2,000 from the Carnegie Institution for assistance in carrying on the researches above referred to on the conductivity of aqueous solutions.

THE CHICAGO MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The program for the *entire meeting* will be issued on Monday, December 30. Copies may be obtained at hotel headquarters and at the office of the permanent secretary, in the Mitchell Tower Arcade, University of Chicago. No "Daily Program" will be issued.

The following events may be announced in advance:

Saturday, December 28, 1907

The register for the Chicago meeting will be open at 2 P.M. at the office of the permanent secretary, Auditorium Annex.

The regular meeting of the executive committee, consisting of the general secretary, the secretary of the council, and the secretaries of the different sections, will be held at noon in the rooms of the permanent secretary, at the Auditorium Annex.

Sunday, December 29, 1907

The office of the permanent secretary in the Auditorium Annex will be open all day for registration.

Monday, December 30, 1907

Meeting of the Council at 9 A.M., at Reynolds Theater, in the Tower group of the University.

First General Session of the Association at 10 A.M. in Leon Mandell Assembly Hall, University of Chicago.

The meeting will be called to order by the retiring president, Dr. W. H. Welch, who will introduce the president of the meeting, Professor E. L. Nichols.

Addresses of welcome will be delivered by Dr. Harry Pratt Judson, president of the University of Chicago, and by Mr. Charles L. Hutchinson, chairman of the Local Committee for the meeting.

Reply by President Nichols.

Announcements by secretaries.

Agreement on the hours of meeting.

Adjournment of the general session, to be followed by the organization of the sections in their respective halls.

Addresses by the vice-presidents at 2:30 P.M. as follows:

Vice-president Kasner, before the Section of Mathematics and Astronomy. Title, "Geometry and Mechanics."

Vice-president Richardson, before the Section of Chemistry. Title, "A Plea for the Broader Education of the Engineer."

Vice-president Conklin, before the Section of Zoology. Title to be announced later.

Tuesday, December 31, 1907, at 2:30 P.M.

Vice-president Sabine, before the Section of Physics. Title, "The Origin of the Musical Scale."

Vice-president MacDougal, before the Section of Botany. Title to be announced later.

Vice-president Conant, before the Section of Social and Economic Science. Title, "The Influence of Friction in Economics."

Vice-president Flexner, before the Section of Physiology and Experimental Medicine. Title, "Recent Advances and Present Tendencies in Pathology."

Wednesday, January 1, 1908, at 2:30 P.M.

Vice-president Warner, before the Section of Mechanical Science and Engineering. Title to be announced later.

Vice-president Brown, before the Section of Education. Title to be announced later.

OTHER PROGRAM ANNOUNCEMENTS

All the sections of the association and, so far as possible, all the affiliated societies, will meet at the University of Chicago on December 30. Several of the sections of the association will hold sessions in which topics of general interest will be discussed.

At 8 o'clock the retiring president will give his address in Leon Mandell Assembly Hall. At the close of the address a reception will be tendered to the association by President H. P. Judson and the board of trustees of the University of Chicago.

On the following days the sections and societies will hold their regular sessions. It is expected that there will be joint meetings when the same subjects are covered, and that some meetings will be arranged for of general interest to all members of the association. No definite arrangements have been made for the general evening functions after Monday night. Dinners and meetings of special societies and groups, smokers and informal meetings may be arranged for these subsequent evenings.

On Friday afternoon, January 3, there will be a convention of the Sigma Xi, followed by a banquet in the evening.

RAILROAD RATES

The railroads have generally authorized a reduced rate of two cents per mile each way, on the card-order plan. In order to get the benefit of these reduced rates, a card order, which can only be secured from the office of the permanent secretary, Dr. L. O. Howard, Smithsonian Institution, Washington, D. C., must first be obtained. A card is only good for one ticket, and should a member be accompanied by any members of his family, he will require a card for each person. Members expecting to attend the meeting will therefore advise the permanent secretary immediately of the number of cards desired.

Members residing in the territory of the Western Passenger Association and of the Southwestern Passenger Association are referred to the reduced rates granted by those associations for the holiday season, which will give them practically the same rate as has been granted by other passenger associations, and will obviate the necessity of obtaining a card order.

ANNOUNCEMENTS BY THE LOCAL COMMITTEE

The University of Chicago is located on the south side of the city, facing the Midway Plaisance. Most of the buildings in which the meetings will be held are located on a plot covering four city blocks, bounded by Ellis Avenue on the west, Lexington Avenue on the east, 57th Street on the north, and 59th Street on the south. The local headquarters are in the Reynolds Club, corner of Lexington Avenue and 57th Street. Enter through Mitchell Tower.

The College of Education, or Emmons-Blaine Hall, is located on 59th Street, between Monroe and Kimbark Avenues.

From the center of the city the university may be reached most easily by taking the Illinois Central suburban express trains. These trains leave the center of the city every twenty minutes from the foot of either Randolph or VanBuren Street. Get off at the 57th Street Station. Take the 'bus, or walk west, six blocks to Lexington Avenue.

The university may be reached from the center of the city and from intermediate points by means of the Cottage Grove Avenue trolley. If the car is marked Grand X, get off at 57th Street and Cottage Grove Avenue and walk east six blocks to Lexington Avenue. If the car is marked Jackson Park, get off at the corner of Lexington and 55th Street, and walk south two blocks.

Passengers arriving by the Lake Shore and Michigan Southern, the Nickel Plate, the Rock Island; Chicago & Eastern Illinois, or the Pennsylvania, may reach the university easily by getting off at the Englewood Station. Take thence the 63d Street trolley east to Cottage Grove Avenue, transfer, and proceed north to 57th Street. Thence walk six blocks east to Lexington Avenue.

Passengers arriving by the Michigan Central, the Illinois Central, the Pere Marquette, or the Big Four, and wishing to go directly to the university, may get off at the 63d Street Station. Transfer to an Illinois Central local or express suburban train, get off at the 57th Street Station, and take 'bus or walk six blocks west to Lexington Avenue.

Passengers arriving over other lines will go to the terminal station of the road in the center of the city and come out to the university as described above.

Passengers over all lines, who wish to locate in hotels in the center of the city, should remain on the train until it reaches the terminal station in the center of the city.

HOTELS

The Auditorium Annex, on Michigan Boulevard and Congress Street will be the general headquarters. The hotels recommended by the local committee are:

Auditorium Annex (Headquarters), Michigan Avenue and Congress Street.

$2.00 and up for single rooms; $1.50 and up per person for double rooms.

The Stratford, Michigan Avenue and Jackson Boulevard.

$1.50 and up, single; $1.25 and up per person, double.

Rooms may be engaged in advance by addressing Percy Tyrrell, manager.

The Victoria, Michigan Avenue and Van Buren Street.

$1.00 and up, single; $1.00 per person, double.

Grand Pacific, Michigan Avenue and Van Buren Street.
$1.50 and up, single; $1.25 and up per person, double.

Great Northern, Jackson and Dearborn Streets.
$1.50 and up, single; $1.25 and up per person, double.

Palmer House, State and Monroe.
$1.50 and up, single; $1.00 and up per person, double.

Wellington, Jackson Boulevard and Wabash Avenue.
$1.00 and up, single; $1.00 and up per person, double.

Kaiserhof, 27 S. Clark Street.
$1.00 and up, single; $1.00 and up per person, double.

McCoy's, Clark and Van Buren Streets.
$1.00 and up, single.

Del Prado, Washington and 59th Streets.
$2.50, American plan, for two in a room, with bath.

Facilities for lunch will be provided on the campus. The Reynolds Club, in the Tower Group, will be thrown open as general headquarters for the members of the association and the affiliated societies. Rest rooms for women are provided in Lexington Hall.

Secretaries of sections and of affiliated societies should notify the local secretary as soon as possible if lanterns are desired for illustrating papers to be read.

AFFILIATED SOCIETIES

All members of affiliated societies who are not members of the association are requested to register at the desk provided for the purpose in the office of the permanent secretary, Mitchell Tower Arcade, University of Chicago, so that an approximate record may be made of the total number of scientific men in attendance of the Convocation Week meetings. The following societies have indicated their intention to meet in Chicago during Convocation Week in affiliation with the American Association for the Advancement of Science:

The American Anthropological Associatiou. President, Dr. Franz Boas, Columbia University, New York, N. Y.; Secretary, Dr. Geo. Grant MacCurdy, Yale University, New Haven, Conn.

Botanical Society of America. Secretary, Professor Duncan S. Johnson, Johns Hopkins University, Baltimore, Md.

The American Chemical Society. President, Marston T. Bogert, New York; Secretary, Chas. L. Parsons, Durham, N. H.

The American Folklore Society. President, Roland B. Dixon, Harvard University; Acting Permanent Secretary, A. M. Tozzer.

The American Mathematical Society. (While this society will hold its annual meeting in New York City during Convocation Week, the Chicago Section will meet with the American Association for the Advancement of Science. The secretary of the section is Professor H. E. Slaught, University of Chicago.)

The American Psychological Association. President, Dr. Henry Rutgers Marshall, New York City; Acting Secretary, Professor R. S. Woodworth, Columbia University.

The American Society of Naturalists. President, Professor J. P. McMurrich, Toronto, Canada; Secretary, Professor Edward L. Thorndike, Teachers College, Columbia University, New York, N. Y.

Association of American Anatomists. Meetings will be held January 1, 2 and 3. President, Franklin P. Mall, Johns Hopkins University, Baltimore, Md.; Secretary, Professor G. Carl Huber, University of Michigan, Ann Arbor, Mich.

Association of American Geographers. President, Professor Angelo Heilprin (deceased); Secretary, Professor Albert P. Brigham, Colgate University, Hamilton, N. Y.

Association of Economic Entomologists. Will meet December 27 and 28. President, Professor H. A. Morgan, Knoxville, Tenn.; Secretary, A. F. Burgess, Department of Agriculture, Washington, D. C.

Entomological Society of America. President, Professor J. H. Comstock, Ithaca, N. Y.; Secretary, J. Chester Bradley, Cornell University, Ithaca, N. Y.

The permanent secretary has received from the local secretary a statement that the American Nature Study Society, the American Federation of Teachers of Mathematics and Physical Science and the Teaching Section of the Lake Placid Conference on Home Economics will meet at the University of Chicago during Convocation Week.

By virtue of a resolution of the council adopted at the New York meeting, the programs of affiliated societies will be published by the association in the general program to be issued on the morning of December 30.

LOCAL EXECUTIVE COMMITTEE FOR THE CHICAGO MEETING

Charles L. Hutchinson,
Chairman Local Committee.
John M. Coulter, *Chairman Executive Committee.*

John R. Angell,	Charles R. Mann,
Thomas C. Chamberlin,	Robert A. Millikan,
Joseph P. Iddings,	Charles F. Millspaugh,
Frank R. Lillie,	Alexander Smith,

J. Paul Goode, *Local Secretary.*

SCIENTIFIC NOTES AND NEWS

The Royal Society has this year awarded its Davy medal to Dr. E. W. Morley, emeritus professor of chemistry, Western Reserve University, and its Copley medal to Dr. A. A. Michelson, professor of physics, the University of Chicago.

Professor G. A. Miller has been appointed secretary of Section A—Mathematics and Astronomy—of the American Association, in place of Professor L. G. Weld, resigned, and all titles and abstracts of papers for the coming Chicago meeting should be sent to Professor Miller, 907 West Nevada Street, Urbana, Illinois.

In view of the fact that Dr. Elwood Mead has been called to Australia to assume direction under government auspices of irrigation work in that country, the Secretary of Agriculture has divided the work of irrigation and drainage investigations of the Office of Experiment Stations, which Dr. Mead has managed since its establishment in 1898, into two sections. Dr. Samuel Fortier, irrigation engineer in charge of the Pacific district of the irrigation and drainage investigations, and stationed at the University of California, Berkeley, Cal., has been made chief of irrigation investigations. Mr. C. G. Elliott, for several years past engineer in charge of the drainage investigations of the office, has been made chief of drainage investigations.

At the *Reichsanstalt* Dr. Liebenthal and Dr. Diesselhorst, associates, have been appointed members and professors and Dr. Henning and Dr. Günther Schulze, assistants, have been appointed associates.

At a recent meeting of the Philadelphia College of Pharmacy the following persons were elected honorary members: Dr. Harvey W. Wiley, chief of the Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C.; Richard T. Baker, curator and economic botanist of the Technological Museum, Sydney, New South Wales; Henry G. Smith, assistant curator and chemist of the Technological Museum, Sydney, New South Wales; Professor Nagayoshi Nagai, professor of pharmacy in the College of Medicine of the Imperial University of Tokyo, and president of the Pharmaceutical Society of Japan; Dr. H. Thoms, professor of pharmacy and director of the Pharmaceutical Institute of the University of Berlin; Dr. Nathaniel Lord Britton, director of the New York Botanical Garden, New York City.

Sir Oliver Lodge has accepted the invitation of the council to succeed the late Sir William Perkin in the presidency of the Faraday Society.

Dr. Carl Beck, of New York City, is the American member of the committee to establish an institution in Berlin, to bear the name of Dr. Robert Koch.

Professor William Campbell, of Columbia University, has been elected a corresponding member of the Canadian Mining Institute.

Dr. Henry M. Hurd, superintendent of the Johns Hopkins Hospital, has returned to Baltimore after spending eight months in Europe.

Dr. Charles Harrington, secretary of the Massachusetts state board of health, has returned from Europe. He has been absent several weeks attending the International Congress of Hygiene and Demography at Berlin, and studying problems of health in Germany and England.

Lieutenant E. H. Shackleton, leader of the British Antarctic expedition organized by himself, left London on October 31 for Marseilles, where he will join the P. and O. steamer *India*. He is due at Lyttelton on December 12.

The regular meeting of the Columbia Chapter of the Society of Sigma Xi was held with the department of physics on October 31. Mr. L. B. Morse presented some of his recent work under the title "The selective reflection in the infra red characteristic of carbonates and its relation to the atomic weights of the bases."

PROFESSOR JOHN DEWEY, of Columbia University, will lecture before the School of Education of the University of Illinois during the second week of December.

MR. W. E. CHANCELLOR, superintendent of the schools of Washington, D. C., will give a course of twenty lectures at the Johns Hopkins University, on the "History of Theory of Education."

DR. EDWARD GARDINER, of Boston, Mass., known for his work on *Turbellaria* and for his active interest in the Marine Biological Laboratory at Woods Hole, of the corporation of which he was secretary, died suddenly from pneumonia on November 4.

WE regret also to record the death, at the age of seventy-two years, of Mr. Howard Saunders, the eminent British ornithologist.

THE Field Museum of Natural History, Chicago, profited by a decision rendered by Judge Cutting of the Chicago Probate Court to the extent of $430,000. The money was paid by the late Marshall Field to the trustees of the museum prior to the date of his will, which contained a bequest of $8,000,000 to the institution. A suit was brought by the trustees against the executors of the will to determine whether the bequest was intended to be exclusive of the amount previously donated. Judge Cutting decided the suit in favor of the museum on the testimony of President H. N. Higinbotham of the board of trustees and of Frederick L. V. Skiff, curator of the museum, who related conversations with the decedent which were held to indicate his intention.

To serve as a botanic garden for the University of Chicago, about four acres of ground have been set apart in the block adjoining Washington Park and the Midway Plaisance. It is easily accessible from the Hull Botanical Laboratory, and is to be strictly a laboratory garden, which will add greatly to the facilities for experimental work. The area, it is hoped, will be largely increased with the further development of plans.

A CERTIFICATE of incorporation has been filed with the secretary of state for the Russell Sage Institute of Pathology of New York City. The directors are Drs. Edward G. Janeway, Theodore C. Janeway, D. Bryson Delavan, Simon Flexner and Graham Lusk. This institute will act as pathologist for the City Hospital and City Home on Blackwell's Island. Heretofore these institutions have had no laboratories for pathologic work.

THE president of Santo Domingo, under date of September 17, 1907, published a decree relating to objects of archeological interest discovered upon the island which will be of interest to collectors. After explaining that the archeological remains in the island should be preserved, that a museum should be established for the purpose, and that many objects have been taken from the island, the decree goes on to state that such objects are the exclusive property of the nation and therefore shall not be taken from the country or appropriated by private persons. Private collections already made will not be disturbed, but they must not be removed from the republic. Any person finding one of these objects shall deliver it to the superior authority of the province or district in which it is found, who shall have the object deposited in a suitable place, inform the government of the discovery and have the fact published in the newspapers. A register of these discoveries shall be kept by the governors of the various provinces. Any person violating the provisions of this decree shall be punished according to law.

THE American Scenic and Historic Preservation Society held a meeting in the new building of the New York Historical Society on November 14, to commemorate the anniversary of the birth of Robert Fulton on November 14, 1765, and the centenary of the successful inauguration by him of steam navigation on the Hudson River in 1807. From 8 to 8:30 o'clock there was a reception at which descendants of Robert Fulton were the guests of honor. Beginning at 8:30 addresses were announced by Gen. Stewart L. Woodford, president of the Hudson-Fulton Celebration Commission; Rear Admiral Joseph B.

Coghlan, representing the United States Navy; Captain George A. White, representing the Hudson River steamboat interests; Mr. Samuel Verplanck Hoffman, president of the New York Historical Society; and Mrs. Robert Abbe, president of the City History Club; concluding with an exhibition of stereopticon views illustrating Fulton's work and the progress of steam navigation during the century.

The Rhode Island College of Agriculture and Mechanic Arts, at Kingston, R. I., announces the following course of popular scientific lectures, which are open to the public:

October 25—"Recent Studies in Heredity and their bearing upon the Problems of Breeding," by Professor W. E. Castle, Department of Zoology, Harvard University.

November 2—"Central America: Its People and its Monuments," by Dr. Alfred M. Tozzer, instructor in anthropology, Harvard University.

November 8—"Sea Farming," by Professor Frederic P. Gorham, Department of Biology, Brown University.

November 16—"The Theories of Bird Migration," by Professor H. E. Walter, Department of Comparative Anatomy, Brown University.

November 23—"The Evolution of the Earth," by Charles W. Brown, head of Department of Geology, Brown University.

December 6—"Some Principles of Organic Evolution," by Professor A. D. Mead, Department of Comparative Anatomy, Brown University.

January 11—"The Question of the Origin and Artificial Production of Life," by Dr. Leon J. Cole, instructor in zoology, Yale University

The British Medical Journal states that the recent election of Dr. Pièrart brings up the total number of representatives of the medical profession in the Belgian parliament to ten. Of these four belong to the liberal left; four, including the new member, to the right; and two to the socialist left.

Arrangements have been completed for the running of a horticultural and soil improvement special train over the Baltimore, Ohio and Southwestern Railroad, in Indiana, about November 19–22, 1907. This movement is the result of cooperation of the railways, Purdue Experiment Station and the Indiana State Horticultural Society. The train is to be equipped and operated by the railway, while the lecturers will be furnished by the Experiment Station and the State Horticultural Society. Stops of one hour will be made at all the important stations, and talks given on the various lines of work. That part of southern Indiana through which the train will pass is especially adapted to fruit growing, and an effort will be made to point out ways by which the average farmer can profitably engage in the business. Along soil improvement lines information will be given on the value and use of commercial fertilizers. In this connection the results of experiments conducted in southern Indiana will be presented. The horticultural work will be in charge of C. G. Woodbury, of the Horticultural Department, while the soil work will be under the direction of Professor Arthur Goss.

We learn from the London *Times* that Sir W. H. White presided on October 17 at the sixth annual meeting of the Northern Scientific Club in Newcastle. After the formal business the president gave an address upon the application of the gyroscope for steadying ships. He showed a working model of Dr. Schlick's apparatus which, he said, when applied to cross-channel boats and coasting passenger steamers, would so prevent the rolling of these vessels as to allow persons troubled with sea sickness to travel on the sea in comfort. The gyroscope had reached beyond the toy stage, which was proved by the fact that the firm who had built the Mauretania were to develop Dr. Schlick's apparatus.

The Forest Club of the University of Nebraska announces addresses for the first half of the present year as follows:

October 8—"Forest Conditions in Michigan," Professor F. J. Phillips.

October 22—"Forest Insects" (illustrated), Professor L. Bruner.

November 5—"Growth of Mistletoe," Mr. R. J. Pool.

November 19—"The Forest Ranger," Mr. J. Higgins.

December 3—"Forest Trees of the World," Dr. Chas. E. Bessey.

December 17—"Utilization of Colorado National Forests," Theodore R. Cooper. "Lumbering in Colorado," Claude R. Tillotson.

January 7—"Fungus Diseases of Trees," Dr. F. D. Heald.

The department of archeology, Phillips Academy, announces the following lectures to be delivered in the lecture hall of the Archeology Building at 7:30 o'clock:

October 31—"Evolution and the Ascent of Man" (illustrated), Warren K. Moorehead.

November 21—"Prehistoric Man in Europe" (illustrated), Charles Peabody.

December 5—"Prehistoric Man in America" (illustrated), Warren K. Moorehead.

January 9—"The Plains Indians" (illustrated), Warren K. Moorehead.

January 23—"Mound Building Tribes" (illustrated), Warren K. Moorehead.

February 6—"Prehistoric and Primitive Art" (illustrated), Charles Peabody.

February 20—"The Cliff Dwellers" (illustrated), Warren K. Moorehead.

March 5—"Central and South American Archeology" (illustrated), Charles Peabody.

March 19—"The Pueblo Culture" (illustrated), Warren K. Moorehead.

April 2—"The American Indian in History and His Destiny," Warren K. Moorehead.

The Teachers' School of Science, established by the Lowell Institute of Boston, offers this winter, as a new departure, a course of fifteen lectures to teachers, on the fundamental principles of physical chemistry, discussed with special reference to their application in the teaching of elementary science. The lectures will be given by Professor G. N. Lewis, of Massachusetts Institute of Technology, on Saturday forenoons, beginning November 16. This course is offered at the request of the New England Association of Chemistry Teachers and will be open free of charge to all science teachers.

Nature states that the Philosophical Institute of Canterbury, New Zealand, is making arrangements for an expedition to some southern islands included in the colony's boundaries. The expedition will be under the leadership of the Hon. R. McNab, minister of lands and minister for agriculture, who is interested in the history of the islands, and has written an interesting work dealing with the old sealing and whaling days in the islands and the southern part of the mainland. The expedition will be under the auspices of the government, and will be taken to the islands in one of the government's steamers. It will leave New Zealand about the end of November or the beginning of December, and will visit the Auckland Islands and Campbell Islands. About twenty New Zealand men of science will take part in the undertaking. They will be divided into two parties, one going to each group. Work will be done in regard to terrestrial magnetism, zoology, geology and botany, and reports will be prepared dealing with the results of the investigations.

The report of the Departmental Committee appointed to inquire and report as to the nature and extent of the benefit accruing to British arts and industries from the participation of Great Britain in great international exhibitions, has been issued as a parliamentary paper. According to an abstract in *Nature*, the committee found that the evidence it received went to show that international exhibitions are of little use to the textile and other great staple industries of the country. The committee is, however, in favor of the continued participation of this country in all really important exhibitions, owing to the indirect advantages resulting. One aspect of exhibitions to which considerable importance should be attached is the effect which they have in encouraging national emulation and in stimulating individual exhibitors to improve their productions. Examples of the effects which particular exhibitions have had on the development of different industries will be found in the evidence of Sir William Preece, K.C.B., Mr. Bennett Brough, and other witnesses. Sir William Preece attributes to the Paris Exhibition of 1881 many of the most important developments of the electrical industry. The exhibition at Paris of certain high-speed tool steels by an American firm is said by Mr. Bennett Brough to have contributed in a large degree to the development of what has become a British industry of great magnitude; and an exhibit by the Courrières Colliery Company, at the mines of which the death-rate from falls of roof was abnormally low, has since led to considerable improvement in the methods of timbering employed and a consequent decrease in the death rate. The report concludes with important recommendations for securing in future continuity of organization from exhibition to exhibition, and more effective representation at any exhibition in which the government may take part.

We learn from *The Harvard University Gazette* that the session at the Bermuda Station this summer extended from June 21 to August 7. The new station is located on Agar's Island, near the entrance to Hamilton Harbor. This island contains about three acres of land, and has numerous substantial buildings. It was formerly used by the British government for the storage of munitions of war, and for the accommodation of the necessary garrison. It has been secured by the Bermuda Natural History Society for the purposes of a public aquarium and a station for biological research. The powder magazine is being converted into an aquarium of the grotto type, and other buildings have been adapted to laboratory, lodging, and dining requirements. The following Harvard men were enrolled at the station this year: Professor E. L. Mark, director; Dr. H. W. Rand (Ph.D. 1900), in charge from June 21 till July 5; Dr. A. M. Banta (Ph.D. 1907), professor of biology at Marietta College, Marietta, Ohio; Professor Webster Chester (university scholar), Colby College, Waterville, Me.; Dr. C. O. Esterly (Ph.D. 1907), professor of biology in Occidental College, Los Angeles, Cal.; Professor H. M. Kelly (A.M. 1893), Cornell College, Ia.; Mr. J. A. Long (G. B. Emerson Scholar); and Mr. J. W. Mavor (Thayer Scholar).

UNIVERSITY AND EDUCATIONAL NEWS

By the will of Mrs. Sarah E. Potter, of Boston, for some years a member of the committee to visit the Gray Herbarium, Harvard University received in June a bequest of $50,000 to be used in connection with the herbarium, and to be called the Sarah E. Potter endowment fund. As one of a number of residuary legatees, the university has now received an addition to this endowment of $130,000.

Harvard University has also received from Miss Maria Whitney, of Cambridge, the sum of $5,000, the income thereof to be applied to the care and increase of the Whitney Library of the Museum of Comparative Zoology.

Clark Hall, of the Massachusetts Agricultural College, the new building named after Col. William S. Clark, an enthusiastic botanist and one of the first presidents of the institution, was dedicated on October 2. Professor D. P. Penhallow, D.Sc., F.R.S.C., of McGill University, gave an address on "William Smith Clark: his place as a scientist and his relation to the development of scientific agriculture"; and Professor John M. Tyler, Ph.D., of Amherst College, read a paper entitled "Reminiscences of Col. W. S. Clark."

According to data published by the Ministry of Education, the attendance of regular students at the summer semester was as follows: Total number of students, 21,504; of whom 9,535 were in law, 7,525 in philosophy, 3,100 in medicine and 1,344 in theology. Vienna had 7,360, the Prague Bohemian University 3,417, the Prague German University 1,407, Lemberg University 3,097, Krakov 2,622, Gratz 1,700 and Innsbruck 1,026.

Dr. Harry L. Whittle has been appointed instructor in physiological chemistry in the University of Maryland.

Dr. H. M. Tory, professor of mathematics at McGill University, has resigned to take the presidency of the newly-established provincial university at Alberta.

Sir Arthur Rücker has intimated his intention to resign the principalship of the University of London in September next.

Mr. Howard Marsh, formerly surgeon to St. Bartholomew's Hospital, and since 1903 professor of surgery in the University of Cambridge, has been elected master of Downing College in succession to Dr. Alex Hill, who had held the post since 1888.

Mr. Leonard T. Hobhouse has been appointed to the professorship of sociology in London University, recently endowed by Mr. Martin White.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, NOVEMBER 22, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

RELATION OF CHEMISTRY TO AGRICULTURE[1]

THE subject assigned the writer on the program of exercises in honor of Dr. W. A. Noyes, who was recently appointed head of the department of chemistry and director of the laboratory at the University of Illinois, is "The Relation of Chemistry to Agriculture."

The friends of the university, who are present here on this auspicious occasion, will, as a matter of course, not expect anything new or startling in a paper of this kind. The application of chemistry to the art of agriculture is characterized by the same results which are manifest in many of the leading industries of the world after this fundamental science had thrown new light upon the processes involved. One general and most important result in this connection has been the establishment of rationalism in the place of empiricism.

It is true that in some of the methods employed in agriculture empiricism has been in advance of science. The beneficial effects of barn-yard manure upon crops was well established in the minds of farmers before chemistry had pointed out that carbon, hydrogen, oxygen, nitrogen, phosphorus, sulphur, potassium, calcium, magnesium and iron were essential to vegetable

[1] This and the following addresses by William McMurtrie, Julius Stieglitz, George B. Frankforter and William A. Noyes were delivered at the inaugural exercises of Professor Noyes as head of the chemical department and director of the chemical laboratory of the University of Illinois, on October 18, 1907.

growth. So also the addition of the more concentrated feeding stuffs, as cereals to hay, straw, roots, etc., in the feeding of domestic animals, was learned by simple observation to be useful in the production of milk, flesh, fat, work, etc., before science had established the fact that the best results could be attained only by the proper proportion in a ration of digestible protein, fat, carbohydrates and ash.

The history of nations, with the exception of one, shows, however, that these empirical observations were not universally put to practise by the tillers of the soil. The capability of a rich virgin soil to produce remunerative crops for a generation or more led to the baneful waste of most fertilizing materials in the past. As a result of this practise the population of many nations increased and civilization advanced until the bountiful sources of plant food contained in the soil became exhausted to such an extent that an adequate amount of food for the teeming populations could no longer be produced, and retrogression in every respect necessarily followed.

The population of countries stands in a direct relation to the food-supply, other things being equal. When the food supply of the territory now occupied by our beloved country was limited to hunting and fishing with a very insignificant amount of agricultural crops, this vast domain could support a population of only about three millions of people. With the advent of the white race and the gradual subjection of the fertile soils to agricultural pursuits, this territory now supports a population of eighty millions of people and the limit has not yet been reached.

It is the province of agriculture to utilize a comparatively few, special, inorganic forms of matter contained in the air and soil and change them into organic compounds, vegetable and animal, which may serve as food and raiment for mankind. Since the transformation which matter thus undergoes is of a purely chemical nature, it stands to reason that the science of chemistry was destined to free agriculture from the slough of empiricism in which it was engulfed and place it upon a sound, scientific basis. The minds of many of the most prominent chemists of the world were imbued with the importance of study and investigations leading to this end. As a result of their labors truths were gradually established and rational systems in the production of vegetable and animal matter based upon them were inaugurated. On this occasion, therefore, it will only be possible to refer briefly to the more important services which the science of chemistry has done to increase and perpetuate the food production of the world.

About three quarters of a century ago Liebig, who is generally regarded as the father of agricultural chemistry, penned the following words:

> A visible, gradual deterioration of arable soils of most civilized countries can not but command the serious attention of all men who take an interest in the public welfare. It is of the utmost importance that we do not deceive ourselves respecting the danger indicated by these signs as threatening the future of populations. An impending evil is not evaded by denying its existence or shutting our eyes to the signs of its approach. It is our duty to examine and appreciate the signs.

After this acute observer and far-seeing philosopher had uttered these words and published his first little book, entitled "Chemistry in its Application to Agriculture," which marks a new epoch in the history of this important branch of human industry, and Wiegeman and Polsdorf had corroborated the theoretical views of the great master by furnishing the infallible, experimental proof, that the mineral or ash constituents of plants were indispensable to vegetable growth, the intelligent farmers of Germany were eager to listen to Liebig's teaching and to profit by any light which the more accurate and rational methods of science might furnish. They had been educated in the school of experience, in which they learned that the closest attention, the most arduous labor and the strictest economy were demanded to extort from their impoverished soils enough to sustain themselves and families. But not only this. The views of Liebig spread rapidly all over the civilized world, and aroused an enthusiasm among scientific investigators in every civilized country, rarely equaled in the annals of history. It is impossible in the time allotted to this paper to go into detail. Suffice it to say that the combined efforts of all these investigators have done more for public welfare than perhaps any other human undertaking. Among the important results of their labors in connection with soil and vegetable production may be mentioned:

1. The chemical composition of agricultural products, including the ash or mineral ingredients.

2. The chemical composition of soils, showing that the soil contains certain elements which serve as plant food and without which vegetable growth is impossible.

3. The establishment of the fact that the most important of the ingredients of plant food, *i. e.*, those which furnish the bulk of the ash of agricultural crops, and contained in the soil in comparatively small quantities, that they are present in two forms, available and reserve plant food, that the immediate fertility of soils depends upon the former, and that by continuous cropping without application of fertilizing materials to the soil this available plant food is gradually exhausted, until maximum or even average crops can no longer be produced.

4. The important observation that if only one of the essential elements of plant food is wanting in the soil, while all others are present in ample quantities, plants will refuse to grow.

5. The devising of methods by which the wanting ingredients of plant food can be definitely determined in an exhausted soil, so that the loss of money and labor in applying fertilizers, which would have no beneficial effect upon the production of crops, can be avoided.

6. The discovery and analysis of natural deposits of plant food, as Guano, Chili saltpeter, Stasfurt salts, apatites, coprolites, limestones rich in phosphates, etc., as well as the analysis of numerous waste products and by-products, such as bones, blood, tankage, oil meals, wood ashes, etc., all of which have been utilized in immense quantities, the world over, for restoring worn-out soils.

7. The control of commercial fertilizers, giving the true composition and money value of the brands brought by manufacturers and dealers upon the market, in order to protect the former against frauds, so easily practised in articles of this nature.

8. The composition, production, proper treatment and preservation of barnyard manure, the most important, most easily obtainable and the best of all fertilizing materials.

9. The chemical composition of all agricultural products, giving an insight into the nature and amount of plant food removed by them from the soil, and indicating a proper rotation of crops, so that one or the other of the essential ingredients of plant food may not be too rapidly withdrawn from the soil, and thus unduly hasten its unproductiveness.

These, my friends, are some of the beneficent results which have followed the application of chemistry to the production of vegetable matter. In passing over to the consideration of the other branch of agricultural industry, namely, the production of animal matter, it may be well to call attention to a few well-known facts. Plants can live on the dead inorganic matter contained in the air and soil alone. They have the power of transforming it into living organic matter and into the more complicated combinations of which their bodies are composed. Animals can not live on inorganic matter alone. They must have in addition the more highly organized forms, which plants produce. Hence the animal kingdom is dependent upon the vegetable kingdom for its existence.

Since animals consume plants for food, it follows that the same elements which occur in plants are found in the animal body. In fact the same compounds that occur in vegetable matter are again found in the animal body, only slightly modified.

Before chemistry began to shed its light upon agriculture, the rearing and feeding of domestic animals for human food and raiment was just as empirical as the production of plants. It is true, as already stated, that simple observation led to many good methods in actual practise, but no intelligent reasons could be given for the methods. The subject of animal nutrition was taken up by scientific investigators with as much zeal and as careful study and experimentation as were expended on vegetable production, and the results and data obtained are sufficient to warrant an intelligent use of the means at hand.

The amount of time and labor expended in changing the rule-of-thumb methods of feeding domestic animals into a rational system is very great taken in the aggregate.

1. The composition of every product of domestic animals, the composition of every part of their bodies, and the proportion of these parts among themselves in forming the living animals produced for various purposes are known to the chemist.

2. The proximate composition of feeding stuffs of all kinds has been accurately determined by thousands upon thousands of analyses made in all parts of the world. Extensive tables giving the percentage of protein, fat, carbohydrates, fiber and ash have been placed at the command of every one engaged in this branch of agriculture. But this is not all. Just as the total amount of plant food in the soil is not completely available for the production of vegetable matter, so the proximate principles just mentioned do not entirely serve as nourishment for the animal body. The digestibility of the various ingredients varies in different plants as well as in different parts of the same plant. Hence a simple analysis of a feeding stuff does not always determine its true food value. For this reason additional investigations were found to be necessary. Just as in the determination of the available plant food of a soil the plants are brought into requisition, so here experiments had to be made in connection with various domestic animals in order to determine the amount of these ingredients which served as nourishment when taken into the system. Tables giving the coefficients of digestion of the constituents of the feeding stuffs, therefore, always accompany the tables of analyses. In addition to all this, experiments have been made with domestic animals to establish the best proportion and amount of these constituents for the purpose of maintenance and development as well as for the production of work, milk, flesh, fat, etc.

3. As in the case of commercial fertilizers, here again the work of the chemist controls the sale of concentrated feeding stuffs, so that the purchaser of these valuable commodities, which are thrown upon the market in immense quantities, is insured against adulteration.

With all of this information at his command the intelligent animal husbandman can utilize his store of feeding stuffs, and, if necessary, by purchasing others, prepare the proper rations for insuring the best and most economical results.

Chemistry has aided agriculture in many other ways. The establishment of new industries like the manufacture of glucose, which annually insures a market for the surplus production of agricultural crops, may be mentioned. Of much greater importance to agriculture has been the establishment of the beet-sugar industry, since it opened a field for the production of a new agricultural crop on an immense scale. From an almost hopeless beginning this industry has by the aid of science gradually grown into one of the leading industries of the world.

When the German chemist, Margraf, examined the garden beet it was found to contain only about four or five per cent. of cane sugar. By careful selection and analysis of mother beets, selecting only those for seed which revealed the highest content of sugar, the quality of this sugar-producing plant was gradually improved. When the writer was a student Professor Wagner, the celebrated technologist of Germany, found, upon analysis, individual beets with a sugar content of twelve per cent. He at that time expressed the hope that by continued effort in the improvement of the beet this exception might prove to be the rule. The results to-day far exceed his expectations. Individual beets have been grown with a sugar content of twenty per cent., and it is safe to say that in the best sugar-beet countries the average content of sugar of beets delivered at the factories reaches sixteen per cent. The gradual improvement in the quality of this plant can be seen from the following statistics. For the production of one ton of sugar there were required:

In 1836	18 tons of beets.
In 1842	16 tons of beets.
In 1857	12 tons of beets.
In 1871	11 tons of beets.
In 1894	7½ tons of beets.

At the present time under favorable conditions less than seven and one half tons of beets are undoubtedly required to manufacture a ton of sugar. To show how this industry has grown in importance it is only necessary to say that of the total production of sugar of the world in 1905, amounting in round numbers to thirteen millions of tons, seven millions of tons were produced from sugar beets.

Other plants are no doubt capable of a similar improvement, and in this connection the writer refers with great pleasure to the work of, and result in, corn-breeding inaugurated by Professor Hopkins, of this institution. The production of corn rich in starch for the manufacture of starch, alcohol and glucose, and rich in protein for the stock-feeder, will add immensely to the value and usefulness of this staple crop.

Chemistry has rendered a great service to agriculture in furnishing the means of combating the insect and other enemies of fruits and crops of various kinds.

The liberal use of insecticides and fungicides has saved many agricultural crops from utter annihilation and has been instrumental in greatly increasing the yield and improving the quality of agricultural products.

Weeds constitute another enemy of the farmer's crops. Where cultivation can be employed throughout the growing season weeds can, of course, be kept down. But in the growing of small grains and grasses this method of destroying them is impossible. In some countries the yield and quality of this class of crops are greatly reduced by weeds. But chemistry has apparently found a way to remedy this difficulty. The latest achievement in this respect is to spray the growing crop with the solution of a chemical which kills the weeds and does not injure the crop. The chemical employed for this purpose is ferrous sulphate in a ten-per-cent. solution. It does not injure cereals, corn or even grasses and clover, but destroys or retards the growth of the most noxious weeds to such an extent that the yield of crops has been increased twenty per cent.

One of the greatest services which chemistry has rendered to the amelioration of the farmer's vocation is the protection assured against artificial and fraudulent imitations of numerous genuine products. A few of the most vicious abuses, through which the farmer and consumer suffered alike, were the sale of oleomargarine for genuine butter, which almost destroyed the dairy industry; the sale of artificially colored distilled vinegar for cider vinegar, which caused millions of bushels of apples to rot in the orchards of the country; the sale of glucose for maple syrup and honey; the sale of skim milk for whole milk; and the sale of skim-milk cheese for full cream cheese.

It is gratifying to refer to the aid which the governments of all civilized nations have given in recent times for the purpose of elevating and perpetuating the art of agriculture, the industry most important to the welfare of humanity. Agricultural colleges and experiment stations, agricultural departments, both national and state, have been established and richly endowed. These are filled with earnest and honest investigators, who are working diligently and faithfully to disseminate truths, already established, among the rural population and to discover new ones, by which this noble vocation may be advanced. May the good work go on.

H. A. Webber

RELATION OF CHEMISTRY TO THE INDUSTRIES

I am gratified that an opportunity has been given me to be present on this occasion and take part in the installation of the new head of the department of chemistry of this great university. To me it is a matter of no little significance, and to all of us, interested, as we are, in the promotion of the work of the institution and its material and scientific progress, it is almost the beginning of a new era in its development. We may congratulate ourselves that the officers charged with the duty of seeking out and appointing the new incumbent, should have had such good fortune in their search, and should have chosen so well. But I know you will sympathize with me when I say that the pleasure and gratification which comes to us now must be tempered by the remembrance of the real cause which brings us together: the early and untimely removal of the late head of the department. To me it brought keen sorrow. I knew Dr. Palmer as a youth, just emerging into manhood. Earnest, enthusiastic, industrious and skilful, he came to his work with qualities of mind calculated to make him a leader among his fellows, and to cause him to quickly take a high position in his chosen profession. A persistent reader of the literature even in his student days, a deep and accurate thinker, a rapid manipulator, confident of the accuracy of his results, he was able to accomplish more within a given time than most men; and all this, combined with a vivid and useful imagination, made possible for him splendid progress in research and opened for him a career which must certainly have placed him in the forefront of the profession, and made him a leading chemist in his country and in the world.

As a teacher the same qualities made him successful. Students respect and follow successful men—men who work earnestly and produce useful results. Such results were manifest as an outcome of all the efforts Dr. Palmer put forth. While we mourn him personally as a friend and colleague, we realize the loss to the world of chemistry and the industries, caused by his death. But in this case particularly we must realize that the oft repeated adage, "The evil that men do lives after them," must be modified, and we may say, "The good he has done lives after him," in the men he has trained, in the results of his investigations, in the publications of his work now within our reach, in his influence upon the standing and position of the university generally. We may congratulate the university and its corps of administration and instruction that so many of her sons should have been so influential and instrumental in establishing the splendid position she occupies in the eyes of her graduates and the world at large.

I have been invited at this time to discuss the relations of chemistry to the industries, and in this, to me, most interesting duty, to occupy fifteen minutes. It is fair to remind you and the committee having these exercises in charge that this has, more than once, been the subject of an encyclopedia of many volumes, that it constituted one of the most important departments of our late national census, reported in several hundred quarto pages. To adequately discuss the subject, therefore, I should be forced to trespass upon your good nature and the wishes of the committee; the day would be all too short, and your patience and strength, as well as my own, would be sorely taxed. You may not expect me, therefore, to offer more than a syllabus of what might be said in the several hours or the several addresses which should be allotted to the subject.

The head of the department will, I hope, have many years to exploit it, for to be fully successful he may not avoid these relations omnipresent. The utilitarianism of our age makes it important that theory and practise, science and industry, shall go hand in hand to insure progress on either side. The good flowing from the relation in question is reciprocal. If the science of chemistry has furnished the industry with knowledge and facts and suggestions, the practise of chemistry in the industry by its needs, by its difficulties, by its successes, has furnished to the science suggestions, facts and knowledge which have been helpful, stimulating and inspiring. The best that can be said of the relations of chemistry to the industries is, the closer they are the better for both. The necessity arising from the large production of wastes in the manufacture of illuminating gas, the utilization of coal tar, which had become an intolerable nuisance, led simultaneously to the establishment of the great color industries, with consequent stimulation of all the allied industries, to the development of the chemistry of the carbon compounds in general, and furnished materials through the study of which the laws of modern chemistry could be worked out and confirmed. It is well known that many of these materials could be produced only when operating in a large way in manufacturing establishments and by methods available only in the industries. It is in this way, as well as others, that the industries have been helpful in the development of the science. But reciprocally the science and its methods, abstract research in the laboratories, have been helpful, nay, necessary to the industries. This is splendidly illustrated in the memorable address of Professor Crookes before the chemical section of the British Association for the Advancement of Science, in the meeting in Bristol, in which, sounding the note of alarm regarding the possible deficiency of the bread supply of Great Britain, due to shortage of nitrogenous plant food in the wheat fields, and advocating the proposed parliamentary legislation for the establishment of national granaries in which supplies of wheat could be stored for protection against national famine, he described methods and apparatus used by himself in abstract research and later by Lord Rayleigh in the search for argon, methods and apparatus whereby atmospheric nitrogen and oxygen could be made to combine with each other with expenditures of energy so low as to make the utilization of atmospheric nitrogen a commercial possibility at costs as low as or lower than the element could be supplied in combination in niter from the celebrated deposits of Chili, until then the sole source of economic supply after the exhaustion of the guano deposits of the world.

The combination of nitrogen and oxygen of the atmosphere through the intervention of the electric arc and the silent electric discharge or under the influence of electrical tension has become commercially an accomplished fact, and other means for fixation of atmospheric nitrogen in forms available for plant food have been worked out, notably the process of Caro and Frank, whereby nitrogen is made to combine with calcium carbide to form calcium cyanamide, since proved to be as efficient for plant food as calcium nitrate or ammonium sulphate. The research laboratory was the direct means for producing these brilliant and immediately useful results. So also the biological studies of Berthelot, which led to the discovery of the nitrogen-fixing bacteria of clay soils; of Wilfarth and Hellriegel, which led to the discovery of nitrogen-fixing bacteria of the root nodules of leguminous plants, notably of clover; of Muntz, which led to the discovery of the nitrifying bacteria of soils, through the agency of which the nitrogen of organic matters and ammonia is changed to the nitric combinations, in which alone it is available for the uses of vegetation. All these have done their share to reduce and remove the threatened danger which Professor Crookes justly saw and which has now been unquestionably removed by the discoveries, then far from commercial attainment, he at the same time described. Abstract research is still essential to progress in the industry, even as it was in his day recognized to be by the great Napoleon, who, realizing that political supremacy is largely, if not wholly, dependent upon industrial supremacy, called to his aid, after the establishment of the celebrated continental blockade, all the great minds of the institute and the academy, to devise and develop means whereby the needs of his empire could be wholly met by internal resources, and out of this grew many of the great industries of France and the world generally: the beet-sugar industry, the madder crop, the production of indigo, the development of the textile industries, particularly in linen and wool. This necessity of industrial supremacy to the assurance of the political supremacy has been recognized by other great statesmen and leaders. What Napoleon saw, the great German Kaiser of the present day saw when he urged and insisted upon the establishment of the engineering doctorate of the universities of his empire, and Senator Morrill saw when he urged upon the Congress of the United States the enactment of the great land-grant law for the establishment of the colleges of agriculture and the mechanic arts, from which this and other great universities of the land have grown. This is, furthermore, what Congressman Hatch saw when he proposed to and urged upon the congress the enactment of the law providing for the establishment and support of the agricultural experiment stations to be devoted to scientific research and the more intimate study of the problems of agriculture pressing for solution; and it is what van Rensselaer, Cornell, Packer, Pardee, Johns Hopkins, Harrison and Rockefeller saw and felt when they made generous provisions for the great universities and schools of technology for training young men in the sciences in their relations to the industries and the arts of human life. It is such genius and its applications which insures the world's progress.

Genius has been defined as "capacity for hard work." It is far more. It is a keen and active imagination combined with industry, energy and ambition to bring to fruitful realization the product of a trained imagination. This leads us to some of the needs of modern education in its relations to our subject. Genius as thus defined and described must be developed in the student of this age. The imagination must be trained and directed, the judgment strengthened. Thus genius becomes a keen and trained imagination, combined with good judgment and an industrious habit, with energy to bring to fruition the work of the imagination. So we should educate our students to the importance of a clear and exact knowledge of the work of others as recorded in literature, for progress means building upon the work of others. They should then be trained in the judicious and scientific use of the imagination suggested by the great Tyndall, whereby they may be able to see how the accomplishments of others may be extended and utilized. Then the power of observation must be developed, and hence the need for and usefulness of the research laboratory, happily recognized more and more as the years pass, in the systems of education and in the organizations of the great industries. It is interesting and inspiring to one concerned with educational matters to see how far the research laboratory is being attached to and made part of the manufacturing plants of this and other countries. It has been claimed that the research laboratories have been the foundation stones upon which the great structure of the German chemical industry has been reared, and the claim can not be questioned. It was inspiring, upon a visit to one of the great chemical works of Germany, where more than 3,000 hands were employed, to see an entire, large, well-arranged, well lighted and ventilated building devoted wholly to abstract research in lines related to the industry, occupied by hundreds of chemists engaged in the work for which the building was provided. And it was even more interesting to follow the results of the research carried on in the several laboratories of that great building.

In this connection we may call attention to the brilliant work lately reported by Professor Harries, of the Technical High School of Charlottenburg, Germany, in the study of the constitution of caoutchouc, or india rubber. By oxidation of the pure gum with ozone he was able to produce what he named its diozonide, and this by proper treatment was converted into levulinic aldehyde, which in turn was oxidized to levulinic acid. This, Professor Harries reminds us, can be obtained more readily and cheaply from starch than from any other material, and he suggests that by a series of deoxidations and condensations, starch may be converted into caoutchouc, which has become so useful and almost indispensable in the industries and yet is provided in such comparatively limited quantity in nature that there is almost a dearth of it in the world's market to-day. It would be interesting, indeed, if we should come to depend for our india rubber supply upon the cornfields of Illinois, the prairies of the Mississippi basin and the manufacturing laboratories, rather than, as in the past and now, upon the jungles of Africa and South America. Yet the production of india rubber from corn starch would be no more remarkable than the production of alizarine and indigo from coal tar. The research laboratory is the source from which artificial alizarine and artificial indigo sprang; the same source may be the starting point of the production of india rubber from indian corn.

What may we expect from the recent announcement of Professor Ramsay that under the influence of the radium emanation copper may be broken down with the production of potassium, lithium and calcium, thus suggesting a new source for potassium compounds, so useful to farm crops?

Other products and questions await the magic touch of the research chemist. Who for instance, will take care of and utilize the comparatively large quantities of selenium and tellurium, thus far so little studied and now so largely issuing as a by-product of the manufacture of vitriol and the refining of copper? Here is abundant supply of raw material to be had from the industry by the research chemist for the asking. Again, who will supply the volatile combustible required to make up the shortage of supplies of petroleum products needed for use in the internal combustion engines, upon which the future must largely depend for inexpensive power? Who will furnish other products sorely needed in the world if not the research chemist? In this connection I am again constrained to quote the inspiring words written by the editor of the *Wall Street Journal* under the caption "Science as a Financial Asset." Among other things this accomplished editor said:

Science as a source of strength in promoting private wealth and public welfare is the one thing that draws the line of demarcation between ancient and modern times. That was a belated mediæval, not a modern, outburst of popular wrath against which Lavoisier's friends appealed for his life on the ground of his scientific service to the French state. The powers then in control then replied that the republic had no use for chemists. Far more like modernity is the declaration of a German chemist that "scientific research is the greatest financial asset of the fatherland." Germany's economic progress proves that he was at least nearer right. The sciences in general have been among the greatest emancipating forces, because they have helped to overcome man's fear of nature, which kept him from utilizing the forces of the world about him, and because they disclosed elements of the highest value to the world in their most practical forms. It has been well said that if we were to take away what the chemists have contributed, the whole structure of modern society would break down at once. Every commercial transaction in the civilized world is based on the chemist's certificate as to the fineness of gold, which forms our ultimate measure of values. Faith may remove mountains, but modern society relies on dynamite. Without explosives our great engineering works must cease and the Panama Canal, no less than modern warfare, become impossible! Chemistry has made possible the transportation systems which span the leading countries of the world. It has made it possible to turn to man's service the wealth of the mineral world. By analysis of plants and soils, the waste materials of the world have been brought to the growing of crops. Indeed, every great industry, whether it be farming, manufacturing, transportation or mining, would almost immediately relapse to barbarism if the secrets of the chemist and physicist, the geologist and mineralogist, could be gathered up and cast into the sea.

This estimate of the work of the research chemist has our hearty sympathy and it brings much of inspiration and encouragement. It justifies all that the rulers and legislators have done for this and similar institutions and loudly calls for generous support in the future. It expresses appreciation of the work done in this university, which has made such magnificent progress under the direction of its present very efficient head and the splendid promise for its immediate future. All here present will, I am sure, heartily join me in wishing for the university and for its department of chemistry no diminution of the splendid prosperity which has attended the efforts of its excellent administration in the recent past.

William McMurtrie

CHEMICAL RESEARCH IN AMERICAN UNIVERSITIES

Gathered here to-day to celebrate the installation of one of our prominent American investigators as director of chemistry in the University of Illinois, we should not do justice to the occasion if our thoughts did not turn to the serious meaning of this event for the future of chemical research in our universities. I have thought to devote the few minutes, during which I shall have the pleasure of addressing you, most usefully to the consideration of some conditions affecting the future of chemical research in our American universities.

Before this audience I need make no lengthy plea of justification for the demand for research work in chemistry in our universities, either on the ground of economic considerations or from the standpoint of our highest ideals, as expressed in the struggle of the human race for enlightenment on itself. As Professor Theodore W. Richards recently said in his inaugural lecture at the University of Berlin:

> All the manifold experiences of the human mind are intimately connected with the presence of that which we call material, enlivened by that which we call energy; and the ultimate deciphering of the great mystery of life will depend just as much on the understanding of these as upon the study of the mind itself. Thus modern chemistry should be regarded not only as bringing to medicine and the useful arts its obvious and multifarious contributions, but as occupying also an essentially important place in the realm of intellectual speculation.

After Dr. McMurtrie's address it is unnecessary to say much about chemistry in the field of economics. It is a trite fact now that the industrial and commercial supremacy of Great Britain is threatened most dangerously by the wonderful growth of manufacturing in Germany. Englishmen, noting this in the face of the fact that they themselves are rather favored in the matter of natural resources and wealth, are attributing the great strength of their competitors almost entirely to their splendidly trained army of chemists. A significant fact is that this onward march of the German industries is characterized by much of the same fearlessness and supreme confidence of victory as was its march on the unprepared armies of France forty years ago; and for much the same reason—again, it is splendidly organized—organized in the matter of trained scientists, chiefly chemists; its industrial adversary is not—as yet. Chemistry, in some form or other, enters into the production and manufacture of almost all the great articles of commerce—from the raising of wheat and corn on soils scientifically analyzed and fertilized, to the making of steel and all iron materials, from the preparation of brilliant dyes to that of common leather, from the drugs of our sick days to the food products of our daily life—all can be developed best under the direction or with the help of able chemists, and, what is equally important, all, without exception, are capable of vast improvement under the seeing eyes of the chemist, trained to observe closely, to reason accurately, to think originally, to experiment rigorously—trained, in a word, to do research work. German universities and polytechnic schools are turning out such chemists, doctors of philosophy, by the hundred—men trained to investigation, so that they can improve and develop new ways for actual work of manufacturing, instead of merely using and transmitting traditions. No branch of industry in Germany need want for such men—their numbers and usefulness are seen best from the fact that a single great factory, the Badische Anilin und Farbenfabrik, had in its employ one hundred and fifty such chemists in 1900. There can be no doubt in the mind of any political economist that a country so thoroughly equipped with scientifically trained chemists and with schools for developing them must have an enormous advantage over competitors that lack both or have them only in lesser degree. But such men can receive their final training at universities only from men who are investigators in their branch of work: the critical attitude of mind, the inspiration to originate, the training to convert the new idea into the new result can come only from men who have thought for themselves and worked out their own problems—from research men in our universities.

American universities are feeling the pressure of a growing demand from our industries for such trained investigators, and with this outside pressure and the inner call to do our share toward the elucidation of the great problems of humanity the last years have also witnessed a rapidly growing and insistent demand for research men to fill important university positions; not every university in recent times has been as successful and fortunate as is the University of Illinois in meeting this need; indeed, there is a very decided shortage of men of proved ability to do and direct investigative work in chemistry, and we may well ask why this should be so and what remedy we have for such a condition in this country. Turning only for a moment to chemical research as it was here twenty-five years ago, the better to understand present conditions, we find at that time only here and there in our universities a man of note carrying on systematic investigations in chemistry: Remsen at Johns Hopkins, the Gibbses at Yale and Harvard, Cooke, Hill, Jackson, Morley, Long, Michael and Ward, only a handful of men devoting their lives to chemical research as an article of faith. Universities at that time did not demand that their chemistry professors should be investigators, and they were, as a rule, instead, technical experts, analytical chemists—thorough, capable, honest men, but engaged in as extensive and as profitable commercial work as the head of any commercial laboratory. As a matter of fact, we had then practically only one real university, devoted to graduate work as distinguished from college work, and that was Johns Hopkins, our pioneer American university; although, as stated, graduate and research work were also carried on to some extent at Harvard, Yale and a few other places. The greatest recent impetus to all branches of research, including chemistry, came in this country, in my opinion, from the founding of Clark University with research as its chief and almost exclusive field and from the founding, only two years later, of the University of Chicago with its strong graduate school, strong not only in its faculty, but, unlike Clark, also in its student body. By one great effort at once a great college as well as a university, its founding stimulated the development of the graduate schools in the older universities of the east which were also both colleges and graduate schools; the western universities have more slowly strengthened their graduate work or have just started to give graduate instruction, that is, to do real university work. With the development of our universities, in the last fifteen years of eager growth, chemistry in this country has given us the work of men like Richards, of Harvard, a second Stas on atomic weights, and in this same subject we still have Morley and also have W. A. Noyes, now of Illinois; in organic chemistry we have Nef of Chicago, with great new ideas powerfully influencing work abroad as well as here, Remsen and his students continuing the work of former years, and again, Noyes; in physical chemistry we have A. A. Noyes in Boston, Franklin at Leland Stanford, Bancroft, Hulett, our enthusiastic friend Kahlenberg at Wisconsin fighting nobly for a lost cause; in inorganic chemistry, Edgar F. Smith, Morse and again Remsen. There are about as many names again which could be mentioned and then our list of really prominent research men in chemistry at American universities would be exhausted—I am not including technical research men. With the older men, there are barely twenty men in all, directing strictly original research work in our American universities, work involving new ideas as well as the preparation of new compounds and salts. The supply is far too small to meet the demand, and in view of the importance of the subject, this condition, unless improved, presents a distinct menace to our educational and economic development. A second significant fact is that with the exception of two or three men working under particularly favorable special conditions, the productiveness of our research men is by no means commensurate with the output of an equal number of men in Germany. An impartial scrutiny of the situation shows unmistakably serious defects in our American conditions which must be removed if chemical research is to flourish here as abroad and if able men are to be attracted in sufficient numbers to a life devoted to research and research instruction.

Contrasting the conditions in German universities with ours, we find the American professor, as a rule, overburdened with an excessive amount of routine work, consisting of lecturing, laboratory instruction and administrative duties. Some teaching must be considered as essential for the welfare of the investigator: in presenting his subject before a critical student body, he is held to an iron logic, he must ever go to the very foundations of our science and, detecting a weak point here, a missing link, a circle proof, a traditional rut there, his mind continually receives ideas for critical work on the very essence of chemistry. But every profound investigation requires a degree of abstraction and absorption as great as that demanded for creative art. And for such work the best powers of the brain are obviously needed: but, after lecturing two hours or giving laboratory instruction for half a day and attending to innumerable petty administrative details, that best power is gone for the days, and each year is made up of just such days or worse in most of our American universities; the mental alertness, the critical and creative faculties, are wasted on routine work, which to a large extent could be done as well or better by a different type of man. Now, in Germany, as I knew it, the great investigators lectured at most once a day, their laboratory instruction was limited to research students, the instruction of all the other students in the laboratory being left wholly in the hands of other men, able men of rank and training, not inexperienced assistants. Then, only a little over half the year was given to academic work, almost half the year being left, not for recreation—a few weeks sufficed for that—but for that intense, absolutely undisturbed work required for the creating mind.

A second important factor in the productiveness of our American chemists as compared with those abroad is found in the problem of research assistants; the creative imagination of the investigator in chemistry must always be held in check, as Richards has said, by experimental realization of the logical outcome of his flights of fancy; but chemical experimentation is one of great minuteness, infinite attention to details and endless preparation. Where the German investigator can have, when he needs them, several assistants, ranking from a newly fledged doctor of philosophy to an associate professor when necessary, a single research assistant in chemistry has until recent years been a rare specimen in America and even now the species is not flourishing—it is being starved to death, by low salaries. From presidents who are chemists down to the least of us, we all have our troubles in securing just one of them; the demand for two would perhaps prostrate the authorities. And yet it would be the economic thing not to limit our investigators to one assistant, for men like Nef, Richards, the two Noyes, can direct half a dozen assistants as well as one, and by the present system their productive years are, to a large extent, simply being wasted. But, unless we secure conditions for a large measure of success and productiveness, chemical research in our universities will never attract our best Americans in sufficient numbers to satisfy the minimum demand of our country for able investigators in academic and in industrial lines—and that is the point of my argument.

The last condition I ought to refer to in this connection is one that has caused a wide-spread sentiment of uneasiness in all our universities—the question of the financial side of an academic existence. This serious question, common to all branches of academic research work, is receiving careful attention from our ablest university presidents, and I will leave it entirely in their wiser hands. It is an important factor in regard to the very point raised, the necessity of attracting our able young manhood to supply the country's need of investigators.

I have tried to point out what I consider the three most essential needs for the development of American chemical research on a plane worthy of our country, on a plane which will enable it to do its share towards the intellectual progress of our race and which will also prepare it for the great commercial struggle of the future: relief of the investigator from an untoward burden of routine and administrative duties; the exploitation of the talents of these gifted men by the employment of a proper staff of research assistants; a proper remuneration, that worry for the future of his family—he cares, as a rule, little for himself—may not impair his usefulness.

The University of Illinois, in selecting a man with the ideals and the capacity of William A. Noyes to develop its work in chemistry, has definitely joined the ranks of those universities which are committed to the attempt to give the highest kind of instruction in chemistry, instruction which will turn out, not artisans, but artists—chemists. In bringing Dr. Noyes here, the university has, as I understand it, wisely kept in mind as far as possible the three conditions for successful work which I have tried to outline. The University of Chicago greeted with the greatest satisfaction the selection of your excellent president to be the head of this institution; we knew he would strengthen Illinois, that he would undertake to raise its standards to those of the best universities of all countries; we rejoiced, not only unselfishly in the satisfaction of seeing the promise of a noble work, but also selfishly; for the higher the ideals of our neighbors, the higher must be the plane of our own lives—in institutional life as in private life. In the same way, I would say on behalf of the chemists of the University of Chicago that we heartily welcome the promise of a strong department of chemistry here; many links of friendship already bind our faculties; our joint efforts to advance the ideals of chemical research and instruction will surely cement still closer these ties!

Julius Stieglitz
The University of Chicago

TEACHING OF CHEMISTRY IN STATE UNIVERSITIES

A new epoch in chemistry has begun in the United States. Development along the lines of pure, industrial and applied chemistry is everywhere evident. The interest now taken by our universities, by our great industries and especially by our national government, bears evidence of wonderful progress. During the past decade, however, the Americans have asked themselves why other countries which can not be compared with our own in wealth and natural resources have surpassed us in nearly every phase of manufacturing and industrial chemistry. Indeed we can not understand how it has come about that the United States, by far the richest country in the world, is so far behind Germany in nearly all lines of manufacturing chemistry.

To one familiar with the European and especially the German industries, the answer seems comparatively simple, depending upon only a few principles, some of which I wish to briefly preface at this time. Germany leads the world in chemical industry, because of her persistent scientific study of every phase of industrial work. For nearly a century her watchword has been "science, industry and economy." She has spent all of her energies along applied chemical lines, and has brought to bear every possible resource which could be utilized in the furthering of her manufacturing conquests. She has long since realized the fact that to take an active part in the industrial world power, she must match her science against the wealth and natural resources of other rich countries like our own. That she has succeeded is borne out by a glance at her export statistics.

By far the most important factor in the development of the chemical industries in Germany has been her universities. The German universities have perhaps cost the nation more than any other one institution, except her army. Unlike German militarism, however, the universities have been the best financial investment the nation has ever made. For two hundred years these great universities have been the nerve centers, yea, even the very brains, of the whole nation. During the last century they have played a unique and important part in this wonderful industrial development. Without them, her mineral industries would not be worth a passing consideration. Without them, her coal-tar, her beet-sugar and scores of other great industries would, in all probability, barely exist to-day. Without them, Germany would still be a fourth instead of a first class industrial power. Without them, I doubt if the nation could have lived through the fierce storms which have, from time to time, swept over the empire. Without losing the dignity of the university, without losing the highest ideals of scholarship, they have joined the purely scientific with the commercial side of the nation, bringing about conditions which have completely changed the life, the financial and social conditions, of the nation. This wonderful change has been brought about as Van't Hoff has well said, "entirely by a hearty cooperation between the scientific laboratories of the nation and the technical and industrial work."

But other nations have universities. Why have they not done for their respective countries what the German universities have done for Germany? The United

States, for instance, has more universities than Germany. Why then is the United States behind Germany in this industrial race? The answer, I believe, may be found in the fact that the American universities and colleges as a whole have not until recently fully realized the fact that the old idea of scientific culture in this present materialistic age is not what is demanded by the nation. University men now fully realize that scientific training of the old culture type, and more especially in chemistry, is worthless to the nation and worthless to the individual except in so far as the mental discipline goes. But simple discipline is not the sole aim in the study of any science. It must embrace experience and a true knowledge of the subject, such as will enable the individual to apply the principles in practical life. It is only when this training is applied that its full value is appreciated by the individual himself and by the nation. Didactic chemistry as taught twenty-five or thirty years ago can no longer be accepted by the universities of to-day. A glance into the history of chemistry will show that no scientific investigation has ever been made, either in the so-called field of pure or in that of industrial chemistry, which has not had its influence on the material development of the world. In fact, a discovery in chemistry or, as a matter of fact, in any other science which does not leave its impression upon the world, which does not help to bring humanity nearer ideality, from both the social and industrial standpoint, which does not directly raise the standard of civilization, is not worthy of being called a discovery. Our universities and colleges as a whole do not at the present time fully appreciate this fact. Our universities are just learning that the scientist and technologist are not born, but made by half a life-time of hard study, and that the universities alone are able to offer this scientific training. The teaching of science in our universities, therefore, is paramount in the industrial and material development of our country.

In taking up the teaching of chemistry in the United States, I can not, I think, do better than to give a brief outline of the conditions under which chemistry has been taught in some of our state universities during the past twenty-five years.

It is a striking but lamentable fact that until the last few years the practical chemist of the United States was essentially a self-made man. He had perhaps taken a course or two of chemistry in his university or college, but rarely had he studied chemistry from the applied standpoint. Therefore, after graduating he was compelled to begin as an apprentice and to spend several years in learning the things which should have been taught to him in his university course. University work twenty-five years ago meant, in a large majority of state universities, the study of Latin, Greek, mathematics and history, with a smattering of modern languages. Seldom did a university curriculum include the study of science except so far as it represented simple didactic training. Applied chemistry was not considered worthy of being placed in the college curriculum.

I distinctly remember my first impressions of chemistry, as offered in one of our state universities. We studied general chemistry by the old didactic methods. Our first lesson was to commit to memory the atomic weights of the common elements. (Imagine a man in the University of Illinois spending the first week of his general chemistry course in committing to memory the atomic weights.) We had no laboratory experiments except those performed by the professor, and these were performed in such a way that the underlying truths were entirely lost to the student. In fact, the only experiments in this whole course which left an impression upon the class, were those with hydrogen and oxygen which some of the students prepared for the professor while he was out of the lecture room. And I think I am not doing the kindly professor an injustice when I say I firmly believe that these experiments were the first to leave lasting impression upon him. Not a word in that whole course in chemistry was said which conveyed to the minds of the students the idea that chemistry was for any other purpose than to be simply dabbled with in college laboratories; not a word was said which conveyed to the minds of the students the fact that the laws and principles which we were studying were the foundation stones of our great industrial structures; not a word which impressed upon us the fact that we were studying the very substances from which our own bodies are made, from which the whole universe is made; not a word concerning the possibilities of the new chemistry; not a word which would indicate that there was anything more in the whole realm of chemistry than that found within the covers of a small elementary text. My surprise was all the greater when a few years later, I sat before a man with a thorough knowledge of industrial and practical chemistry.

The above is a fair sample, I think, of the methods of teaching chemistry in a majority of our state universities twenty-five years ago. In fact, very little progress had apparently been made since the introduction of laboratory work into the United States some twenty-five or thirty years earlier. In 1850 there were, so far as I can learn, only four or five institutions in the country which could boast of a chemical laboratory, and these were equipped in the most primitive way. Yale College had a small laboratory barely large enough to accommodate a dozen students. Amherst had just opened a small laboratory and Lawrence Scientific School likewise had a very imperfect one. There were, perhaps, two or three other institutions which had so-called chemical laboratories. There were, however, no systematic courses of study such as we find in our universities to-day, and no courses in applied and industrial chemistry. Students who were desirous of a systematic study of chemistry and more especially along technical lines, were forced to go abroad. With the exception of these few institutions the teaching of chemistry was entirely didactic. It is not surprising, therefore, that little or no progress should have been made during the next twenty or thirty years in the teaching of chemistry.

I do not mean to say that there were no great teachers of chemistry during these pioneer days. Such a statement would be incorrect, for there were men who stood out in chemistry during the fifties, sixties and seventies, as prominently in our own country as Liebig and Wöhler did in Germany during the early part of the century. Such men as Silliman and Cook stood out preeminently during the fifties and sixties, while men like Elliott, Remsen, Chandler, Morley, Mabery, Mallet and others have given the institutions with which they were connected such a standing as to place them on the same plane with the older institutions of Europe.

In this early epoch, practically none of the state universities of the center and middle west had reached a point where they could offer to the student good practical courses in chemistry. One reason, I think, was a lack of well-trained teachers, but the chief reason was doubtless an economic one. The state universities turned out few skilled chemists because there was no demand for such men in the center and middle west. The great industrial institutions were not compelled to resort to science and to the reclamation processes in order to earn large dividends. The trained chemist had not yet entered on the industrial stage. He did not hold the great industries in his hand as he does to-day. Furthermore, the state universities were scarcely able to train such men had there been a demand. They were struggling to keep up with the rapidly growing population of the state, and little more could be done than to teach general chemistry in crowded and poorly equipped laboratories. In fact, the state universities of the center and middle west twenty-five years ago were supported by the state as belonging in the same class as reform schools and institutions of similar nature. The state had not yet come to realize that the university is its best investment, not only from the mental and moral but also from the strictly commercial point of view.

The state universities, I think, occupy a position quite different from any of the other educational institutions. They are a part of the great commonwealth, they belong to the people of the state and hence must, if they fulfill their obligations to the state, not only train men and women for civic but also for purely scientific and industrial life. Neither must be neglected. During the past decade practically all of the state universities have come to realize this fact, and nowhere in the world has there been such rapid development along the lines of both pure and applied chemistry as in these institutions. The teaching of chemistry in these rapidly developing states has naturally and properly taken an industrial trend. There is not a single state university to-day which is not, besides doing research work, materially assisting in the industrial development of the state from which it receives its support. It is no longer difficult to obtain appropriations to well equip laboratories, as is evident from the splendidly equipped laboratories of the University of Illinois.

Of all these great unversities which have become not only great educational but also important industrial factors within the bounds of the states from which they receive their support, the University of Illinois stands among the first. Situated in the center of a great industrial population where trained men are always at a premium, its opportunities are boundless. It is bound to play an even more important part in the chemical development of the country in the future than it has in the past. With the man at the head, whom we have gathered here to-day to honor and bid a god-speed, I do not believe it is possible to predict too much for this university not only in purely didactic but also in industrial and applied chemistry. None of the branches of chemistry which must be taken up by this state university are new to him. He is the peer of Elliott or Remsen in didactics and of Silliman and Chandler in industrial chemistry. No man in the whole country is better fitted to take up the broad lines of chemistry now demanded by the state university. I congratulate the University of Illinois and the whole state in securing Dr. Noyes as standard bearer, and with such coworkers as Parr, Grindley, Bartow, Lincoln and Curtiss, this university will stand second to none of the state universities in preparing young men and women for the work demanded by this great state and by the whole nation.

George B. Frankforter
University of Illinois

THE CONTRIBUTION OF CHEMISTRY TO MODERN LIFE

I think that few who have not paid especial attention to the subject realize how completely the world, as a place to live in, has been transformed during the past century. This transformation rests for its basis almost entirely on our fund of scientific knowledge, and especially upon the knowledge of physics and chemistry and biology which has been accumulated by scientific workers during the past seventy-five years. I wish to say something to you, this afternoon, of the part which chemistry has had in bringing about this wonderful change in our surroundings.

Our science goes back to the dark ages and before for its beginnings, but we, as chemists, haven't much reason to be proud of our intellectual pedigree. From the fifth to the fifteenth century, those who were known as chemists, or rather as alchemists, spent their time in searching for the philosopher's stone, which should change all things to gold, or for the elixir of life which should give eternal youth. The object which they sought was a sordid one, and while its attainment was quite generally believed to be possible, we have reason to think that many of the alchemists used the little knowledge which they possessed to deceive others more ignorant than themselves. We have been accustomed to say that our fuller knowledge has shown the folly of the alchemist's dream. Five years ago a distinguished chemist, in a public address, spoke of the doctrine of the transmutation of the elements as dead and every chemist who heard him agreed with his statement. But such revolutionary and startling discoveries have been made since then that a transmutation of the elements must now be considered as an accomplished fact.

This new discovery of transmutation did not come, however, along the paths the alchemists were following. Those paths were mostly blind alleys leading nowhere, though, now and again, some new fact about the way substances act on each other was discovered. And in spite of its obscure and mystical symbols and literature, and although the methods of experimentation were often more allied to magic and astrology than to science, alchemy left us a valuable inheritance of experimental knowledge. Many who took up the pursuit of alchemy from a desire for gold doubtless continued to work from a pure love of experiment.

In the sixteenth century some of those who had busied themselves with alchemy conceived the idea that chemistry might be of service to medicine. For one hundred years or more, the most notable of the chemists followed chiefly this new direction. They did not, however, discard the belief in the transmutation of metals. It was an age when authority still counted for very much and it seemed to them impossible to disbelieve the many circumstantial accounts of transmutation which had come down to them, often from sources that seemed thoroughly reliable. But, either because they despaired of success or because they found other things to do which seemed of more value, the chemists of this period turned their attention more and more away from alchemy and towards medicine and pharmacy. We may well doubt if their labors were much to the advantage of the suffering humanity of their time. Their crude empiricism and their wild and often mystical speculations as to the processes which go on in the body in health and disease were a poor basis for medical treatment. Doubtless many a poor patient fell a victim to their imperfect knowledge.

Thus far our science, such as it was, had followed utilitarian ends. The alchemist sought for gold—the medical chemist for new medicines. An embarrassing question often asked of a scientific man who has spent months or years of work over some problem is "What is the use?"—"Of what value will be the solution of the problem, if you succeed?" The contrast between the product of this thousand years of utilitarian science and the material results which have accrued during the two and a half centuries of better ideals is a sufficient answer, even from the material point of view—but I wish to protest against measuring the value of scientific work on the basis of dollars and cents.

About three hundred years ago there began to appear men who took an interest in the study of natural phenomena for the purpose of gaining a deeper insight into the nature of the world about them. There were, at first, very few men of this new type, and progress was slow in comparison with that of later times, but it was rapid when compared with the time of the alchemists. For these men were actuated by an entirely new and different spirit—the desire to *know* and the desire to gain knowledge that it might become freely the property of the whole world—and the knowledge they sought was not like that of the alchemist, whose aim was selfish and personal and whose greatest fear was that his secret discovery might become common property and so lose its value.

During the two centuries that followed there was a slow accumulation of chemical knowledge which passed freely among the few who had become imbued with this new spirit of investigation. During this period there was developed, too, the first really important generalization of the science—the theory of phlogiston which gave a qualitative explanation of the phenomena of combustion. This theory lived for more than a century and was useful in its time, but when the fundamental facts about combustion were discovered by Priestley and Cavendish and Lavoisier the theory was no longer needed. It was not displaced by a new theory, for the knowledge of the simple facts about oxygen and its relation to combustion was enough.

At the dawn of the nineteenth century Dalton gave to the world the next great generalization of our science—the atomic theory. This theory has been the central idea which has permeated the science and guided its development since that time. It has given to us a vivid picture which interprets and classifies for us the bewildering mass of experimental facts acquired by the work of thousands of chemists.

But while we find that this central guiding principle in the science was given to the world early in the century, there were as yet but few workers to cultivate the rich fields lying before them. There were no schools of chemistry, no great laboratories for instruction and research, such as we find to-day. But there were a few brilliant workers—Sir Humphry Davy in England, with his discovery of the alkali metals; Gay Lussac in France, with his laws of gases and discovery of iodine; Berzelius in Sweden, with his incredible achievements in the development of analytical methods and determination of equivalent weights. And for each of these there was another who gained from him an inspiration for scientific achievement—Faraday from Davy, Wöhler from Berzelius and Liebig from Gay Lussac. But Liebig did much more than go back to Germany to work in a laboratory of his own with perhaps an assistant or two. He founded in Giesen a laboratory for the training of investigators and it is scarcely possible to overestimate the importance of the influences which went out from that laboratory. To that laboratory came a company of enthusiastic young men gathered from all over the world. These men gained from their association with Liebig something of vastly greater importance than a knowledge of chemistry—they carried away an inspiration for research and an enthusiasm for the laboratory method of instruction. Largely from that laboratory as a center, chemical laboratories for the training of students spread throughout Germany and the world.

The fundamental principle of laboratory instruction is that the student comes into direct personal contact with the things about which he is to study and so gains first-hand knowledge. While chemists were the pioneers in this method of instruction, physicists and biologists soon saw its advantages and introduced it in those sciences. The principle has now permeated almost every line of teaching and we hear, to-day, of the laboratory method in history and psychology as well as in the physical sciences.

By the middle of the nineteenth century the methods to be used in training a band of chemists were being rapidly developed. And it came to be more and more clearly recognized that the training is not merely to give to the student a knowledge of chemical facts—it must give to him the power to think for himself and to strike out into new and untried paths. It is this power of individual initiative which is given to the students in the German laboratories that has placed Germany in the front rank in chemical manufacture as well as in research and instruction.

Some of the most important applications of chemistry in the industries were developed early, along experimental lines having little or no connection with scientific work. One hundred and fifty years ago, those who were smelting ores of iron and copper and lead and zinc knew very little of the work of the chemists of their day. And the same was true of those who were tanning leather, dyeing cottons, woolens and silks, burning bricks and pottery and china, making glass and working in many other chemical industries already well developed.

The soda industry was one of the first large chemical industries to be developed on a scientific basis. When we consider that the soda for our soap is now practically all made from salt, it seems hard to believe that one hundred years ago soap was made almost exclusively from the potash of wood ashes or from natural soda, the supply of which was very limited. I think we are forced to the conclusion that our great-grandmothers used very much less soap than we do. The first factory for making soda from salt was built by Le Blanc in France in 1791, but, partly because of the political conditions at the time of the Revolution, partly for other reasons, the factory was not a success. Le Blanc himself died a few years later, in extreme poverty, and it was not till 1823 that Muspratt established the industry successfully in England. From that time the Le Blanc process held undisputed sway till the early seventies. Since then it has fought a losing battle with the ammonia soda process, and to-day there is not a Le Blanc factory to be found in America. Now the ammonia soda is, in turn, being displaced rapidly by electrolytic soda. This sort of competition is typical of that which occurs in many chemical manufactures. In the case of Le Blanc soda it has been a most powerful incentive toward the improvement of the process. It has resulted in developing improved mechanical appliances for carrying out the operations, in the recovery of the hydrochloric acid and its use in the manufacture of chloride of lime and in the recovery of sulphur from the calcium sulphide. I visited a Le Blanc factory in England two years ago, where they told me that their sulphur for making the sulphuric acid used in the process came from Spain in the form of pyrites and that 85 per cent. of it left their factory as pure sulphur. In all this development the chemist has taken an ever-increasing part—in the development of new processes and the direction of old ones, and in that analytical control of raw material and finished product which has become indispensable in all kinds of manufacture.

The soda industry in its various branches was begun and has developed as the result of chemical work applied directly to the solution of technical problems. Since then it has often happened that work begun with the sole purpose of adding to our fund of scientific knowledge has led to important technical industries. The founding of one of our greatest industries began in this way, at the middle of the nineteenth century. In 1856 William Henry Perkin, then a young man of eighteen, was working in London as the private assistant of Professor A. W. Hoffmann. He was not satisfied, however, merely to spend the day on Hoffmann's researches and he fitted up a rough laboratory in his father's house where he could work in the evenings and in vacation time. Here, with a purely scientific interest, he tried some experiments which he hoped might lead to a synthesis of quinine. He got, instead, a dirty brown precipitate which must have seemed very unpromising. He became interested in it, however, and repeated the experiment with aniline. This gave him a black and still more unpromising product, but on examining it further he found in it a beautiful purple coloring matter which proved to be what we now know as the "Mauve dye." At that time, only fifty years ago, such a thing as an artificial dye was unknown, and we must marvel at the wonderful insight and energy of this boy who grasped the significance of his discovery and made it the beginning of the great industry of coal-tar dyes. After further study of the new compound and after practical tests in the dyeing of silk he gave up his position as Hoffmann's assistant and began the manufacture of the new dye. He was fortunate in having a father who had enough faith in the undertaking to risk almost his whole fortune on the venture, for it would have been hardly possible, then, to secure from outsiders enough capital for so hazardous an enterprise.

At that time benzene, the raw material for the manufacture, was not to be had in the market, of definite quality, and its distillation from tar had to be developed. Further, after the dye had been prepared it was quite different from the dyes then in use and methods for its application to silks and other goods had to be worked out. All these difficulties were finally overcome and within two years the mauve was supplied for the dyeing of silk. As soon as success was assured, others turned their attention in the new direction. Three years later magenta was discovered in France and soon after other dyes were prepared by Perkin, by Hoffmann and others. Hoffmann's discoveries of dyes are especially interesting because he thought that Perkin was making a mistake when he left him. And Perkin himself was much afraid that by entering a technical pursuit he would be prevented from following the research work in which he was so much interested. He determined, however, that he would not be drawn away from research, and in that determination and its imitation by others I think we may see the secret of much of the success of this industry. In no other industry are so many highly-trained chemists employed and in no other is the work so closely related to research in the pure science.

Twelve years after the discovery of mauve, Graebe and Liebermann succeeded in preparing alizarin, or turkey red, from the anthracene of coal tar. This discovery, again, was the result of pure scientific work undertaken without reference to its technical importance. The first method of preparation, too, was by a difficult process which was too expensive to be commercially feasible. As soon as the scientific problem had been solved, however, the question was taken up from the commercial standpoint and Perkin soon found an economical method for the manufacture of the dye. At that time large quantities of madder root were raised in Holland and elsewhere for the preparation of alizarin. It was soon found that the dye could be made much more cheaply from anthracene and within a few years the artificial alizarin drove the natural product from the market and the Dutch farmers were compelled to raise other agricultural products. So important is this dye that the value of the amount manufactured in 1880 is given as $8,000,000. It is estimated that it would have cost $28,000,000 to manufacture the same amount of the dye from madder root. This means that the world saves $20,000,000 a year in the manufacture of this single dye, an amount that would pay for the maintenance of a good number of chemical laboratories.

The development of this manufacture was so rapid that by 1873 Perkin and his brother found that it would be necessary to double or treble their factory to supply the demand. Perkin was then only thirty-five years of age and his love of research had survived his seventeen years of experience as a manufacturer. Partly for this reason, partly because he did not wish to assume the responsibility of the larger factory, he sold the works and after that time he devoted himself to scientific research, with distinguished success. The jubilee of the discovery of mauve and the founding of the coal-tar industry was justly celebrated last year as one of the great events of the century, but Perkin's scientific achievements and the way in which he stood for high ideals in research are, I think, of even greater value to the world.

The manufacture of mauve was quickly successful and after the scientific discovery of the structure of alizarin, commercial production soon followed. With indigo, the case has been somewhat different. The scientific problem was in itself more difficult and the course of events has illustrated with especial clearness the difference between the scientific and the technical solution of the same problem. Baeyer began his work on indigo in 1865. During the five years following he prepared a number of important derivatives, which contributed much toward the clearing up of the relation between indigo and other compounds. In 1870, he found that some of the work he was doing seemed to cover much the same ground as some work which Kekulè had undertaken and out of scientific courtesy he allowed the matter to lie dormant for eight years. In 1878, as Kekulè had published nothing further of importance, Baeyer returned to the problem and in 1880 he obtained a successful synthesis of indigo. With the brilliant success of alizarin in mind patents were taken out, and it was generally expected that the manufacture of the artificial dye would soon become of commercial importance. But these hopes of immediate success were not realized. Two principal difficulties were encountered. The original methods of synthesis involved a considerable number of difficult transformations between the raw material, toluene, and the finished dye, indigo. These transformations required a very large amount of careful scientific study before the conditions could be found under which they could be carried out in ways that would be economical of time and material. But when this side of the problem had received a partial solution as the result of fifteen years or more of work, a second difficulty presented itself in the magnitude of the interests involved. It is estimated that the world uses about 5,000 tons of indigo in a year. Now, even with the perfected methods it takes about four pounds of toluene to make one pound of indigo and the present production of toluene is only about 5,000 tons a year. The whole of the toluene produced would give only about one fourth of the amount required to supply the world's demand for indigo. Furthermore, the toluene now produced finds a ready market for use in the preparation of other dyes and other compounds. Any attempt to use a considerable amount of toluene for the manufacture of indigo would be met, therefore, by a rising price which would quickly make the production by this method commercially impossible.

Fortunately, another synthesis of indigo was discovered by Heumann in 1890 which made it possible to prepare indigo with the use of naphthalin as a raw material. As the supply of naphthalin is ample for the purpose, the second difficulty was overcome. But the new process required the solution of a whole set of new problems and it was not till seven years later that the Badische Anilin and Soda-Fabrik considered that the process was sufficiently well developed to justify preparation for the manufacture on a large scale. So carefully had they worked out every detail, however, that during the three years that followed they were willing to expend four and a half million dollars in building the factory and apparatus for this one enterprise. As the world uses in a year twelve to fifteen million dollars' worth of indigo, the manufacture on a large scale is justified, and there is every indication at present that the artificial indigo is slowly displacing the natural product. The farmers in India are already feeling this new competition and it is doubtless only a question of a few years before they will be compelled to devote their attention to other crops. The hope has been expressed that the land released in this way may be used for raising food products, which may give some relief from the famines so common in that country.

In 1856, in the same year in which Perkin discovered mauve, Henry Bessemer presented to the world at the Cheltenham meeting of the British Association the first account of his new process for the manufacture of steel. Previous to that time steel had been made by a roundabout, tedious process. The carbon was burned out of pig iron in puddling furnaces so constructed that only comparatively small amounts could be handled at once and the most arduous hand labor was required. From the wrought iron obtained in this way steel was prepared by packing the bars in charcoal and heating them for several days until they had reabsorbed the requisite amount of carbon. Bessemer conceived the idea that by blowing air through melted iron it would be possible to burn out the carbon and silicon in the iron, while the heat resulting from their combustion would keep the iron liquid. He thought, too, that if he could stop the blast at the right moment, before all the carbon was gone, he would have steel. He showed that in this way several tons of iron could be converted into steel in fifteen or twenty minutes, whereas the old process took half as many days. Such a revolutionary process attracted a great deal of attention, and he succeeded in selling the right to use the process to a number of manufacturers for a considerable sum of money. When they attempted to make steel by the new method, however, every one of them failed. It was found practically impossible to stop the blow at the right point to secure a uniform product. But Bessemer was not disheartened by the failure and for the two years and a half following he worked continuously, building new furnaces and tearing them down, until he finally solved the difficulty. It was found possible to determine when the burning out of the carbon in the iron was practically complete by watching the flame as it issued from the converter. Then, by adding the right amount of an iron containing manganese and carbon, the proper composition for steel could be secured. When Bessemer tried again to introduce his perfected process he met with a very cold reception from the manufacturers. They said they were not to be deceived a second time. He was finally compelled to build works and establish the manufacture for himself. He succeeded beyond the most sanguine expectations, and the revolution in the manufacture of steel which dates from that time is common knowledge.

Agriculture still remains the most important industry in the world. From the time that primitive man began to till the soil to the middle of the nineteenth century the farmer received but little aid from chemistry. The work of the last seventy years has changed all that. As late as 1840, it was generally supposed that plants grew chiefly from the vegetable humus in the soil. Many of the fundamental facts on which to base a more correct view had been known long before, but it was Liebig who first grouped these facts together and pointed out clearly that plants are nourished by the inorganic constituents of the air and soil and that it is the potash and lime and phosphorus and inorganic nitrogen of the soil which are vitally essential to their growth. On this simple foundation has grown up our great modern fertilizer industry, which brings to our farmers the phosphates from the south, the potash salts from Germany, and the nitrates from South America. The supply of the last is limited in consideration of the present demand, and there has been a good deal of speculation as to what our farmers will do when the beds of nitrates are exhausted. There is plenty of nitrogen all about us in the air, however, and several methods have already been developed for utilizing this inexhaustible supply.

I might speak further of the part that chemistry plays, to-day, in the making of paper, in the tanning of leather, in the boiling of soap, in the manufacture of glass, in making paints and varnishes and india rubber, in the making of cement and in the refining of petroleum, but I will not take your time with further details. In these and in many other industries the work of the chemist has become an indispensable factor. Fifty years ago there were very few chemists in America and those few were almost exclusively engaged in teaching. To-day it is estimated that there are 8,000 chemists in the United States and a very large proportion of these are employed in industrial work. But it is not in technical lines only that great advances in chemistry have been made. I believe the advance which has been made in chemical research is of much greater importance. I have spoken of the fact that Liebig gave to his students the love of research and that they acquired in his laboratory the power of individual initiative. In many of the chemical laboratories of our colleges and universities and technical schools are to be found to-day earnest workers who are seeking for new truths and who inspire their students with the power to think independently and to do original work. Whether the student's life work is to be in the field of pure science or in its technical applications, this power is the greatest gift that a teacher can impart.

While the material advantages which have come to us from chemistry are very great and may be justly emphasized, its greatest achievement is, after all, the part which it has had, together with other sciences, in transforming the way in which the world *thinks*. In its laboratory method it has replaced the old idea of authority by the idea of first-hand knowledge. It leads the individual to seek for himself the fundamental basis of his knowledge and it leads him not merely to pass that knowledge on to the next generation, but to transform it into a new and truer form. And as this scientific spirit permeates society it more and more destroys deceit and fraud, wherever found.

William A. Noyes
University of Illinois

SCIENTIFIC BOOKS

Foods and their Adulteration: Origin, Manufacture and Composition of Food Products, Description of Common Adulterations, Food Standards, and National Food Laws and Regulations. By Harvey W. Wiley, M.D., Ph.D. 8vo, pp. xi + 625. Eleven colored plates and 86 other illustrations. Philadelphia, P. Blakiston's Son and Co. 1907. Cloth, $4.00.

Seldom has a more timely book appeared than this, following so closely as it does the beginning of the enforcement of the new national pure-food law. For some time prior to the passage of this law public interest throughout the country had become vitally awakened to the importance of the pure-food issue. Amid a large mass of confusing and often exaggerated newspaper articles dealing with the subject, it is a comfort to find a book covering the field so completely, so sanely and withal in so interesting a way.

The book treats systematically and quite exhaustively of all the principal food products, dealing in turn with their manufacture, properties and composition, forms of adulteration and dietetic value, and including much information of a general nature concerning them. Beginning with the animal foods, it thus covers meats and the various meat preparations, fish, milk and its products and oleomargarine. Then follow the vegetable foods, cereals, vegetables proper, condiments, fruits, sugar, syrup, confectionery, honey, and finally infants' and invalids' foods.

Beverages are to be separately treated in another volume.

Though destined for a wide variety of readers, the book is apparently designed first of all for the benefit of the public, at a time when the public wants particularly to know about its food; and written as it is from a strictly scientific standpoint, yet in a popular way, by one who from long experience knows so thoroughly his subject, it will be widely read and to great advantage by the people as consumers.

Not only does the author cover the ground directly suggested by the title, but in a general and useful way gives throughout much information about food values and the use of food for bodily nourishment. The colored plates illustrating the appearance of cuts of healthy beef, for example, will be found especially helpful to the householder.

To the food manufacturer and dealer the book is almost indispensable, since it describes very plainly the methods of preparation and standards of purity, the effects of storage, and, in addition, gives much good and sound advice regarding what might be termed controversial forms of adulteration, such as chemical preservatives and artificial coloring, called controversial because their use with restricted labels has to some extent been legalized under some of the state laws, and because they have for years formed the subject of much difference of opinion among experts in food litigation.

In treating of these substances, the use of which unfortunately seems to be on the increase, and which form undoubtedly one of the most important phases of food adulteration, the author speaks in no uncertain way. He unequivocally condemns the use of chemical preservatives, such as boric, sulphurous and benzoic acids and their compounds, as in all cases deleterious to health, and would rigidly exclude them from all food products. Even saltpeter, so long used in the corning of beef, he regards as undesirable.

As to artificial colors, he would keep them out of all foods, and with good reason, with the exception of confectionery and similar products, even regarding the time-honored custom of coloring butter as an attempt to deceive, which it certainly is.

In discussing baking-powder compounds and the toxic effect of their residues, a matter of much conflict in the past between legal experts, the author caustically points out how the interests of rival commercial companies often shape their views, and with justice recommends the investigation of such subjects by wholly unprejudiced observers, from a strictly scientific standpoint.

The author specifically states that in all cases the opinions expressed are strictly his own, and are not to be otherwise considered.

While the manual, by the author's statement, is not especially designed for the expert chemist, and chemical terms are carefully explained for the benefit of the public, yet the food analyst will need the book on his shelves for reference. From the chemist's standpoint, the many tables and results showing the composition of the various food products are especially useful for comparison. In many cases also are given some of the later and more improved tests for adulteration, which in some instances have not hitherto been so readily available.

Among these are the detection of yeast extract in meat extract, conclusions and results of constants for fats as a guide to adulteration of mixed meat products, the Wisconsin curd test for the purity of milk, methods for distinguishing between edible and poisonous mushrooms, etc.

In appendices are given in full the latest adopted standards of purity for food products, rules and regulations for the enforcement of the food and drugs act of 1906, the text of the act, regulations governing meat inspection, and finally the first sixty-four food inspection decisions rendered by the secretary of agriculture.

In appearance the book is very attractive with its large, clear type and well-selected colored plates and cuts.

First Course in Zoology. By T. W. Galloway, Ph.D. Philadelphia, P. Blakiston's Son and Co.

Dr. T. W. Galloway has written a book which, as is stated on the title-page, is designed for "secondary schools, normal schools and colleges." The work is divided into two main parts, the first dealing with the broad general principles of zoology, the second consisting of a systematic review of the animal kingdom. After a short introductory chapter concerned chiefly with the principal subdivisions of the science there are chapters on the nature and functions of protoplasm, the structure and physiology of the cell, the development of the cell into a complex animal, the differentiation of cells and tissues, and the general animal functions, such as digestion, respiration, excretion, sensibility and reproduction. Chapter VII., headed by the unfortunate term promorphology, deals with the various types of symmetry exhibited by animals and the metameric composition of the body in segmented forms. In chapter VIII. under the title Individual Differentiation and Adaptation, there is discussed a variety of topics such as heredity, variation, selection both natural and artificial, adaptation to the environment organic and inorganic, classification, habit and instinct, social and communal life, symbiosis, parasitism and the general subject of distribution. The treatment of many subjects necessarily suffers from being confined to the limits of a short paragraph, notwithstanding the fact that the exposition on the whole is logically developed.

The systematic survey of the animal kingdom is preceded by a short chapter designed to give the student a general concept of the field, and containing a useful diagram of the numerical proportions of species in the different phyla. The description of the main groups of animals is usually introduced by laboratory directions for the study of a typical form. When the student has made this study he is prepared to assimilate the additional information given in the text upon the type and other members of the group. The laboratory directions are not so explicit as in most laboratory manuals. They form a series of hints and suggestions rather than fixed outlines which can be slavishly followed. The purpose of this is to enable the teacher to modify and direct the work in large part according to his own ideas, as many teachers would naturally desire to do. Opinions may differ as to the feasibility of this mode of presentation. More responsibility is placed on the teacher as well as more labor, and the method may be better or worse than the usual course of laboratory outlines, depending on the qualifications of the person giving the course.

A part of the work is printed in larger type for students who have time for only a limited course in the subject. At the ends of the chapters there is a series of topics and questions for additional investigation in the laboratory, field or library. The book which consists of 481 pages includes sufficient material to keep an average class busy for two or three years, but the teacher is expected to select from it what he deems suitable for the conditions he has to meet. It is a work which stands in marked contrast to many of the infantile treatises which have recently appeared and which religiously abstain from including anything which is liable to tax the gray matter of the student. It is evident that a good deal of thought and effort have gone into its making, and it has consequently a degree of character and individuality which is rare among the members of its genus.

The price, $2.50, may unfortunately tend to limit its use in secondary schools, but the general make-up of the book is excellent, and it is well illustrated with 240 figures, many of which are new. S. J. H.

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for October is mainly devoted to the third of a series of "Studies of Gastropoda," by A. W. Grabau, this being "On Orthogenetic Variation in Gastropoda." The author notes the general disregard of the immature stages of development, and considers this a decided mistake. He also points out that the mollusks are perhaps the best organisms for the study of ontogenetic stages between the embryo and the adult, since these stages are permanently recorded in the shell; he also considers the gastropods the best for study. J. A. Allen discusses "Mutations and the Geographic Distribution of Nearly Related Species in Plants and Animals," pointing out that the different views held by botanists and zoologists are partly due to too sweeping assertions, partly to misunderstandings and partly to deductions drawn from dissimilar conditions. Under "Notes and Literature" is a detailed account of the various and important exhibits made at the meeting of the Seventh International Zoological Congress.

Bird Lore for September-October has the second, and final, article by F. H. Herrick on "Bird Protection in Italy as it Impresses the Italian." Roughly speaking, protection seems to impress him as eminently undesirable and that the more of his own and his neighbor's birds that can be killed the better. It is this feeling that leads to so much trouble between our Italian immigrants and game wardens. W. W. Cooke has the fifth, final and very brief paper on "The Migration of Thrushes," and there is considerable information regarding "The Starling in America," showing that it has commenced to spread. There are quite a number of communications, some favorable in tone, on the English sparrow. The report of the Audubon Societies records the establishment of two more bird reservations in the Gulf of Mexico, and contains encouraging reports of those already established.

The Bulletin of the Charleston Museum for October contains a paper by William G. Mazyck on the "History of the Museum" previous to 1798, showing that it was in existence even prior to 1778. Under Ornithological Notes is recorded the first capture of Bewick's wren, *Thryomanes bewicki,* on the coast of South Carolina.

The Museums Journal of Great Britain for September contains an article on the Malmo Museum which contains many picturesque groups of animals, although there seems to be a tendency to show rather too much of the cruel side of animal life. In the notes it is stated that the resignation of E. Ray Lankester as director of the British Museum has been accepted, but will not go into effect at present.

The Museum News of the Brooklyn Institute for November has a good article on Zuni masks, and notes on the recent expedition to South America which secured among other things several Matamata, *Chelys fimbriata*, and examples of the huge jabiru, *Mycteria*. Three of the Matamata have been deposited in the New York Zoological Park. The leading article in the Children's Museum section is on "The Value of an Escort" in that institution.

SOCIETIES AND ACADEMIES

THE AMERICAN PHYSICAL SOCIETY

The fall meeting of the Physical Society was held at Columbia University on Saturday, October 19, President Edw. L. Nichols presiding.

The following papers were presented:

L. A. Bauer: "Results of Careful Weighings of a Magnet in Various Magnetic Fields."

C. B. Thwing: "On the Emissivity of Molten Iron and Copper."

Leighton B. Morse: "The Selective Reflection of Carbonates as a Function of the Atomic Weight of the Base."

F. C. Brown and Joel Stebbins: "The Variation of the Light Sensitiveness of the Selenium Cell with Pressure."

Ernest Merritt: "The Recovery of Selenium Cells after Exposure to Light."

F. L. Tufts: "Wave-length—Luminosity Curves for Normal and Color-blind Eyes."

F. C. Brown and Joel Stebbins: "The Effect of Radium on the Resistance of the Selenium Cell."

J. Barnett: "An Investigation of the Electric Displacement and Intensities Produced in Insulators by their Motion in a Magnetic Field, and its bearing on the Question of the Relative Motion of Ether and Matter." (By title.)

It was announced that the annual meeting would be held this year in Chicago in connection with the meeting there of the American Association for the Advancement of Science during convocation week, and that in consequence the usual Thanksgiving meeting at Chicago would be omitted.

Ernest Merritt,
Secretary

THE AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION

The seventy-eighth regular meeting of the section was held at the Richardson Hotel, Lowell, Mass., on October 25, at 7:30 p.m., Vice-President F. G. Stantial in the chair. Forty-two members and guests were present. Professor Louis A. Olney, of the Lowell Textile School, president of the section, presented a paper upon "Standard Methods of Determining and Recording the Relative Permanency or Resistance of Coloring Matters to the Common Color Destroying Agencies."

In general the value of a dyestuff depends upon its resistance to the ordinary color weakening or destroying agencies, or to use the terms of the trade, upon its fastness. Other properties must also be considered in the ultimate valuation of a dyestuff, namely, its solubility, its affinity for fibers, and its equalizing power.

The qualities demanded of any particular coloring matter depend upon the conditions to which its uses will necessarily subject it, therefore the requirements vary greatly. Taking any dyestuff at random, we may find it to be particularly well suited for one branch of textile work, and wholly unfit for another.

With the numerous variations in requirements, the question of fastness becomes of great importance, and much responsibility rests with the textile colorist in the selection of the proper dyestuffs in any particular case.

If standard methods could be established whereby the relative fastness of dyestuffs to the common color destroying agencies could be determined, and the results recorded in such a manner as to permit of their being used as standards of general reference, the problem could be very much simplified, and the reports given in regard to the properties of dyestuffs more reliable.

It was the purpose of the paper to show that the establishment of standard methods was by no means an impossibility, and to make certain suggestions, which had resulted from work carried on at the Lowell Textile School during a period of five years, with the object of formulating such methods. While the speaker was by no means ready to offer such a series of tests, in what he could call a perfected form, he did wish to present for the consideration of the members certain phases of the work, which had been done.

The principal color-destroying or changing agencies toward which the fastness of dyestuffs are usually tested may be enumerated as follows: Fastness to light, fastness to weather, fastness to washing, fastness to scouring, fastness to milling (including felting and fulling), fastness to alkalies, fastness to acids, fastness to chlorine, fastness to sulphur dioxide, fastness to rubbing, fastness to ironing and calendering, fastness to steaming, fastness to perspiration, fastness to urine.

The paper then went into detail concerning the methods of determining the fastness of dyestuffs to the above agencies, and also the methods of recording the same. To make the record of a color complete, certain other data were also recorded namely: Its name, dyestuff concern manufacturing or selling, samples of the textile material dyed full shade, and in various percentages to indicate its coloring value, a detailed recipe of the process used in making the dyeings that are tested, its solubility, color of its solution, action of its solution with acids, action of its solution with alkalies, and finally three samples of dyed cotton and wool union material to indicate its affinity for the two important fibers, and to give some idea as to its value for union dyeing.

The paper was accompanied by many dyed and tested samples which indicated the manner in which all of the above tests and determinations of an individual color could be easily recorded upon a single folder of the proper size for an ordinary letter file.

In conclusion, it was said that the tests described had been formulated with the constant aim to make them as comparable as possible with the actual conditions of practise, and that they had been revised each time that it was thought that any change would make them approach nearer to this desired condition. In the opinion of the speaker they were subject to still further change and modification, but as he looked back to the series of tests made four and five years ago, he felt that great improvement had been made. He was inclined to believe that all of the members present, who were directly interested in textile coloring, would agree with him that great advances could be made if color dealers and textile manufacturers in general would agree upon certain standards of fastness, and adopt uniform methods for making the various tests which, at the present time, are often so valueless, because of lack of information as to how they were made.

Much could be accomplished by cooperation, and it was sincerely hoped that the future would see an organized effort, upon the part of those interested, toward the establishment of such methods.

The paper was discussed at some length by members and guests. At the close of the meeting a vote of thanks was passed, to the Lowell members of the section for the enjoyable and instructive program and visits of the afternoon and evening, and to the managers of the several industrial plants where visits were made, for their courtesy and attention to the comfort and enjoyableness of the visits.

Preceding the meeting the members of the section were provided with a tempting lunch at the Lowell Textile School, after which the various departments of the school were visited and the students observed at their work. At 2:30 p.m. parties were formed to visit (*a*) the Bigelow Carpet Works, (*b*) the Lawrence Hosiery Mill; (*c*) the Lowell Gas Light Company, (*d*) the Merrimack Print Works. At all of these industrial plants the members were shown many interesting and instructive processes.

Frank H. Thorp,
Secretary

DISCUSSION AND CORRESPONDENCE

THE EFFECTIVE SURFACE-TEMPERATURE OF THE SUN AND THE ABSOLUTE TEMPERATURE OF SPACE

To the Editor of Science: I have before me yesterday's issue of Science. As for myself no more striking illustration could be given of the chaotic state in which this whole disputed question of the sun's effective surface-temperature still remains, than the results obtained by Professor Poynting, as set forth in the single paragraph in the second column on page 602 of SCIENCE.

For the past six years my whole time has been given up to work relating to investigations as to the probable origin and physical structure of our sidereal system. In the course of these investigations the question, *What is the present surface-temperature of the sun?* has recently given me much trouble, for the results of different investigators vary all the way from twelve hundred degrees up to eighteen million degrees centigrade!

With the aid of recent observations, made with a mirror which I figured about three years ago, and which, for this kind of work, is by far the most powerful telescope ever constructed (aperture two feet, focal length three feet) I finally deduced the simple, fundamental, *theoretically exact* expression given below.

This equation proves that if Professor Poynting's value for the temperature of the "small black particle" is correct the sun's surface temperature is twelve million degrees instead of only six thousand.

In my approximate determination of the absolute temperature of space with the aid of the mirror, no allowance has yet been made for absorptions and reflections due to ponderable matter in the space between the sun's surface and the focal point of the mirror. Professor Poynting's value for the absolute temperature of the "small black particle" is 300°; my uncorrected value for the same particle is 0°.5 +. So that according to my results the effective surface temperature can not be less than twenty thousand degrees centigrade.

If t is the temperature of the "small black particle" at the distance r from the *center* of the sun, and t_0 is the effective temperature of the surface of the sun at the distance r_0 from the sun's center, then my *theoretically exact* formula is simply

$$t_0 = t\left(\frac{r}{r_0}\right)^2,$$

a Newtonian expression which, according to the assertions of modern astrophysicists, can not be used for determining the effective surface-temperature of the sun; so far as I can learn this stand has been taken mainly for the reason that the very high resulting temperatures heretofore obtained seem to be inadmissible.

I had intended to defer the publication of my present views regarding the probable origin of our stellar and solar systems until more definite observational and more theoretical data had been deduced; but as repeated reference to a theory should be accompanied by some evidence bearing on the question "Is the theory tenable?" I will shortly forward for publication in SCIENCE a very brief statement of the results so far obtained.

J. M. SCHAEBERLE

ANN ARBOR,
November, 2, 1907

ARTICLE 30 OF THE INTERNATIONAL CODE OF ZOOLOGICAL NOMENCLATURE

THE new article 30 of the International Code of Zoological Nomenclature, adopted by the International Congress of Zoologists at its recent meeting in Boston,[1] is beyond question a great step forward in providing definite methods for determining genotypes in zoology. Although the old article 30 is canceled, the new article 30 includes all of the principles of the old one, of which it is virtually an extended amplification, embracing seven distinct "rules," and thirteen additional "recommendations," the former numbered *a* to *g*, and the latter *h* to *t*. The recommendations have relation to the selection of types for genera still typeless, but one of them, numbered *i*, and relating to "virtual tautonomy," might well have been transferred to the "rules." The "cases" are wisely separated into two categories: "I. Cases in which the generic type is accepted *solely* upon the basis of the original publication." "II. Cases in which the generic type is not accepted *solely* upon the basis of the original publication."

The first class includes: (*a*) all those genera, the founder of which designated the type at the time of founding the genus; (*b*) those genera, the founder of which used *typicus* or

[1] See SCIENCE, N. S., Vol. XXVI., pp. 520–523, October 18, 1907.

typus as a *new* name for one of the species he included in it when founding it. In both groups the type designated by the founder "shall be accepted as type regardless of any other considerations." (*c*) A genus proposed with a single species takes that species as its type. (*d*) Any genus founded without a type being provided for it under one or the other of the above conditions, but which "contains among its original species one possessing the generic name as its specific or subspecific name, either as valid name or synonym, that species or subspecies becomes *ipso facto* type of the genus."

It is safe to claim that 70 per cent. of all generic names in ornithology, and probably in vertebrate zoology, are determinable upon the original basis of publication, by one or the other of the methods above prescribed—methods, too, which everybody accepts. The other 30 per cent. are provided for by rules *e* to *g*, rule *e* designating the conditions upon which rules *f* and *g* must rest—namely, that the species alone available are those that were included in the genus when it was originally published, of which, however, none is available that was indicated by the author as, from his standpoint, either of doubtful status or of doubtful pertinency to the genus. With this useless rubbish cleared away, rule *f* provides:

> In case a generic name without originally designated type is proposed as a substitute for another generic name, with or without type, the type of either, when established, becomes *ipso facto* the type of the other.

This is a sensible innovation that may now and then prove extremely useful. But the grand stroke is rule *g*, as follows:

> If an author, in publishing a genus with more than one valid species, fails to designate (see *a*) or to indicate (see *b*, *d*) its type, any subsequent author may select the type, and such designation is not subject to change.

This last rule, as old as the B. A. Code, completes the rules for type determination, and provides essentially only four methods, which are designated:

(1) "Type by original designation" (rules *a* and *b*); (2) "Monotypical genera" (rule *c*); (3) "Type by absolute tautonomy" (rule *d*); (4) "Type by subsequent designation" (rules *e*–*g*). By a wise stroke of diplomacy, the word "elimination" is not mentioned; yet elimination is the basis and the method, and necessarily always has been, of any sound work by a first reviser.

To rule *g* is added:

> The meaning of the expression "select a type" is to be rigidly construed. Mention of a species as an illustration or example of a genus does not constitute a selection of a type.

This seems explicit, but is far from being so; while it will tide over some difficulties, it will open up others. Not only this, but must the designation of a first reviser always be accepted, right or wrong, or only when made in accordance with fundamental rules of nomenclature that have been extant in all codes since the publication of the British Association Code of 1842?

One need not have had very extended experience with the work of "first revisers" to have learned that it is of all grades of quality from absolutely pernicious to unqualifiedly beneficent, having been often done by systematists who knew nothing of rules of nomenclature, or else disregarded them. One need not go very far back in the history of even American ornithology—less than half a century—to find that species have been taken as types of genera that were not described till long after the genera were founded; or that genera have been taken from pre-Linnæan authors when they became tenable only from Linnæus or from some much later author; or that types thus designated for certain genera had long before properly become the types of other genera and were not available as types of entirely different genera.

That the new article 30 is not intended to countenance such work is clearly indicated by the first section of rule *e*, which states that no species can be taken as the type of a genus that was not included in it at the time of its original publication. Again, if a reviser, ignorant of the literature of his subect, or merely neglectful of rules, chooses as the type of a genus a tautonomic species of an earlier genus, or the type of a previous monotypic genus, or a species some earlier reviser has properly chosen as the type of some other genus, rules *a* to *d* clearly show that his work must be construed as void. Evidently an earlier monotypic genus can not be canceled by the act of some blundering reviser who chances to seize upon its only species as the type of some other genus; nor can a genus with a "type by subsequent designation" be canceled because its type was later made the type of another genus. This would seemingly all go without saying were it not that some systematists assume that the designation of a type by a first reviser is sacrosanct and must stand regardless of any other considerations.

This emphatic reaffirmation of the principle of "type by subsequent designation" is exceedingly gratifying. Yet, for reasons in part already stated, it is to be regretted that the International Commission did not define the manner of its application. This doubtless did not seem necessary; but there is apparently nothing so uncertain as the point of view from which any problem in nomenclature may be approached.

The great utility of the "type by subsequent designation" rule as an aid in establishing genotypes is not at first apparent; and in recent years it appears to have been to a great extent overlooked, it having been regarded by many as vague and illusory, and difficult to apply with certainty and precision. That the principle was formerly respected and extensively and effectively employed is evident from a study of nomenclatural progress during the last half century. My recent investigations in an attempt to show how the types of the genera of North American birds were determined,[2] to which Mr. Stone has recently directed attention,[3] resulted in disclosing the extent to which the currently accepted types of polytypic genera in ornithology have been fixed by "subsequent designation."

As Mr. Stone has well said (*l. c.*):

Much of the chaos in generic nomenclature which has become intolerable to the systematist of to-day has been brought about by the failure of many writers to explain by what process they have determined the types of old polytypic genera. Had they been more explicit upon this subject, we should have been able long ago to see the weaknesses in our codes and should have abandoned methods which were neither definite nor final in their operations.

In fact, it is only about thirty years since it became the practise for even monographers to give types for genera founded by previous authors except sporadically, and rarely has the method of their determination been stated, except in the case of types determined by elimination, beginning with the A. O. U. Nomenclature Committee in 1886. There is merely the bare statement that the type of a genus is a certain species. Usually it is necessary to trace back the literature to ascertain whether the genus was originally monotypic, or whether the type was designated by the founder, or determined in some other way. Nor can this be fully shown until, in addition to giving the author, date and place of description, is also given the original constitution of the polytypic genera, with a list of the species and their final generic disposition.

My purpose in preparing the paper above cited was to ascertain for my own satisfaction two things: (1) whether it was true, as alleged, that no two investigators could reach practically the same results in type determination by the method of so-called elimination; (2) to determine the relative number of changes necessary in the generic names of North American birds by elimination and by the first species rule. An entirely independent, or *de novo*, application of elimination resulted in only three changes chargeable exclusively to elimination, equal to about three fourths of one per cent. of the total number of genera and subgenera involved; twenty would be necessary from the enforcement of the first species rule, *with all the Linnæan genera excluded*, eighteen of which have received the approval of the A. O. U. Committee, acting tentatively under the first species rule.

[2] "The Types of the North American Genera of Birds," *Bull. Amer. Mus. Nat. History*, Vol. XXIII., pp. 279–384, April 15, 1907.

[3] Science, N. S., Vol. XXVI., pp. 444–446, October 4, 1907.

As Mr. Stone has said some very pleasant things in his notice (*l. c.*) of this paper, I regret that he seems to have so imperfectly understood its scope and methods as to have been misled into some erroneous criticisms of it. For instance, its scope is distinctly stated to be "the genera and subgenera of the second (last) edition of the A. O. U. Check List and its several supplements, for the purpose of showing how the types, as now currently accepted, came to be so recognized." Only two of the eleven genera Mr. Stone states to have been omitted from this paper are embraced in the Check List and its supplements. He evidently has confused the unpublished decisions of the committee with those actually published. Of the two subgenera omitted, one has been abandoned by its author and the other has lost standing; so both were purposely (but perhaps unwisely, as now appears) left out of consideration.

He also charges me with using various methods to reach my results, as "'elimination,' 'subsequent designation,' 'general consent' and 'restriction.'" As a matter of fact, I had a right to use each of these methods, under my proposition to show how the types as now recognized were determined, in any case where they were evidently employed. Obviously elimination (in its restricted sense) can not apply to (1) genera based solely upon a diagnosis, (2) to genera containing originally only congeneric species, nor (3) to genera containing two or more congeneric species after the non-congeneric species have been removed. I gave the results of elimination where it applied, and added, as matter of presumable interest, the other information. For instance, as stated in my introduction (p. 286), I became impressed in the course of my work "with the great frequency with which the types of genera and subgenera as designated by him [Gray] in 1840 to 1855 are still the currently accepted types." And added: "The agreement was of such striking frequency that finally after my manuscript was typewritten and revised for publication I compared my results with Gray's designations, and interpolated, as an afterthought, 'type as designated by Gray,'" etc. It is therefore rather surprising to be informed by my reviewer that I am so inconsistent as sometimes to accept Gray's type designations and at other times to ignore them, or even deliberately reject them; and that owing to my following so many different methods "my conclusions with regard to the types of many of the older polytypic genera will hardly be accepted."

Mr. Stone's criticisms as a whole show how a strong mental bias may blunt one's perceptions. Space can not be taken here to point out his misstatements in detail; nor would any notice be taken of them were it not that my paper can have only a limited circulation, and is thus likely to be judged by Mr. Stone's presentation of it rather than on its actual merits, or demerits, as the case may be. In a work of this character mistakes of various sorts are inevitable; it is impossible to reproduce in print thousands of citations without clerical or typographical errors, or without some errors of omission. In addition to the several actual errors pointed out by Mr. Stone, for the indication of which I am grateful, there are others that he fails to mention.

In regard to Gray's work as a first reviser, I stated (*l. c.*, p. 286):

> Of the genera published prior to 1855, the types, as now recognized, are the same for about 90 per cent. of the genera as those indicated as the types by Gray in 1855; in about half of the remaining cases Gray took as type a species not originally included in the genus. The discrepancy in the other cases is due to Gray's point of departure for generic names, since in twenty instances in the case of North American birds alone he took genera from Ray (1676), from Moehring (1752), or from Linnæus prior to 1758 (1735–1748).

In all such cases his type designations have been consistently repudiated by subsequent systematists, while all those made in accordance with the essential rules of all nomenclatural codes have been adopted and form a part of our standard nomenclature.

Gray was a pioneer in the work of designating types of genera, and his great influence in reducing the nomenclatural chaos of his day to some degree of order and stability appears to have received heretofore very little formal recognition. He began his work before there was any authoritative code of nomenclature; the basis of his decisions was, as he states, "the inflexible rule of priority," strictly enforced, which he employed without any of the modern restrictions as to when it should begin to be operative. He was handicapped, as he especially complains, by the lack of the works of continental authorities; and his knowledge of the world's ornis at this early date (1840–1842) was grossly defective, judged even by his own later standards. When preparing the first three editions of his "List of Genera," hundreds of the genera of his predecessors were unknown to him; many were still omitted from his greatly enlarged 1855 edition, and some few escaped him altogether, as shown by their absence from his wonderfully complete and invaluable "Hand-List of Birds" published in three volumes, 1869–1871. Nor is this surprising, since old names by the score are even now being brought to light. But his early omissions and his early point of view regarding the value and relations of groups named by his predecessors have an important bearing upon the validity of many of his earlier type designations; and also upon the application of rule *g* of article 30 of the International Code, and, I may add incidentally, upon Mr. Stone's strictures upon my alleged treatment of Gray's type designations. A few illustrations of the haphazard manner in which Gray, Lesson, Vigors, Swainson and others designated types from about 1824 to 1845 would make clear the impropriety of taking their work too seriously, but space for the purpose can not well be taken in the present connection.

Mr. Stone says, there are "two methods of type fixing, either of which will yield definite and final results—the first species rule and type by subsequent designation." In as much as the first species rule has been rejected, in effect if not formally, by the Nomenclature Commission of the International Zoological Congress, this is hardly an ingenuous statement, coupled as it is with the further assertion that the Zoological Commission has "repudiated the elimination method." As a matter of fact, the elimination method includes "type by subsequent designation"; a careful canvass of some 500 bird genera shows that the results by the two methods are practically identical, as would be expected on the principle that the greater includes the lesser.[1]

Under a common sense construction of article 30, a species not originally included in the genus can not be taken as its type; neither can the original species of a monotypic genus, a tautonymic species, nor a species that is the type of a genus by original designation, be subsequently taken as the "type by subsequent designation" of some other genus. This being conceded, it is safe to say that the emphatic and unequivocal affirmation, in euphemistic phraseology, of the long-standing "first reviser rule" will ensure the permanency of the types as now recognized of virtually all the genera of vertebrates, and probably of many other groups of animals. To illustrate, the authors of the various volumes of the British Museum "Catalogue of Birds" (1874–1898) assigned types for all of the bird genera known to them, whether valid genera or synonyms, while nearly all of the later published genera have had their types designated by the founder. In a few cases the authors of the British Museum "Catalogue of Birds" assigned as type of a genus a species not originally contained in it, or otherwise made a few improper designations, but such mistakes are fortunately few. It thus happens that probably 98 per cent. of the genera of birds will be found to have already types that conform to the provisions of the new article 30 of the International Code.

It remains now simply to hope that the good sense of systematists will lead them to adhere strictly to the International Code.

J. A. Allen

[1] *Cf.* D. W. Coquillett, "The First Reviser and Elimination," Science, Vol. XXV., pp. 625, 626, April 19, 1907.

SPECIAL ARTICLES

TWO INTERESTING APPLE FUNGI

Hypochnus.—A fungus which appears to be *Hypochnus ochraleuca*[1] of Noack published first in 1902 as *Hypochnopsis,* occurring on apples and quinces in Brazil,[2] and which does not seem heretofore to have been seen elsewhere than in Brazil, was collected by the writer in the mountains of North Carolina in the autumn of 1906 as being very destructive on apples and quinces in that region, especially in damp localities and on neglected trees. It was also later found on the pear in the same region by Mr. J. G. Hall.

Later specimens were received from Fatima on the coastal plain in the eastern part of the state, showing the fungus to be of much wider range than was at first suspected. The fungus, as at first seen, consisted of sclerotial bodies on the branches in proximity with affected leaves.

It was not until September 4, 1907, that spores of the fungus were found by Mr. J. G. Hall, of this laboratory, on leaves associated with twigs having the same sclerotial forms so frequently collected before. These spore-bearing specimens were collected at Mt. Airy by Professor F. C. Reimer and brought to this laboratory by him for examination. The fruiting stage exists as a filmy white to brownish network covering the lower sides of the affected leaves.

While it has not yet been possible to compare this fungus with authentic specimens of Noack's fungus, it seems very probable from the description that the species in hand is identical with his. The fungus is widespread and of serious import.

The localities so far known, from the most of which collections have been made, are:

On Apple

Horseshoe, August 18, 1906, F. L. Stevens.
Addie, August, 1906, F. L. Stevens.
Franklin, August, 1906, F. L. Stevens.
Hayesville, August, 1906, F. L. Stevens.
Marshall, August, 1906, F. L. Stevens.
Murphy, August, 1906, F. L. Stevens.
Robbinsville, August, 1906, F. L. Stevens.
Sylva, October 3, 1906, J. G. Hall.
Horseshoe, October 10, 1906, J. G. Hall.
Bryson City, March 7, 1907, G. P. Miller.
Fatima, March 14, 1907, J. F. Johnson.
Marshall, March 21, 1907, J. C. Tilson.
Fatima, April 8, 1907, J. F. Johnson.
Bryson City, April 8, 1907, F. C. McCracken.
Newton, August 28, 1907, B. B. Higgins.
Enfolia, October 31, 1907, B. B. Higgins.
Mt. Airy, September 2, 1907, F. C. Reimer.

On Pear

Sylva, October 3, 1906, J. G. Hall.

On Quince

Horseshoe, August 18, 1906, F. L. Stevens.

A Phyllosticta Canker.—A canker of apple twigs due to *Phoma* or a *Phyllosticta* has been repeatedly collected in the state as follows:

June 8, 1907, Cary, J. G. Hall.
August 19, 1907, Auburn, J. G. Hall.
May 1, 1907, West Raleigh, F. L. Stevens.
May 6, 1907, West Raleigh, F. L. Stevens.
August 30, 1907, Newton, B. B. Higgins.

The fungus seems to be wide-spread on this host and the cankers are destructive to the trees. The fungus was isolated and cultivated in agar plate culture in April, 1907, and inoculation experiments have been in progress since that time.

It assumes much more than local importance from the fact that, on examination of specimens which were kindly submitted by Mr. W. M. Scott, it appears that the fungus is identical with the one referred to by Scott and Rores[3] as causing a serious apple fruit disease in Arkansas; one which is rapidly increasing in importance and destructiveness. Also from specimens kindly submitted by Professor John L. Sheldon, it seems to be the same as the fungus supposed by him to be *P. solitaria* E. & E., which he

[1] Saccardo, "Sylloge Fungorum," XVI., 197.

[2] *Boletim do Instituto Agronomico do estado de Sao Paulo Em Campinas,* Vol. IX., 1898, Marco Numero 1. Sao Paulo, Brazil.

[3] "The Relation of Twig Cankers to the *Phyllosticta* Apple Blotch," *Proc. Benton Co. Hort. Soc. Arkansas,* August 8, 1907.

[4] "Concerning the Relationship of *Phyllosticta solitaria* to the Fruit Blotch of Apples," Science, N. S., 26, 658, 183, August 9, 1907.

considers[4] to be not only the cause of fruit disease and canker formation, but also of the familiar leaf spot so prevalent upon apple trees.

F. L. Stevens

N. C. Agricultural Experiment Station,
West Raleigh, N. C.,
September 16, 1907

THE AMERICAN SOCIETY OF NATURALISTS

The American Society of Naturalists will hold its annual meeting at Chicago during Convocation Week. The topic of the discussion, the date of which is the afternoon of Tuesday, December 31, will be: "Cooperation in Biological Research." The speakers will be as follows:

Dr. Frank R. Lillie.
Dr. William Trelease.
Dr. H. H. Donaldson.
Dr. Simon Flexner.
Dr. W. H. Howell.
Dr. James R. Angell.

The dinner and the address of the president, Professor J. Playfair McMurrich, of the University of Toronto, are arranged for the evening of December 31. The exact hour and place for the discussion and also for the dinner will be given in a later announcement.

Edward L. Thorndike,
Secretary

Teachers College,
Columbia University

SCIENTIFIC NOTES AND NEWS

The National Academy of Sciences is holding its autumn meeting at Columbia University, New York City, this week.

The trustees of the Carnegie Foundation for the Advancement of Teaching held their annual meeting at the offices of the foundation in New York City on November 20.

The Eastern Branch of the American Society of Zoologists meet at New Haven on December 26, 27 and 28.

The winter meeting of the Bibliographical Society of America will be held in Chicago, December 30–31. The discussion of "The present problems of the bibliography of science," will be opened by Dr. Cyrus Adler, of the Smithsonian Institution.

The New York State Teachers' Science Association will meet at Ithaca on December 27 and 28.

The Central Passenger Association reports that card orders will not be required in the territory of the Central Passenger Association, but that tickets at the reduced fare, for the Chicago meeting of the American Association for the Advancement of Science and affiliated societies, have been made available to any applicant. Card orders, therefore, are necessary only in the territory of the Trunk Line Association.

On the occasion of the dedication of its new natural history museum the Senckenberg Natural History Society of Frankfort elected several corresponding members, including Dr. Hermon C. Bumpus, director of the American Museum of Natural History and Dr. E. Ray Lankester, director of the British Museum of Natural History.

The Anders-Retzius medal, bestowed every five years on an anatomist or a physiologist, has been awarded to Professor G. Schwalbe, of Strassburg.

A portrait of Professor Arthur Schuster has been presented to Manchester University. It will be remembered that Professor Schuster recently retired from the active duties of the chair of physics.

Dr. Samuel G. Dixon, state health commissioner of Pennsylvania, has been appointed by the Secretary of the Treasury to represent this country as an official delegate to the Third International Sanitary Convention of the American Republics, to be held in the City of Mexico, December 2.

President David Starr Jordan, of Stanford University, will lecture under the auspices of the New York Board of Education at Cooper Union on November 23. The subject is "The Human Harvest—a Study of the Biological Effects of War."

On Tuesdays and Fridays at 8 p.m., beginning on November 12, Dr. Gary N. Calkins is giving a course of Lowell lectures on "The

Protozoa." The subjects of the lectures are as follows: (1) "The Lowest Forms of Animal Life." (2) "Their Habits and General Physiology." (3) "Protozoa and Protoplasmic Old Age." (4) "Problems of General Biology. Fertilization and Growth." (5) "Protozoa and Parasitism." (6) "Protozoa and Pathology. Malaria and Sleeping Sickness." (7) "Protozoan Parasites of Dysentery, Hydrophobia and Smallpox." (8) "Some Doubtful Protozoan Diseases." General Conclusions.

Dr. de Castro Barbasa, Inspector-general of railways and public works in Brazil, has, according to foreign papers, arrived in Paris from the United States, where he has been investigating the Mallet locomotive. Next month he proceeds to Italy to inspect the canalization of the River Pô, and to Egypt in order to visit the Assuan Dam and the irrigation works connected therewith. On his return to Brazil he proposes to undertake the irrigation of the region of the River San Francisco and the interior of Bahia, Pernambuco, Sergipe, Rio Grande do Norte and Ceará by means of a system of canals which he proposes to construct on a scale similar to those in India and Egypt, and thus to develop large regions which, up to the present, have been almost unexplored.

The Journal of the American Medical Association reports that the hundredth anniversary of the birth of Dr. L. R. de la Loza, an eminent physician and chemist in Mexico during the last century, is to be celebrated by official decree with due honors to his memory. Besides a special ceremony on November 15, a souvenir volume is to be published containing articles on chemistry from the professors of this science throughout the republic, and Loza's works are to be collected and published in a separate volume. The chiefs of the national medical, agricultural and preparatory schools form the committee, appointed by the secretary of public instruction, to take charge of the matter.

From the same source we learn that the issue of the *Revista Medica* for September is almost entirely devoted to doing homage to G. Barreda, a physician who died in 1881, who revolutionized medical education in Mexico, and was one of the pioneers in organization of the profession and a leader in science. A notice is published from President Diaz and congress, announcing that $40,000 has been appropriated from the public treasury for the erection of a suitable monument to Barreda. He occupied the chair of medical natural history and later of general pathology in the National Medical Institute, and was a leading practitioner in Mexico.

Dr. Lucien Marcus Underwood, head of the Department of Botany, Columbia University, and chairman of the Board of Scientific Directors of the New York Botanical Garden, eminent for his researches on the ferns, hepaticæ and fungi of North America, died by his own hand, while apparently suffering from an attack of acute mania, on November 16.

There will be New York State examinations on November 30, when a zoologist for the Education Department, with a salary of $1,200, and an assistant to the state entomologist, with a salary of $700, will be selected. There will also be at the same time examinations for electrical engineers and gas engineers with salaries ranging from $1,500 to $3,600.

There will be a civil service examination on December 4 and 5 for the position of miscellaneous computer in the U. S. Naval Observatory. Computers are paid by the hour and earn from $1,000 to $1,200. On December 11 and 12 there will be an examination for the position of assistant chemist in the Bureau of Chemistry, U. S. Department of Agriculture, with a salary of $1,200 to $1,800.

Mr. H. H. Taylor, manager of the North American Commercial Company, has under date of November 6, addressed a letter to President David Starr Jordan, which reads as follows:

On September 1, at Dutch Harbor, and in its vicinity, a heavy shower of volcanic ash occurred. At the time, it was generally supposed that Makushin had increased its activity, but investigation proved that the ash had not originated there. The following from the log of our Dutch Harbor Station, received this morning, may interest you: "The U. S. S. *McCulloch* left Unalaska at 6 A.M. (Oct. 15) for a cruise to Bogoslof Island. She returned to Unalaska at 6 P.M. Bogoslof was found very much changed. McCullock Peak had disappeared, also half of Berry Peak. It is now thought that the eruption of September 1st was at this island."

A number of Italian physicians and professors met at Perugia last month and organized a society for the study of the history of medicine.

An institute for cancer research has been established in Japan, and a journal has been established exclusively for the publication of research work on cancer.

A special correspondent of the Berlin *Lokalanzeiger* has had a conversation with Dr. Koch on board the Prinz Regent *en route* from East Africa. According to an abstract in the London *Times,* Dr. Koch, who is in the best of health, told the interviewer that he had been living for the past eighteen months on a desolate island belonging to the Sesse group, in the middle of Lake Victoria Nyanza, with an army medical sergeant as his sole white companion. They dwelt in a straw hut similar to those occupied by the natives, and saw only three Europeans throughout their stay. Sleeping sickness is particularly prevalent in the Sesse Islands, the inhabitants of which are gradually dying off through the ravages of the disease. Dr. Koch discovered that the insect known as the Glossina Palpalis, which conveys the germs of the disease (trypanosomæ), breeds not only on the banks of the lakes, but also along the streams up to their source. Dr. Koch's remedy, consisting of subcutaneous injections of arsenic, has proved efficacious; and the chief means of fighting the disease lie in constant medical attendance and in preventing patients from going into hitherto uninfected districts. Professor Koch has ascertained that there is a distinct connection between crocodiles and sleeping sickness. Wherever crocodiles are found the disease may be discovered, but only in places near the banks. The blood of crocodiles forms the chief nourishment of the glossina, which sucks the blood between the plates of the animal's hide. The extermination of the glossina is impossible, but the same end may be reached by destroying the crocodiles or by the removal of the bushes and undergrowth where the animals lurk.

According to a press bulletin of the U. S. Geological Survey the production of platinum in the United States in 1904 was 200 ounces, valued at $4,160; in 1905 the production was 318 ounces, valued at $5,320; in 1906 the platinum production of the country amounted to 1,439 ounces, valued at $45,189, a fourfold increase in quantity and more than eightfold increase in value over the figures for 1905. The principal feature of interest in the platinum industry during the year was the phenomenal rise in prices for ingot platinum, which, beginning with $20.50 per troy ounce on January 6, 1906, had on November 17 reached $38, remaining at this figure until the end of the year, after which there was another slight rise in price. In February, 1907, for the first time, a distinction was made between ordinary platinum and hard platinum, that is, platinum rich in iridium and osmium, considerable iridium being allowed to remain alloyed in the platinum of the ingots. Such hard platinum was quoted at $41 per ounce on February 23, and this price held until April 6, 1907, when the placing on the market of more than 100 pounds of platinum by a new producer interested in American developments checked the advance, and on May 4, 1907, ordinary platinum was quoted at $32 and hard platinum at $35. Then a gradual decline set in and the price in October was $23 for ordinary and $25 for hard platinum.

According to the *Journal* of the New York Botanical Garden an interesting fungus was recently presented to the garden by the China and Japan Trading Company of the city. A bale of cotton cloth, made in this country, stored for a year in Shanghai, China, and lately returned to New York by a Suez steamer, was wet on the voyage home, and, standing in the warehouse of the company here, developed the fungus. The fruit-body is about ten inches broad, six inches long, and four inches high. It consists of a mass of pure white, overlapping, leaf-like portions arising from a common point of attachment on the outside of the bale and connected with the vegetative portion of the fungus (mycelium), which permeates the inside of the bale in the form of numerous minute white threads. The plant is readily recognized as belonging to the genus *Pleurotus*, of the fleshy fungi, but the species has not yet been determined.

UNIVERSITY AND EDUCATIONAL NEWS

Announcement is made that Columbia University has received an anonymous gift of $100,000 to establish in memory of the late Henry Bergh a foundation to inculcate a spirit of kindness and consideration toward the lower animals.

By the will of Trenor L. Park, which has been filed for probate, Harvard University receives a bequest of $25,000.

Mr. Henry Stoddard, of New Haven, who was sent to England in connection with the will of Mr. Blount, has returned. It is said that he reports that the amount of the bequest will be $450,000. No light has been thrown on the question as to the reasons leading Mr. Blount to make this bequest.

The sum of $70,000 has been left by the late Miss Lucinda Bailey for the establishment and maintenance of an industrial school for boys and girls of Bath, Me.

Mr. Andrew Carnegie, retiring lord rector of St. Andrews University, has intimated his intention of giving £2,000 in addition to the £10,000 he has already given for the completion of the buildings of the university library.

Eleven teaching fellowships have been established at the University of Kansas for graduates of special merit. Each fellowship entitles the holder to $265, and he is obliged to teach not more than seven hours a week. The remainder of the time is to be devoted to investigation leading to an advanced degree.

The number of freshmen who have matriculated at Cambridge is, according to the London *Times*, 1,099; this is an increase of 78 over the number of last year. Since the beginning of the century there has been a steady annual increase in the number of students coming up to Cambridge in the October term, with the exception of the year 1904, when there was a drop of two. In 1900 the entry was 841, and it steadily increased, except in the year mentioned, by about 20 each year up to 1905, when there was a sudden increase of 124. The numbers at the several colleges are as follows: King's, 45; Trinity, 204; St. John's, 62; Peterhouse, 16; Clare, 61; Pembroke, 79; Caius, 82; Trinity Hall, 44; Corpus, 27; Queens', 51; St. Catharine's, 26; Jesus, 61; Christ's, 66; Magdalene, 28; Emmanuel, 82; Sidney Sussex, 30; Downing, 43; Selwyn, 42; non-collegiate, 50. Of these, 15 are advanced students.

According to recent data there are now in Germany 116 cities with special schools for backward children. The total number of these schools is 203, and the number of pupils is 13,100. Berlin has 31 of these accessory schools.

Mr. George M. Plympton, of the New York branch of Ginn and Company, has been elected president of the board of trustees of Amherst College, to succeed the late John E. Sanford.

Lord Avebury has been elected Lord Rector of the University of St. Andrews, succeeding Mr. Andrew Carnegie.

Mr. Earle G. Linsley has been appointed professor of geography and geology in the newly established department at California College, Oakland, Cal.

Dr. Naohidé Yatsu, formerly lecturer in Columbia University, has returned to Japan and has become lecturer in zoology in the Science College, Imperial University of Tokyo.

At Liverpool University, Dr. Joseph Reynolds Green, D.Sc., F.R.S., fellow and tutor of Downing College, Cambridge, lately professor of botany to the Pharmaceutical Society of Great Britain, has been appointed to the newly-created Hartley lectureship on plant physiology.

At Manchester University, Dr. C. H. Weizmann has been appointed lecturer in chemistry; Mr. J. M. Pring, B.Sc., Harling Fellow, demonstrator in electro-chemistry; Mr. F. H. Gravely, B.Sc., assistant lecturer and demonstrator in zoology; and Mr. J. L. Simonson, M.Sc., junior demonstrator in chemistry.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, NOVEMBER 29, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

UNIVERSITY REGISTRATION STATISTICS

ON page 730 will be found the registration returns for November 1, 1907, of twenty-four of the leading universities of the country. The only institution that has been added to the list this year is the University of Iowa. By reason of the great diversity that exists in the classification into schools of the various institutions, it is becoming increasingly difficult to retain uniformity in compiling the table, and considerable difficulty arises especially in connection with extension and similar courses; in some instances students in attendance on such courses are included in the regular enrollment, whereas in others they are carefully excluded. In spite of the effort made to prevail upon the institutions listed to distinguish closely between regular students that have satisfied at least the requirements for entrance to the academic department, on one hand, and students enrolled in extension courses, evening courses, etc., who do not possess a high school training, on the other, some confusion still exists, as several institutions were rather loath to avail themselves of the separate rubric provided for the latter category. Similarly, the summer session presents certain difficulties, inasmuch as there are, no doubt, at most of these sessions a number of students who have not

Faculties	California	Chicago	Columbia	Cornell	Harvard (incl. Radcliffe)	Illinois	Indiana	Iowa	Johns Hopkins	Kansas	Michigan	Minnesota	Missouri	Nebraska	New York	Northwestern	Ohio State	Pennsylvania	Princeton	Stanford	Syracuse	Virginia	Wisconsin	Yale
College Arts, Men	447	764	609	} 779	2268	365	414	433	166	398	980	509	428	285	279	389	281	270	665	973	} 1358	316	757	1314
College Arts, Women	922	668	420		360	423	396	460	—	438	665	915	379	672	136	507	296	—	—	477		—	746	—
Scientific Schools*	794	—	585	1633	162	1059	—	221	—	443	1324	666	649	670	201	—	853	706	532	†	386	109	868	961
Law	65	183	247	200	707	177	201	199	—	162	747	424	209	167	845	242	136	304	—	71	182	221	146	336
Medicine	38	141	298	316	325	454	112	302	825	88	445	175	63	130	475	637	—	590	—	—	151	103	24	137
Graduate Schools	249	381	715	206	442	165	106	115	160	36	95	65	137	102	252	—	46	339	114	62	68	30	353	340
Agriculture	118	—	—	325	22	419	—	—	—	—	—	927	152	235	—	—	171	—	—		—	—	139	—
Architecture	45	—	123	100	‖	150	—	—	—	—	—	—	—	—	—	—	—	} 107	—	—	49	—	—	—
Art	69	—	—	—	‖	10	—	†	—	25	—	—	—	65	—	—	—		—	—	78	—	—	—
Commerce	166	—	—	—	—	99	—	†	—	—	—	—	—	—	675	—	—	225	—	—	—	—	—	35
Dentistry	69	—	—	—	68	75	—	179	—	—	169	175	—	—	—	328	—	389	—		—	—	—	—
Divinity	—	172	—	—	31	—	—	—	—	—	—	—	—	—	—	227	—	—	—		—	—	—	80
Forestry	§	—	—	—	‖	§	—	9	—	—	—	§	—	—	—	—	17	—	—	—	—	—	—	61
Music	†	—	24	—	‖	105	—	61	—	107	—	†	—	400	—	273	—	41	—	—	637	—	202	83
Pedagogy	†	180	891	—	‖	†	—	†	—	—	—	16	252	†	420	—	18	—	—	—	155	—	—	—
Pharmacy	41	—	229	—	—	260	—	61	—	86	95	85	—	—	—	142	58	—	—	—	—	—	33	—
Veterinary	—	—	—	81	—	§	—	—	—	—	—	—	—	—	25	—	157	131	—	—	—	—	—	—
Other Courses	—	125	—	244	—	48	—	41	—	—	—	—	—	—	—	298	94	924	—	—	30	—	—	—
Deduct Double Registration	(45)	(193)	—	(5)	(12)	(4)	(54)	(107)	—	(25)	(31)	—	(314)	(75)	(76)	(319)	(2)	(130)	—	—	(50)	(22)	(140)	(48)
Total	2978	2421	4141	3878	4373	3805	1175	1964	651	1758	4489	3957	1955	2651	3233	2624	2125	3896	1311	1583	3043	757	3128	3299
Summer Session, 1907	522	2577	1392	755	1125	555	721	344	—	292	1064	335	452	244	640	265	425	363	—	65	205	—	651	162
Deduct Double Registration	(154)	(404)	(336)	(340)	(152)	(188)	(229)	(120)	—	(118)	(600?)	(85)	(133)	(83)	(126?)	(175)	(206)	(125)	—	(54)	(86)	—	(378)	(26)
Grand Total, 1907	3345	4594	5197	4293	5346	4172	1667	2188	651	1932	4953	4207	2274	2812	3648	2714	2344	4134	1311	1594	3162	757	3401	3435
" " 1906	3246	4731	4650	4075	6343	3810	1515	1950	618	1690	4674	3944	2071	2807	3283	2635	2180	3934	1352	1630	3004	745	3099	3477
" " 1905	3631	4557	4755	3871	5283	3635	1377	1700	688	1706	4521	3940	1887	2635	2912	2791	2057	3430	1361	1606	2776	696	3083	3477
" " 1904	3738	4035	4833	3833	5392	3369	1206	1460	740	1446	4000	3886	1704	2728	2380	2856	1768	3027	1385	1424	2452	691	3370	3008
" " 1903	3690	4146	4557	3438	6013	3239	1614	1260	694	1319	3926	3550	1540	2513	2177	2740	1710	2644	1434	1370	2207	638	3221	2990
" " 1902	3676	4296	4302	3281	5468	2819	1648	1320	669	1294	3764	3505	1408	2560	2201	2875	1603	2549	1345	1378	2020	586	2884	2804
Extension and Similar Courses	—	23,425	3085	—	153‡	—	—	—	—	—	—	—	246‡	—	—	124	136	203	—	—	—	—	239	—
Officers	478	376	646	517	593	430	87	165	193	122	385	272	182	235	310	333	193	405	188	118	215	91	353	387

? Estimated (see second item of double registration for Michigan and New Ynrk University)

*Includes schools of mines, engineering, chemistry and related departments

† Included in college statistics § Included under agriculture ‡ Figures for 1906-7

‖ Not a separate school; courses taken by undergraduate and graduate students in college or scientific school and graduate school, respectively completed the secondary school course. Taking these discrepancies into consideration, and not losing sight of the fact that large registration is not necessarily synonymous with great efficiency or high requirements, the impartial observer may nevertheless be able to draw some interesting conclusions from the figures herewith presented.

Comparing the figures for 1907 with those of the previous year, it will be seen that only three institutions have suffered a loss in enrollment, namely, Princeton (3.03 per cent.), Chicago (2.91 per cent.), and Yale (about 1 per cent.), the decrease in the last case being due to a falling off in the attendance on the summer session, there having been, on the contrary, a gain in the number of students registered in the fall. Last year California, Columbia, Johns Hopkins, Northwestern and Stanford all experienced a decrease. The largest gains in terms of student units this year were made by Columbia, New York University, Illinois, Wisconsin, Michigan and Minnesota; in other words, by two eastern and four western institutions, the two New York City universities standing at the head of the list. At Harvard, Nebraska and Virginia the enrollment has remained stationary, while all the other institutions show a fair increase. Comparing this year's enrollment with that of 1902, we notice that every institution included in both tables, with five exceptions, exhibits a growth in registration during the intervening period, the exceptions being California, Harvard, Johns Hopkins, Northwestern and Princeton, the largest gains during this five-year period having been made by Pennsylvania, New York University, Illinois, Michigan, Syracuse, Cornell, Columbia and Missouri, that is, by five eastern and three western institutions. Carrying the comparison a little farther by considering the *twelve* institutions that have made the most consistent gains during the past five years, we shall find that six of these are located in the east and six in the west, Iowa, Ohio, Minnesota and Yale being the four universities to be added to the eight mentioned above. As pointed out last year, the establishment of summer sessions is responsible for much of this growth in several instances.

According to the figures for 1906, the twenty-three universities included in the table ranked as follows: Harvard, Chicago, Michigan, Columbia, Cornell, Minnesota, Pennsylvania, Illinois, Yale, New York University, California, Wisconsin, Syracuse, Nebraska, Northwestern, Ohio, Missouri, Kansas, Stanford, Indiana, Princeton, Virginia, Johns Hopkins. Comparing this with the order for 1907, we notice that Columbia has resumed second place, while Michigan has passed Chicago. The changes are fewer this year than they have been for some time, the only other transpositions being New York University and Yale, Wisconsin and California, Indiana and Stanford, the institution first mentioned in each pair having passed the other since last year. Omitting the summer session registration, the order is somewhat changed, although practically identical with that of last year, the only changes in position being due to the passing of Harvard by Michigan, of Pennsylvania and Cornell by Minnesota, and of Syracuse and California by Wisconsin. The order this fall is as follows: Michigan, Harvard, Columbia, Minnesota, Pennsylvania, Cornell, Illinois, Yale, New York University, Wisconsin, Syracuse, California, Nebraska, Northwestern, Chicago, Ohio, Iowa, Missouri, Kansas, Stanford, Princeton, Indiana, Virginia, Johns Hopkins.

An examination of the individual faculties reveals the fact that the institutions continue to show a fairly general increase in the attendance on the academic department, although the gain is by no means as consistent as it was last year. At three of the prominent state institutions of the middle west we discover a decrease in the number of male students enrolled in the academic department going hand in hand with an increase in the number of women, while at several other western institutions the gain in the number of women is larger than that in the number of men. The exact opposite of the first condition is noticeable in the case of at least two of the eastern institutions, namely, Harvard and New York University, where we find an increase in the number of male academic students accompanied by a decrease in the number of women students. It is no doubt safe to draw the broad conclusion that there is a more pronounced tendency on the part of eastern girls to attend separate colleges for women, and this view is borne out by the fact that there has been a steady gain in the enrollment of colleges like Smith, Vassar, Bryn Mawr, etc., during the past few years. At California and Nebraska there are more than twice as many women as men in the academic department, Chicago, Indiana, Michigan, Missouri and Wisconsin being the only western institutions that enroll more men than women in the department under discussion, whereas at all of the eastern institutions included in the table there are more men than women in the academic department, with the possible exception of Cornell and Syracuse, which do not furnish the separate figures for the two classes. Wisconsin has 87 less men in 1907 than in 1904, but 138 more women; Indiana has 176 more women but only 7 more men, while Nebraska has 30 less men but 39 more women.

With the exception of Syracuse, Virginia and Harvard, all of the scientific schools show an increase, which in some cases is quite considerable, whereas last year three of the leading institutions in the east, namely, Columbia, Princeton and Yale, reported a decrease in the number of scientific students. It must not be forgotten that this year's falling off in the Lawrence scientific school at Harvard is to be explained by the gradual working out of the system inaugurated by the establishment of the new graduate school of applied science in 1906. Last year the professional schools of law and medicine showed a general decline in attendance, and this decrease has continued in medicine, while in law the number of students has remained practically uniform. Yale, New York University and Chicago have made the largest gains in law, while Indiana, Northwestern, and Harvard and Johns Hopkins report the largest increase in the number of medical students. It is interesting to note in this connection the figures given in the latest report (1904–05) of the commissioner of education, where we learn that the total number of law students in the country during the year under review was larger than ever before, namely, 14,714, whereas the number of medical students decreased by 1,114 to 25,835, which is smaller than the number of medical students in any other of the four preceding years. The reasons for this decline in the number of medical students were described in a previous article.

In contradistinction to last year, the graduate schools report healthy gains, a decrease being noted only in the case of Cornell, Kansas, Virginia and Yale. All of the agricultural schools, with the exception of those at Harvard, Ohio and Wisconsin, have also gained in the number of students. The schools of architecture exhibit a gain at every institution, with the exception of Pennsylvania, while dentistry has increased numbers everywhere, except at Illinois. Divinity, on the other hand, shows a loss at all of the institutions, except at Northwestern. The two institutions that report their forestry students under a separate category have made gains in this direction. Music, pharmacy and veterinary medicine remain fairly uniform, losses in some of the institutions being balanced by gains in others. Columbia is the only university that reports a noteworthy gain in pedagogy. The most consistent and largest gains in the actual number of students have been registered by the summer sessions, California, Chicago and Yale being the only schools that have suffered an appreciable decrease in enrollment.

Harvard continues to maintain the large lead that it has held for a number of years in the academic department. Inasmuch as Cornell and Syracuse do not separate men from women in the academic statistics, it is difficult to determine the exact order for men only, but taking both men and women into consideration, the order would be Harvard, Michigan, Wisconsin, Stanford, Chicago, Minnesota, California, Syracuse, Yale, Columbia—all of these enrolling over one thousand academic students. The largest number of scientific students is still found at Cornell, Michigan and Illinois being the only others that attract over one thousand students to their scientific schools; these are followed by Yale, Wisconsin, Ohio State, California, Pennsylvania, Nebraska, Minnesota, Missouri and Columbia, the order being exactly the same as last year, while Princeton has this fall joined the institutions that register an attendance of over five hundred scientific students. New York University continues to have the largest law school among the institutions in the list, with Michigan second, Harvard third, and Minnesota fourth, Harvard being the only one of the four to demand a baccalaureate degree for admission. The largest medical school is still found at Pennsylvania, Northwestern being second and New York University being third. As for the graduate schools, Columbia with an enrollment of 938 students (to the 715 in the table should be added 223 graduate students in Teachers College, who are omitted in the table for the sake of avoiding double registration) has by far the largest, Harvard with 442, Chicago with 381, and Wisconsin with 353 students, following in the order named. Minnesota has the largest school of agriculture, enrolling more than twice as many students as Illinois, its closest numerical competitor, while the latter leads in students of architecture, being followed by Columbia. New York University has the largest school of commerce, Pennsylvania has the largest number of dental students, Northwestern continues to lead in divinity, and Yale in forestry, although, as pointed out last year, some of the state institutions that include forestry under agriculture or elsewhere may actually have more students of forestry than Yale; Syracuse still has the largest school of music, and Columbia the largest school of pedagogy, while the college of pharmacy of the University of Illinois has passed Columbia's. As for the summer session of 1907, Chicago, Columbia, Harvard and Michigan attracted over one thousand students, Cornell, Indiana, Wisconsin and Illinois following in the order given. In the field of extension teaching the University of Chicago occupies a unique position, Columbia being the only other institution in the list that is pushing this phase of work with energy. Columbia continues to maintain the largest number of officers.

The reporting officers of the various institutions have in several cases kindly furnished interesting information with regard to changes in registration, equipment, etc., all of which is embodied in the following paragraphs. Wherever no such information was given, the comparison is based upon the figures contained in the table of last year (Science, December 21, 1906).

Mr. Sutton, recorder of the faculties, reports as follows for the *University of California:*

Our registration for November 1, 1907, as compared with that of the corresponding date in 1906, shows an increase of forty-five in the graduate school, of eighty-two in the undergraduate body in arts, science and engineering, and of one hundred and eight in the professional schools. The downward drift which has been observed for about ten years in the enrollment in the professional colleges in San Francisco has apparently been checked, as manifested by an increase of twenty-five students in law and thirty-four students in dentistry. The colleges of medicine and pharmacy, however, do not yet share in this reaction. Both of these colleges are undergoing some readjustment in their matriculation requirements. In the colleges at Berkeley—arts, science, agriculture, commerce and engineering—there is a fairly uniform advance, excepting only the college of letters, which requires both Greek and Latin for the bachelor's degree. In spite of the steady growth of the university as a whole, the number of students in the college of letters is less to-day than ten years ago.

Among the more important items of the university's growth during the past collegiate year are the following:

The Hearst memorial mining building, erected by Mrs. Phoebe Hearst in memory of the late Senator George Hearst, has been completed and was formally dedicated on August 23. The building and its equipment have cost to date about five hundred thousand dollars.

By grant of the state legislature, the university has come into possession of a farm at Davisville, California, a tract of some seven hundred acres, purchased by the state to facilitate the work of experimental agriculture in the university. The cost of the farm with its equipment to date is approximately one hundred and fifty thousand dollars.

John W. Mackay, Jr., has given the university one hundred thousand dollars for the endowment of a chair of electrical engineering and for the support of research work in the laboratories of electrical engineering and mechanics.

The Bancroft library of American—particularly of west-coast—history, which was purchased by the university at a cost of two hundred and fifty thousand dollars before the San Francisco earthquake and fire, has been brought from San Francisco, where it escaped all damage, to the third floor of California Hall, a fireproof building in which are housed the administrative offices of the departments at Berkeley. The regents of the university have entrusted the control and administration of the Bancroft collection to the council of the Academy of Pacific Coast History, an organization recently formed under the auspices of the University of California. The secretary and executive officer of the academy is Professor Henry Morse Stephens, sometime professor of modern European and English history in Cornell University, and now professor of history in the University of California.

A little over a year ago the university established a students' infirmary at Berkeley. During the past year the university has founded in San Francisco, using for this purpose one of the buildings of the College of Medicine, a university hospital, in which students of medicine will have an excellent opportunity for clinical work of the most varied sort. To get this project under way, friends of the university donated something over twenty-five thousand dollars.

The university's art college, an affiliated school formerly known as the Mark Hopkins Institute of Art, and now designated the San Francisco Institute of Art, found it necessary to suspend its work during 1906–07 on account of the destruction of its buildings. The school has resumed its work in a new building erected for it upon the site of the former building on the California street hill in San Francisco, and it already has an enrollment of sixty-nine students.

The Greek theater, the university's open-air auditorium in the eucalyptus grove on the campus at Berkeley, has been the scene of a long list of musical and dramatic events, in addition to the more formal university celebrations, such as charter day, classday and commencement. Perhaps the most novel production of the past year was the Sanskrit play, "The little clay cart," translated from King Shudraka (A.D. 600) by Dr. Arthur W. Ryder, instructor in Sanskrit in the university.

The foundations of the Doe library building are now in process of construction. For this building the late Charles F. Doe bequeathed to the university about six hundred thousand dollars. The foundations are to be completed at once and the superstructure built in sections, each section to be occupied as soon as completed. The cost of the entire structure will probably be one million dollars.

Mr. and Mrs. T. S. Brandegee, of San Diego, have donated their entire botanical collection and library to the university. As a result of this gift, the facilities for botanical research at the university are practically doubled. The university now possesses the most complete representation extant of Pacific coast flora.

Beginning with this year (1907–08) the university maintains a new administrative officer known as the alumni secretary. Mr. Gurden Edwards, of the class of 1907, has been appointed to this place. It is the duty of the alumni secretary to keep in active touch with the university graduates and former students, and to cooperate with the appointment secretary of the university in answering demands upon the university for men and women to take positions of responsibility in business and the professions.

The difficulty encountered in endeavoring to establish a just comparison of the enrollment at the *University of Chicago* with that of the other institutions has frequently been pointed out, nevertheless its fall quarter may be compared with the first half-year of the other institutions, as is done in the table. Comparing the enrollment of this fall with that of the fall quarter of 1906, we find that gains have been registered in all of the faculties, with the exception of medicine and divinity, which have remained stationary. The largest increase is found in the number of male students in the academic department, the gain being one of 62, while the law school has gained 37 students. The instruction given in the business center of the city in 1905–06 was withdrawn during 1906–07, a few courses being offered for teachers in the university buildings. This accounts for the change from 247 reported a year ago to 125 reported under "other courses" this year. The summer quarter shows a loss of 125 compared with that of 1906. In the extension division seventy-seven lecture-study courses are offered, the estimated attendance reaching 21,175, while 2,250 active students are enrolled in the correspondence-study courses.

The enrollment of *Columbia University* shows a considerable gain in comparison with the preceding year. The total gain is one of 547, the present enrollment of 5,197 being the high-water mark in Columbia's history. This is exclusive of 3,055 students who have thus far registered in extension courses at and away from the university and in evening technical courses. The total registration of resident students this fall shows a gain of 255 over 1906.

So far as registration by faculties is concerned, Columbia College shows a slight gain, the entering class being smaller, but an unusually large number of students having entered on advanced standing from other institutions. The tuition fees in the college have been raised considerably, and this has no doubt affected the registration, not sufficiently, however, to bring about a decrease in the total. Barnard College, the undergraduate department for women, shows a total gain of 22 and a gain of 10 in the entering class. The non-professional graduate faculties of political science, philosophy and pure science, have experienced the considerable gain of 130 students, all of the three faculties sharing in the increase. The schools of mines, engineering and chemistry exhibit an encouraging increase over last year, the figures being 585 and 524, respectively, and for the entering class 186 in 1907, as against 137 in 1906. A large number of students has also been admitted to advanced standing in this faculty. A uniform first-year curriculum has been established for the different schools in applied science, and opportunities are now offered to work off conditions in the summer session, in extension courses and in parallel courses offered by Columbia College. The results of the active administration of the new head of the schools of mines, engineering and chemistry are reflected in this year's heavy registration. Fine arts records the largest enrollment in its history; the registration in the department of music having remained uniform, while there has been a gain of 36 in the department of architecture.

The school of law, which now demands a baccalaureate degree for admission, shows a slight loss, namely, from 261 to 247. The entering class is a little smaller than that of last year, containing 103 students, inclusive of 18 seniors from Columbia College; the latter, however, are not counted in the total for the school. The standards for admission and advancement to the medical school were increased several years ago, and as a result there has been a gradual falling off in numbers, the figures for this year being 298, as against 352 in 1906. Ten Columbia College students are also registered in the school, bringing the actual total to 308. The college of pharmacy shows a decrease from 254 to 229, this loss also being due to the stricter requirements for entrance first enforced in 1905. The entering class, however, is larger than it was last year. Teachers College has increased its enrollment by no less than 165 students, in spite of the fact that its second-year class has been abolished, its first-year class having been withdrawn last fall. The grand total this year is 891, of whom 223 are candidates for the higher degrees (A.M. and Ph.D.).

The summer session of 1907 was the largest in the history of the institution, 1,350 students having been enrolled on Morningside Heights and 42 at the college of physicians and surgeons, the total number representing an increase of 351 over the summer of 1906. There is also a large gain in the number of students registered in extension courses, and the evening technical courses, first established last winter, have become exceedingly popular. The number of officers has increased from 571 in 1906 to 646 in 1907, this being exclusive of the instructors in the Horace Mann and Speyer schools.

The only new building to be chronicled this fall is Brooks Hall, the Barnard dormitory for women. Kent Hall, a half-million-dollar building for the school of law, is in process of erection. Hamilton Hall, erected at a cost of $500,000 for Columbia College, the undergraduate academic department, was completed and occupied last February, as was St. Paul's Chapel, the cost of the latter being about $300,000. Teachers College is erecting a domestic economy building, an anonymous donor having recently presented $400,000 for the development and support of a school of domestic economy. The university residence halls, Hartley and Livingston, are almost full at this writing, over five hundred rooms being occupied.

The incumbent of the Kaiser Wilhelm professorship this year is Professor Rudolf Leonhard, dean of the faculty of law of the University of Breslau, President Hadley of Yale being the second incumbent of the Theodore Roosevelt professorship at the University of Berlin.

At *Cornell University* the largest gains have been made by the scientific schools, the total increase being one of 89 students. The school of agriculture has gained 69, the academic department 48, and the school of architecture 17, students. On the other hand, the professional schools of law and medicine both show a decrease, the former of 6, the latter of 20, students, while the graduate school and the school of veterinary medicine both have 7 students less than last year. The 244 students mentioned under "other courses" are those in attendance on the short winter session in agriculture, there being 4 less than last year. The summer session shows an increase of 113 students, the grand total being 218 in excess of last year.

Harvard University reports as follows:

The increase of numbers in Harvard College, and the falling off in the Lawrence Scientific School, is to be explained by the gradual working out of the system inaugurated by the establishment of the new graduate school of applied science in 1906. This establishment has encouraged many students who were studying for the scientific professions to exchange the prescribed groups of studies in the scientific school for a more liberal course of studies in Harvard College, with the intention of doing their more advanced and specialized work in science, after graduation from the college, in the new graduate school of applied science. The gradual disappearance of the undergraduate scientific programs, and the absorption of their students in Harvard College may be expected. The schools of law and medicine show gains in enrollment, agriculture has lost twenty-one, divinity six, while the attendance on the graduate schools and the school of dentistry has remained stationary. The summer session shows a gain of fifty-one students. Of the graduate students, fifty-five are registered at Radcliffe.

Langdell Hall, the new building of the law school, costing between $300,000 and $400,000, is now ready for partial occupancy.

Within the last month the university has received a gift of about 2,000 acres of valuable timber land in Petersham, Massachusetts, which is offered as a special adjunct to the division of forestry, and therefore as part of the equipment of the graduate school of applied science. The forest included in this gift comprises what is probably the best body of timber now to be found on an equal area in Massachusetts. The division of forestry will supervise the Petersham forest, and conduct there a large part of its instruction. According to the probable arrangement of the curriculum, students who enter the graduate school of applied science to study forestry will be in residence at Petersham during a considerable part of the year. There they will take up in the first of their regular two years' course, and largely in the field, all their elementary work, including tree botany, the theory and practise of forest mensuration, and the whole subject of silviculture. This will lead them directly to the work of their final year, which is mainly devoted to lumbering, forest engineering, and the study of forest production as applied to actual problems. They will secure in combination the advantages of the German *Meisterschule*, with its provision of practical experience under direction, and of the university forest school, with its broad attention to theory and principle.

By the will of Mrs. Sarah E. Potter, of Boston, the university received in June, 1907, a bequest of $50,000 to be used and applied in connection with the Gray herbarium. As one of a number of residuary legatees, the university has subsequently received from the executors an addition to this endowment consisting of cash and securities of an estimated value of $130,000.

The *University of Illinois* shows consistent gains in every department, with the exception of medicine (where there has been a loss of 34 students), of dentistry (which reports a loss of 10), and of the schools of art and music (where the registration has remained stationary). The largest gain is in the school of pharmacy, namely, one of 89 students, while agriculture has gained 58 and the scientific schools 39. The students mentioned under "other courses" are enrolled in the five-year library course. The students enrolled under the head of "commerce" were last year included under the college of arts. These men have complied in full with the requirements for admission to the university, that is, they have completed the usual high school course, so that they are properly included here and not under the head of extension and similar courses. The commerce course is one of four years. There has been a gain of 53 students in the summer session, the increase in the grand total amounting to 362.

Indiana University reports a gain of 47 in its school of medicine and of 12 in its school of law, while the number of women in the academic department has remained stationary. The students in the graduate schools have been reported separately for the first time, and some of these may have been included under the academic department in previous years, thus partly explaining the loss of 89 male students in the college of arts. The summer session shows a gain of 39, the gain in the grand total being one of 152.

Inasmuch as the *University of Iowa* is included for the first time this year, no comparisons by faculties can be made with last fall. The students mentioned under "other courses" are registered in the training schools for nurses. In order to avoid duplication, the students enrolled in courses in art, commerce and pedagogy are not indicated under these categories, but included in the college of liberal arts. More than one half of the students registered in the school of music are not registered in any other department of the university, the remainder carrying work also in the college of liberal arts, for which their credentials show them to be properly prepared.

The university occupies for the first time this fall its new hall of natural science. The building has been erected at a cost of $300,000, is of Bedford stone, four stories in height and fireproof in construction. It houses the museum of natural history, the department of zoology, including biology and—temporarily—the university library. The building also contains a large auditorium.

During the past summer the regents organized the school of education within the college of liberal arts. Professor Bolton, of the department of education, was made director of the school, the work of which is to prepare teachers for the high schools, principalships and superintendencies. There are 240 students in the school, all of whom are included in the enrollment of the college of liberal arts. The college of law and the college of homeopathic medicine increased their requirement for admission from three years of high-school work to four years. In spite of this fact, both of the colleges show an increased attendance this fall. Forty-four of the 302 medical students are enrolled in the college of homeopathic medicine. There has been no change in tuition fees, and no special reason is apparent for the increase in attendance this fall. The attendance at this time is 220 ahead of the enrollment at the corresponding time last year, this being regarded as a normal increase.

The medical school of the *Johns Hopkins University* shows a gain of 29 students, while the graduate schools have gained 4. The enrollment in the college is exactly the same as last year, the total gain, therefore, amounting to 33 students. The undergraduate course has been increased to four years (instead of three), and the restrictions against the admission of women to the graduate courses have been removed. There are this fall 23 women in the school of medicine and 5 in the graduate school.

The *University of Kansas* submits the following report:

The total number of undergraduates in the college of liberal arts and school of engineering is 1,279, a gain of 194 as compared with November 1, 1906. This is the largest number of undergraduate students ever enrolled at this period of the academic year. The gain in attendance in all the schools of the university is 243, or 13.6 per cent. This increase in attendance is largely due to the closer relationship of the preparatory high schools. Under the direction of a high-school inspector, the number of accredited preparatory schools whose graduates are admitted to the freshman class without examination has been brought up to 190, and by the operation of the Barnes law, recently enacted, the number will be increased to nearly 250 by another year. Slight losses have been suffered by the schools of law, medicine and music, and by the graduate schools.

The principal additions to the equipment of Kansas University during 1906–07 were as follows: Robinson gymnasium was completed and is now occupied. The cost of the building, including equipment, was $100,000. Its facilities are such that a very large number of students may receive physical instruction at one time. The Eleanor Taylor Bell memorial hospital and clinical laboratory were completed and occupied by the school of medicine at Rosedale. These buildings cost $90,000.

During the current biennium, by the generosity of the state legislature, the equipment of the engineering school will be materially increased. Work is now in progress on a general engineering building to cost, with equipment, $150,000. A mining engineering building will be erected at a cost of $50,000, and $50,000 will be put into additional shops. General repair shops, to cost $7,000, and additions to the heating system, to cost $7,752, will be erected. The law library will be increased by the addition of $6,000 worth of books.

The moral tone of the institution has made decided advances. A distinctive feature of university life is the large attendance of students and faculty at the daily chapel services. Chapel attendance is not compulsory, yet within six years the attendance has increased from a mere handful to an attendance ranging from 800 to 1,500. The result is a unified college spirit, and, in all probability, the main contributing cause to the complete cessation of student disturbances. During the past two years there has not been a class fight or a single case of hazing at the University of Kansas. Every student enterprise receives marked support; 1,400 students have paid voluntarily two dollars each into a student enterprise fund which is managed by the university and distributed among the athletic, musical and debating organizations of the students. The payment of this sum entitles the student to admission to all entertainments by these organizations.

The total enrollment of the *University of Michigan* shows a gain of 279 students over last year, the increase in the fall registration alone amounting to 318. The largest gains have been registered in the academic department and in the scientific schools, the graduate school, and the schools of law, dentistry and pharmacy having remained stationary. Medicine shows an increase of 22 students.

Beginning with the fall of 1909, admission to the medical school will be exclusively through the literary department, and no student will be admitted to the medical school who has not secured sixty hours of credit from the literary department.—The fees in the law school have been increased by ten dollars a year.

A new dental building, to cost $150,000, is in course of construction; also an alumni memorial building and art gallery to cost $200,000. Plans are being prepared for a chemical building to cost $250,000.

The largest gain at the *University of Minnesota* has been made in the college of agriculture, there being 164 more students than there were last year. The scientific schools report an increase of 51, the school of pharmacy of 14, and the school of dentistry of 13, students. There are 44 more women in the academic department, but 6 less men. The professional faculties of law and medicine both show a decrease—the former of 17, the latter of 21, students, while the graduate schools have gained 12. The summer session remained stationary, the gain in the grand total amounting to 263. The registrar reports as follows:

Undoubtedly the standard for admission to the professional and technical schools will continue to be raised. The college of medicine and surgery requires two full years of college work as premedical preparation. It has gone a step further and now specifies that these two years shall include a year of physics, a year of general inorganic chemistry, one year of qualitative analysis, one year of biology and one year of language, either German or French.—The college of law is now admitting graduates from accredited schools, and will undoubtedly require one or two years of academic work in the near future.—The college of engineering is considering the advisability of extending the present four-year course to five or six years, and including correlated courses in the college of science, literature and the arts. A combination of work in the college of science, literature and the arts with the courses in the professional schools seems to be more in demand. Students may now in their senior year in the college of science, literature and the arts elect dentistry, and thereby receive two degrees in six years. Students may elect medicine in their senior year and receive two degrees in seven years, or by electing law receive two degrees in six years.

The total registration at the *University of Missouri* shows a gain of 203, no unusual conditions having affected the increase in registration. The percentage of increase for the entire university is practically the same as during the last three or four years. The decreased registration in the professional faculties of law and medicine is ascribed to increased entrance requirements recently established for these departments. The only other school registering a loss is that of pedagogy, where there are 25 students less than there were last year.

The total attendance at the *University of Nebraska* is practically identical with that of last year, although a gain is expected before the close of the year. In last year's table 200 students were included under "other courses," whereas no figures are given under this item for 1907, and this fact may explain the apparent absence of a healthy increase. The largest gains were registered in the schools of music (85), agriculture (60), and the scientific schools (51). All of the other faculties, as well as the summer session, have remained to all intents and purposes stationary.

New York University again reports a considerable increase over last year, the largest, one of 131, being found in the school of commerce. The loss of 16 women in the academic department is offset by a gain of 16 men. The law school has gained 39 students, the medical school 27, and the graduate school 30. The department of veterinary medicine reports a decrease of 11 students, while the scientific schools have gained 7. The summer session of 1907 had 189 students more than that of last year.

Northwestern University has been in the habit of including in its statistics the students enrolled in its various preparatory departments, and consequently the earlier figures in Science do not seem to agree with the reports occasionally found in the press. One thousand one hundred and seventy-one students were reported by this university under "other courses," but only 131 students in the school of oratory and 167 students in the Evanston Academy that are taking courses in the college of liberal arts, in the school of music, in the theological departments and in the school of oratory, have been included, whereas 124 students, who apparently do not belong to the preparatory departments, are given under "extension courses." No figures were given last year under summer session, whereas there was an enrollment of 265 in the summer session of 1907. Mr. W. H. Long, secretary to President Harris, writes as follows:

Every item is an increase over last year at this time, and should the later registrations equal those of last year, the total attendance for the year will show a gain of more than 200. It may be of interest to note that the suspension of intercollegiate football for a term of years has not been followed by a decrease in the attendance on the college of liberal arts. The attendance in medicine has been increased partly because new requirements for admission are announced to go into effect in January, 1908.

Work on the new engineering school will begin in the fall of 1908. The course of study will extend over five years, to be extended later to six years. The course will include a large element of general culture studies, and is intended to lay the foundation for practise in any line of engineering. The new engineering laboratory, the gift of Mrs. G. F. Swift and Mr. Edward F. Swift, will be in process of construction before the year is out. The plans have been submitted and it is expected the building will be in use before the end of the next college year.

Plans are under consideration for the inauguration of a dormitory system for men. The gift of Mr. William Deering is available for the erection of the first building and it is expected that ground will be broken before the end of the college year.

Carefully laid plans have been prepared by architects and landscape gardeners for the development of the campus. This plan will lay out sites for future buildings, and includes the landscape development of the Evanston property. It is expected that it will result in a group of buildings and a campus among the most noteworthy in the country. Courses for teachers and courses in finance and accounting, in the Northwestern University building in Chicago, have been inaugurated, and have proved popular.

The following report was received from *Ohio State University:*

The enrollment for the year shows a good healthy increase in all colleges except the colleges of law and pharmacy. The slight shortage in the college of law may be due to the organization of a combination arts-law course, whereby a student is able to obtain two degrees in six years, instead of seven, receiving the A.B. degree at the end of the fourth year and the LL.B. degree two years later. Instead of entering the law college at the end of the second year of the arts college work, the students have deferred doing this until the end of the third year and have become candidates for the two degrees. The increased enrollment in the college of agriculture and domestic science is in the course in domestic science. The demand for teachers in this line of work for the secondary schools is probably responsible for this increase.

The university announces the organization of a college of education which was opened at the beginning of the fall term. The organization of the college was authorized by legislative enactment at the first session of the seventy-seventh general assembly. Its purpose is to aid in the execution of the policy of the state to furnish training for teachers. To that end opportunity is afforded for preparation for the work of teaching in high schools and normal schools, of superintending schools, of supervising special branches, and of acquiring a knowledge of, and a right attitude toward, education. Two general classes of courses of study have been provided. The first consists of four-year courses leading to the degree of bachelor of science in education; the second consists of certificate courses two years in length. In the four-year courses, the first two years are given largely in the college of arts, philosophy and science.

A special course in dairying has been established to meet the demand for a short practical course of training in the handling of milk and in the manufacture of milk products. It is intended primarily for those desiring to engage in buttermaking or cheesemaking, and those interested in the city milk supply, and who are unable to avail themselves of the advantages offered by the longer courses given in the college of agriculture. The course will extend over a period of twelve weeks, beginning December 2.

The university has been offering special opportunities in the line of manual training for teachers in its summer term. A course for artisans has been included in the course of study for the summer term of 1908.

The new buildings which were authorized by the seventy-seventh general assembly are well under way and will be ready for occupancy before the year is over. These include buildings for electrical and mechanical engineering, cattle and horse barns and judging pavilion, and a dormitory for women.

Forty-five of the scientific students and 49 of the agricultural students are registered in the short courses, which are two years in length, and 16 of the students mentioned under "other courses" are enrolled in the so-called short course in domestic science, which also extends over two years.

The *University of Pennsylvania* has experienced a total gain of 200 students, the largest increase being found in the scientific schools, namely, one of 70. The graduate schools have gained 54, dentistry 33, veterinary medicine 20, and law 7, students. The academic department shows a loss of 37, and architecture one of 29, while the schools of medicine and music have remained stationary. The students given under "other courses" are distributed as follows: Twenty-five regular students in biology, 332 special and partial students, 345 students in the college course for teachers leading to the baccalaureate degree in arts or science, and 222 students in the evening school. In addition, 203 students were reported as evening school specials and were transferred to "extension and similar courses," on the supposition that they were not students who had completed a high-school course. The summer session shows a gain of 88.

Princeton reports a decrease of 41, there being a loss of 93 in the academic department, as against a gain of 48 in the scientific schools, and of 4 in the graduate school. The entering class numbers 322, as compared with 323 last year, 385 two years ago, and 347 in 1904.

Stanford University shows a gain in the grand total of 64 students. Last year 140 students were counted twice, while all double registration was done away with this fall. As a result, it is impossible to compare the attendance of the separate faculties with that of last year. It may be well to point out again, however, that the number of women is limited to 500, and that the number of men in the undergraduate schools and in the law course is also strictly limited.

Syracuse reports a total gain of 158 students, about half of which is found in the summer session. All of the schools show a gain, although in some the increase is very slight. The engineering school and the teachers college show an apparent loss, but this is due to the fact that last year the enrollment in these schools included a number of duplicates which have been eliminated this year.

The buildings now under construction are the Bowne hall of chemistry, which is, however, partly occupied; the Lyman hall of natural history, a section of which is occupied; the stadium, to seat 20,000 people, which will require about a month's work to finish, and the gymnasium, the foundations of which are in. The latter is to be a four-story building with glass dome. The plans call for a structure 150 × 210 feet. The ground floor comprises rooms for home and visiting teams near the entrance to the stadium, for a bowling alley and baseball cage, for a rowing-room and a swimming-pool and for offices; the first floor contains a large social hall, shower-room and drying-room, trophy-room, etc., also 3,750 lockers. The second floor contains the gymnasium proper, 100 × 208 feet, a kitchen, property-room, rooms for managers, coaches, etc. The top floor has the running track, twelve laps to the mile, lighted from above. The gymnasium will be nearly two years in building.

The *University of Virginia* shows a gain of 12 in its total, there being an increase of 38 men in the academic department, and of 15 in law, which more than offsets the loss of 9 in the scientific schools, of 30 in the school of medicine, and of 13 in the graduate school.

The following is the report from the *University of Wisconsin:*

The total increase in attendance at the university this year, as compared with last year's registration for the corresponding date, is 309. A loss of four students is shown in the college of law; this is probably due to the fact that the college has just added an additional requirement of one year's college work for admission, making the requirement for admission to the college of law two years of college credit, instead of one, as was required for last year. Our courses in commerce, pedagogy and pharmacy are included under the general head of the college of arts, and are integral parts of this college. The enumeration of the students taking these courses, therefore, with the exception of pharmacy, is included under the general head of college of arts. On the other hand, the number of graduate students has been deducted from the separate colleges, where they were included last year, and are given now only under the head of graduate school. In the graduate school are included the graduate students in attendance at our summer session, the total number of 353 graduate students including 151 who were in attendance at the summer session only, and this latter number is consequently deducted in determining the grand total. The summer session graduate students are affiliated with this school, and many of them become candidates for the higher degrees on the completion of their work, which is limited entirely to attendance at the summer session.

Owing to a decrease in the summer-session attendance, the grand total of students in attendance at *Yale University* this fall shows a loss of 42 compared with last year. The summer session is to be withdrawn entirely in 1908. The largest gain, one of 46 students, has been made by the school of law, while the Sheffield scientific school shows a gain of 32. In addition to the 961 students mentioned in the table, there are 145 graduate students in the scientific school who are included under "graduate school." The academic department has lost 36 students, and it is interesting to observe in this connection that the gain in the academic department since the fall of 1904 is one of 28 students, as against an increase of 187 students in the Sheffield scientific school. Medicine reports a loss of 18, and the graduate school one of 17 students, while the other departments have remained practically uniform.

In endeavoring to compile a table showing the number of degrees granted by the various institutions in the list during the academic year 1906–07, considerable difficulty was experienced by reason of the large variety of degrees awarded. Although it was found impracticable to present this material in tabular form, it may nevertheless be of interest to consider some comparisons in this field. Taking the total number of degrees awarded in course, exclusive of honorary degrees and of diplomas for teaching and the like, it is seen that the greatest number, namely, 1,187, was awarded by Harvard, the other institutions ranking in the following order: Michigan, 876; Columbia, 809; Yale, 800; Cornell, 714; Illinois, 616; Pennsylvania, 557; Chicago, 538; Wisconsin, 516; Northwestern, 508; Minnesota, 502; California, 482; New York University, 409; Princeton, 336; Syracuse, 327; Iowa, 325; Nebraska, 296; Indiana, 291; Missouri, 263; Ohio State, 249; Kansas, 246; Stanford, 234; Johns Hopkins, 154, and Virginia, 141. The largest number of honorary degrees, namely 30, was granted by Yale, Pennsylvania following with 27 and Harvard with 22. Several institutions gave no degrees *honoris causa*, the average number for the other institutions that did award them being five each.

Harvard, with 589, leads in the number of bachelor of arts degrees conferred; Yale, follows with 347, and then come Michigan, 316; Wisconsin, 250; Stanford, 219; Minnesota, 193; Columbia, 189; Indiana, 186; Nebraska, 166; Cornell, 154, and Princeton, 151. The degree of bachelor of philosophy is still popular at Yale, where it was conferred upon 211 graduates of the Sheffield scientific school; at Chicago, where it was awarded to 189 graduates, and at Syracuse and Wisconsin, where it was given to 110 and 28 students, respectively. The degree of bachelor of letters is in vogue principally at California (148), Virginia (60), and Princeton (58). Most of the institutions on the list award the degree of bachelor of science, but it is difficult to determine in every instance whether it is given on the completion of a college course or upon the completion of a professional course in engineering, chemistry, architecture, or the like. It is not at all a rare occurrence to have the degrees of civil engineer, electrical engineer, mechanical engineer, and engineer of mines, conferred for graduate work, the B.S. being given upon the completion of the regular undergraduate engineering course. Michigan, for example, awarded 154 bachelors of science in engineering, but only 2 E.E.'s and 2 Mech. E.'s, and similarly, Pennsylvania awarded 65 B.S.'s in engineering, but only 3 Mech. E.'s, the same custom being followed at Iowa, Missouri, Nebraska and New York University. Grouping together the various kinds of engineering degrees as well as those in the related departments of chemistry and architecture, we find that Cornell heads the list with 347, followed by Michigan, 158; Pennsylvania, 100; Columbia, 94; Ohio State, 79, and Missouri, 75. However, California granted 162 B.S.'s, Illinois, 161; Wisconsin, 119; Harvard, 96; Chicago, 75; Pennsylvania, 72, and Northwestern, 69, and some of these may have been awarded at the completion of a professional course.

The greatest number of baccalaureate degrees in law was awarded by Michigan (214), which is followed by Harvard, 196; New York University, 129; Minnesota, 87; Columbia, 75; Pennsylvania, 73, and Yale, 72. New York University also gave 16 LL.M.'s and 3 J.D.'s, while Chicago gave 30 J.D.'s to students who held a baccalaureate degree in arts or science before entering the law school. In medicine (M.D.) the order is as follows: Illinois, 147; Northwestern, 131; Pennsylvania, 113; Columbia, 93; Cornell and Johns Hopkins, 72; Harvard, 70, and New York University, 68. Degrees in veterinary medicine (D.V.M. or D.V.S.) were granted as follows: Cornell, 32; Pennsylvania, 27; Ohio State, 18, and New York University, 7.

The A.M. is by far the most popular of the master's degrees, although most of the institutions still grant the master of science, while Chicago, Syracuse and Wisconsin give the master of philosophy, and Chicago the master of letters. The largest number of A.M.'s was given last year by Columbia—193; Harvard with 152, Yale with 69, and Princeton with 52, being the only other institutions that awarded more than fifty. Chicago, with 54, leads in the number of Ph.D. degrees conferred, and is followed by Columbia, 42; Johns Hopkins, 35; Harvard, 33; Pennsylvania, 26; Yale, 23, and Cornell, 19.

Illinois leads in the number of degrees conferred upon students of agriculture—43, and is followed by Cornell with 34. New York University granted 32 degrees in commerce. Pennsylvania, with 95, leads in the number of dental degrees, being followed by Northwestern, 88; Michigan, 46; Iowa, 38, and Illinois, 34. Chicago granted 23 degrees in divinity, Yale 11, and Harvard 7, while Yale conferred 25 degrees in forestry and Syracuse 14 in music. Columbia leads in the number of bachelor's degrees in education—103, Missouri awarding 42; New York University, 37, and Chicago, 21. Northwestern granted 81 degrees in pharmacy; Illinois, 30; Michigan, 28, and California, 27; Columbia only gave 12, but to this number should be added the 110 given by the New York college of pharmacy. The largest number of diplomas (not degrees), namely 219, was conferred by Columbia University to students of the Teachers College.

Rudolf Tombo, Jr.,
Registrar

Columbia University

EVOLUTION AS IT APPEARS TO THE PALEONTOLOGIST[1]

I desire to introduce this paper by the statement of a law which seems to be axiomatic, although it is largely ignored by biologists. I may term it the *law of the four inseparable factors.*

These four factors in the life of organisms are known to us under the terms heredity, ontogeny, environment and selection. The following statement regarding these factors expresses the whole truth:

1. The life and the evolution of organisms invariably center around processes which, in our observations, are grouped under heredity, ontogeny, environment and selection.

2. These have been inseparable and interacting from the beginning.

3. A change introduced through any one of these factors causes a change in all.

This I believe to be the most fundamental law of biology; far more fundamental than the well-known biogenetic law. Yet a survey of recent discussion among biologists as to the theory of evolution shows broad lines of division into several schools of opinion strictly according to the factor from which the subject has been approached. It is true that, conceiving any one of these principal factors as separable, we become involved in endless difficulties; conceiving them as inseparable and continuously interacting under natural conditions, we reach the only true conception of the evolution process. Of these four factors *selection* is the only one which can be experimentally removed through the agency of man; heredity, ontogeny and environment may be modified but they can not be removed.

I shall not stop here to demonstrate, as I shall do elsewhere, that changes may be initiated or find a gateway through any one of these four factors; I shall state simply that under certain circumstances heredity, under other circumstances ontogeny, under still others environment, or finally under selection, a new order of adjustments begins in animals and plants and a new series of characters appears. When such a new order sets in through any one of these

[1] Address before the Seventh International Zoological Congress, Section of Paleozoology.

factors a readjustment of all the others sooner or later ensues.

There are two other laws which I personally regard as demonstrated, although they have not yet reached the stage of axiomatic truth. These are: (4) that all changes in ontogeny, environment and selection sooner or later are reflected in heredity; (5) that all changes in heredity originate (*a*) either from within (keeping in mind always the law of the four inseparable factors) or (*b*) they originate from without through ontogeny, environment or selection.

The *origin of new characters,* not the origin of species, is the central problem in evolution. In using the word *originate* I do not imply *cause;* I use "originate" simply to imply appearance in order of time.

I. HEREDITY AS IT APPEARS TO THE PALEONTOLOGIST

I may now restrict the present discussion to heredity as it appears to the paleontologist. As compared with his brother and sister zoologists the paleontologist enjoys certain peculiar advantages and labors under certain disadvantages.

First, it is a decided advantage that the paleontologist as an observer is practically immortal; that is, if the two or three million years in which he is able to follow certain characters constitute a reasonable longevity. Concentrating his attention on the *history of individual characters,* entirely irrespective of the species question, which is wholly a by-question, the paleontologist may trace such individual characters from their origin through their various changes, through their entire history, in fact. In this sense he is immortal. The zoologist and experimentalist (*e. g.,* de Vries, Bateson, Morgan), on the other hand, is mortal. First, he is not always in a fair position to judge which characters are important and which are unimportant. This, for instance, is the chief difficulty with Bateson's first great work, "Materials for the Study of Variation." Second, the zoologist and experimentalist is too short-lived to observe and measure those changes, if such exist, which are so excessively slow as to be invisible and immeasurable by his mortal eye, and he is most naturally led to the conclusion that visible, observable and measurable changes, viz., *saltations, discontinuities* or *mutations* (of de Vries) are the most important if not the only changes.

Having pointed out the peculiar opportunity of the paleontologist, let us omit discussion of all other modes or sources of change and concentrate our attention on what is certainly the most vital point, namely, the *origin of new characters in heredity.* We shall, therefore, begin by considering this origin as a question not of ontogeny, nor environment, nor selection, but of heredity pure and simple. By this statement we do not commit ourselves either way upon the question of the inheritance of new ontogenetic or environmental characters, we simply confine the subject to changes which first appear through heredity, that is congenitally or at birth.

II. THE RATE OF ORIGIN OF NEW CHARACTERS

Thus we come to the *paleontologist as a student of heredity.* What are his peculiar advantages and disadvantages in this limited field of observation? Our answer is a bit embarrassing because we find that as to the velocity or suddenness of origin of characters paleontologists have not thus far agreed; they have reached two opposite opinions, as follows:

First opinion: *Hypothesis of sudden appearance.* This was first set forth by Geoffroy St. Hilaire, and has been advocated by Cope, Dollo, Smith Woodward and other paleontologists.

Two unanswerable criticisms of this opinion may be made. First, in attempting to support this hypothesis of sudden origin by inductive evidence the paleontologist is certainly at a great disadvantage through deficiency of material. In order to demonstrate a sudden change, a discontinuity or a saltation in single characters, one must have all or a very large number of contemporary individuals for comparison. I maintain, therefore, that the paleontologist can never demonstrate a discontinuity, because he must always entertain the suspicion that it may arise from lack of evidence. The zoologist and experimentalist, on the other hand, may demonstrate a discontinuity for the reason that they may have at hand large series of contemporary individuals for comparison. The paleontologist is never favored in this way.

Second, the paleontologist can never prove that the appearance of a new type combining a *number* of adaptive characters is a sudden appearance, because he must always admit the possibility that such a type may have slowly evolved elsewhere and come into the field of his observation suddenly through migration. Thus I maintain that the hypothesis of Cope, Dollo and Smith Woodward as to the sudden appearance either of new adaptive characters or of new types does not rest on a demonstrable foundation so far as paleontology is concerned.

These criticisms, however, in no way invalidate the numerous observations of these and other paleontologists, among both vertebrates and invertebrates, that new adaptive types do suddenly come into the field of observation in geological horizons and mark the beginnings of rapid evolution.

Finally, I am neither opposing nor advocating the so-called "mutation theory" of de Vries; I simply assert that paleontology is not a branch of biology in which this theory can be either proved or disproved.

Second opinion: *Hypothesis of gradual appearance.* So far as I know, this hypothesis is solely paleontological in origin, and is to-day chiefly maintained by certain, although not by all, paleontologists. I regard it as the greatest contribution which paleontology has made to evolution. So far as I know, the first to express it was Waagen (1869). He distinguished *mutations* from local or geographical variations. The mutations of Waagen can only be observed in successive geological levels, *i. e.*, at intervals of many years. They are very constant, although seen in minute features, and can always be recognized again. This was Waagen's original definition of mutations as distinguished from the more conspicuous contemporary fluctuations.

This law of Waagen received the powerful support of Neumayr (1889) and of many other invertebrate paleontologists, and it is receiving fuller support daily. As regards the vertebrates, Osborn in 1886, at the time ignorant of Waagen's law, made the same observation in the study of the teeth of mammals, and termed it the law of "definite variation." It has since been confirmed and extended on a very large scale. Thus vertebrate and invertebrate paleontologists working entirely independently of each other on wholly different materials have reached similar opinions. This *law of gradual change in the origin of single characters, measurable only at long intervals of time, rests on a vast number of observations.*

III. THE ADAPTIVE QUALITY OF NEW CHARACTERS

So much for the older history of the subject.

I may now, as a paleontologist, add *three* supplementary statements as to the origin of new characters by heredity which, it is true, rest upon a large number of my own observations, but still requires collateral evidence and further examination by others.

First: *That such origins are adaptive in direction from the beginning.* The cusps of the teeth of mammals offer a peculiarly advantageous field of observation because they are born complete, and, unlike most other organs of the body, they do not depend upon ontogeny for their perfection, in fact, ontogeny and environment destroy rather than perfect them. In seventeen orders of mammals, in thousands of species, and in millions of individuals, a very limited number of similar cusps rise in the teeth; the number is eleven in all. So far as observed: (1) they rise independently, (2) they rise gradually, (3) they rise adaptively; hence I have termed them "rectigradations," *i. e.*, rising continuously, orthogenetically, in definite or straight lines, and finally reaching a condition in which they may be considered adaptive. This phenomenon I first observed in the teeth and later in the origin of horns.

Second: *That such origins are predetermined by hereditary kinship.* This statement, or rather hypothesis, is supported by observations of two kinds. Without interbreeding, animals of similar kinship, near or remote, in different parts of the world originate independently similar characters. For example, the Eocene Equidæ evolved the same cusps in the grinding teeth simultaneously in Switzerland and in the American Rocky Mountain region.

This example has to meet the criticisms, (1) by the paleontologist Depéret, that this is not an independent evolution, but that these rectigradations *are* due to actual community of descent brought about by migration and interbreeding; (2) there is the older criticism of the selectionists, that these similarities are due to the similar action of natural selection working upon fortuitous variations in different regions.

Neither of these explanations is tenable, in my opinion.

Third: *This predetermination is due to a similarity of hereditary potential.* That is to say that animals of similar kinship do not continuously evolve in certain directions, but merely transmit a similar potentiality in the origin of new characters. This both renders possible the occurrence of certain characters and conditions or limits these characters when they do occur. For example, in a certain series of extinct mammals we can predict where a new cusp will arise before its actual occurrence.

As to these three propositions, which are enormously important, if true, we make six notes.

We note (1) that only through some restraining or limiting law of this kind can we explain the marvelous uniformity in the fundamental structure of the teeth of mammals which has now been observed in all orders of mammals except four.

We note (2) that this is not identical with the internal perfecting tendency of Nägeli, because under the law of the four inseparable factors, it operates, in a manner adaptive to new conditions which is entirely incomprehensive to us. Thus, for example, if a primate (a monkey or lemur) begins to imitate the habits of an ungulate by becoming herbivorous, it also begins to acquire the dental cusps of an ungulate in about the same order as these cusps would arise in an ungulate; thus some of the Eocene monkeys so closely paralleled the Eocene ungulates in dental structure that they were at first placed in the order Ungulata.

We note (3) that the kinetogenesis or Neo-Lamarckian theory of Cope and Ryder apparently fails (as pointed out by Poulton), *especially* when applied to the teeth, because the teeth appear through the gums fully formed and are not modified or improved by use, but, on the contrary, are destroyed by use.

We note (4) that there appears to be an analogy between heredity and ontogeny. This hurrying up or acceleration of characters in heredity parallels the acceleration of useful characters in ontogeny. In other words, from unknown causes (even if the Lamarckian inheritance is admitted) characters are accelerated (hastened) or retarded (slowed up) in development, according to the needs of the animal. Thus there arises this most interesting analogy between the hereditary origin of new characters and the subsequent ontogenetic history of characters after they have reached a presumably adaptive condition. In other words, just as the lateral digits of the horse are retarded and the median digits are accelerated, so the origin from unknown causes of new characters is accelerated or retarded, according to the needs of the animal. For example, a postero-internal cusp of the upper grinding teeth, known as the hypocone, and the intermediate cusps, known as the conules, are retarded in hereditary origin in insectivores and in frugivorous animals; they are accelerated in origin in herbivorous animals.

We note (5) that our failure to see any reasons or causes of these timely hereditary origins of new characters has no bearing whatever on the fact of the existence of such origins, *that fact is a matter of direct observation independent of hypothesis.* For my own part I have for many years (ever since I observed this fact and recognized all the difficulties in the Lamarckian explanation) stood as a complete agnostic as to the cause of such origins. I now repeat that we have no conceivable explanation at present.

We note (6) that an important distinction must now be made, namely, that such origins of new characters are chiefly numerical; something is added to the organism which did not exist before, the rudiment of a cusp, or the rudiment of a horn. The changes of form of proportion and of modeling, follow after.

A very interesting thought has just come to me during the preparation of this paper, a paper which summarizes the conclusions I have been gradually forming in the last twenty-one years. The thought is this: That *theoretically there is no conflict between the hypotheses of continuity and discontinuity.* If there does exist hereditary predisposition to evolve in a definite direction, it may manifest itself suddenly, as a saltation, or a "mutation of de Vries," or very gradually as a rectigradation, or "mutation of Waagen."

SUMMARY

The following facts are those which are put forth through paleontological observation, for verification by others:

1. That many origins of new characters are through some internal action in heredity.

2. That many important adaptive characters arise determinately, definitely, but by extremely slow stages.

3. That degrees of similarity in such origins correspond with degrees of kinship.

4. That degrees of kinship also affect to a certain extent, but not absolutely the time of appearance, or the time of the origin, or the rate of evolution.

5. That such origins find expression not spontaneously, or irrespective of conditions, or from purely internal mechanical causes, but through some entirely unknown and at present inconceivable relation to ontogeny (habit and use), to environment (external conditions), and to selection.

6. That if such origins do spring from internal hereditary principles, as they appear to do in many cases, slow origins (mutations of de Vries) may be simply

due to the same law operating with a different velocity.

Henry Fairfield Osborn

SCIENTIFIC BOOKS

Temperatur und Zustand des Erdinnern—eine Zusammenstellung und kritische Beleuchtung aller Hypothesen. Von Herrmann Thiene. Jena, Fischer. 1907. Pp. 107. Price two and a half marks.

This useful paper is the result of a prize offered by the Jena philosophical faculty for a critical review of the literature and theories as to the temperature and state (solid, fluid or gaseous) of the earth's interior—a useful undertaking since the literature is much scattered. Astronomers, mathematicians and physicists as well as geologists, have contributed to it. The conclusions of the author, an assistant in the Jena Mineralogical Institute, are that the earth has an outer crust, of the composition of diorite, and an iron core. The surface density is about 2.8; the mean density is between 5.4 and 5.7. The density at the center according to Stieljes must be between 7 and 12.16, having due regard to all the facts, including the moment of inertia (resistance to change in its axis of rotation and the effect of the attraction of the sun and moon on the equatorial bulge) and the difference of gravity at pole and equator. Thiene does not describe the methods, but the results and assumptions merely of the different writers. The reviewer would note that our knowledge of the density must be the more inaccurate the nearer the center since the density of any ellipsoidal layer has less and less importance and effect either on the mass or the moment the nearer the center respectively the axis of rotation it is. Laplace's law of density is shown by the author to agree with the known facts. But any law in which the constants were so taken as to be consistent with the known data would, if expressed and expanded in a series in which the density is a function of the ratio of the distance from the surface of the earth to its radius, according to Maclauvin's theorem, reduce to Laplace's law for the first two terms.

It is obvious, though Thiene does not remark it, that other things being equal the law of density will be different and the densities at the center less if the temperature keeps on increasing clear to the center than if it increases less rapidly or attains a maximum.

Thiene leans to the view that the temperature increases toward the center more and more slowly from a rate of something like 1° C. in thirty-three meters to begin with so that the greatest heat reached is probably from 2,000° C. to 10,000° C. He is not aware of the arguments of See and Chamberlin for an increase in temperature clear to the center and a possible increase in the gradient. He would attribute the heat to the original warmth of condensation. The Kant-Laplace theory is taken as established.

The interior he believes a plastic crystalline (anisotropic) solid mass, which would, however, turn into a fluid or possibly a gas were the pressure removed.

A list of references at the end and an alphabetical list of authors are valuable additions and enable one to grasp the scope of the work which seems fairly full for Germany. An American can hardly think that the hope of the author that nothing essential has been overlooked is fulfilled. He mentions the metallic interior without mentioning Durocher. He could not, of course, have had access to so recent a work as Chamberlin and Salisbury's geology, but many of the thoughts therein collected have appeared in the *Journal of Geology*, to which he seems also not to have had access.[1] He discusses and turns down theories of a gaseous interior without mentioning See. And by the way he does not note that a temperature of 10,000° C., together with the theory of an iron core favored by him, and the critical temperature of iron and platinum which he cites, from 5,000° to 7,000°, would needs imply the possibility of a gaseous center.

The bearing of theories of isostasy is but mentioned. Neither Dutton nor Gilbert's work with Putnam is mentioned nor that with Woodward, only one of the least important of whose papers is cited. To the

[1] Other writers too recent to be mentioned are Hayford, Gregory, and those cited by Love in Science, N. S., Vol. XXVI., No. 669, Oct. 25, 1907.

reviewer the work of Gilbert and Woodward on Lake Bonneville seems of fundamental suggestion, in considering subcrustal fluidity. Consideration of the early stages of the planet without mentioning Winchell, of the cooling at the surface without mentioning Angström, of the increase of heat in deep borings without mentioning Darton or Hallock, of the coolness of the Keweenaw copper mines without mentioning Wheeler or Agassiz or Jackson, or Pierce or the reviewer (hinc illæ lacrimæ!) seems seriously defective. He mentions earthquake vibrations, which are a most promising source of enlightenment, but without mentioning Milne. Two excursuses on the age of the earth and the cause of glacial periods might have been omitted, and might certainly have had more value. The reviewer wonders if Thiene ever saw Joly's paper which he pronounces wholly worthless! One is led to doubt if he had good command either of English or of mathematics. The caliber of his mathematics may be gauged quite early by his critique of Suckow, taking his own account of it, as the reviewer has not access to Suckow's paper. Suckow "tries to prove that the temperature of the earth can not decrease with the square of the distance from the center" (x). "Let C/x^2 be the drop at the distance x, and the intensity of the heat decrease by du if x increases by dx then" differentiating and noting the peculiar definition of du which eliminates the minus sign customary

$$\frac{du}{dx}=\frac{2C}{x^3}\therefore C=\frac{x^3}{2}\frac{du}{dx}$$

"Letting $du=1°$, $dx=100$ feet and r" ($=x$ when $x=$ radius of earth) "19,608,944, C would be $75,398\times10^{15}$"—or really half this—and, substituting in C/x^2, the surface of the earth if it was independent of this heat of the sun, would have a temperature of 196,090°" (or rather half this and *below* that at the center).

Now Thiene criticizes this calculation because "it is dependent upon the unit chosen to measure the earth radius." But while the calculation as Thiene gives it is slightly in error, his criticism is not right. The expression C/x^2 would vary with the unit chosen for x, were it not that C also depends on that unit and is of the same dimensions. One can hardly fairly criticize for lack of mathematical equipment, except that by criticism the author had laid himself open, since this difficult subject requires really a scientific syndicate to handle. We are not surprised, therefore, that in giving account of the results of various authors he has often not shown their bearing one on the other. For instance, he does not show how the theory of a metallic core affects Kelvin's theories, nor is there any discussion of the effect of varying diffusivities in detail, though a table of them is cited from Winkelmann. The greater the diffusivity the lower the gradient unless there is a constant source. It is clear that if we imagine a large core of metal of high diffusivity covered by a stony rind of relatively low diffusivity we are likely to have the flow of heat, in the latter, reduced to the constant state, the gradient depending not on the time but upon the difference in temperature of the earth and the hot core, which will take billions of years to cool, and also upon the varying diffusivity and thicknesses of the rocks composing the crust or rind. It is the reviewer's belief that it is more than probable that the flow of heat in the crust early attained this constant condition.

The author rejects the theory of a gaseous interior, as he rejects the theory that the greater density of the interior is due to pressure. Would it not be better to ask rather to what extent is each factor important? Pressure must have some effect on density. What will it be in view of the various probable or possible changes in temperature and composition?

Without making a sweeping statement at the start as to the gaseous interior of the earth, it is perhaps safe to say in view of what we know of solid solutions and of the gas-like behavior of molecules in dilute solutions, that some of the elements of the earth's interior are in a gaseous condition, and the earth, for them at least, might be likened to a toy balloon, but one in which the gas was so condensed, under such pressure, that one could easier dent a steel ball than it. Under conditions of temperature not easy to disprove that should be the condition of all of the earth's elements toward the center. The study of seismic vibrations will probably settle this question.

A. C. LANE

Modern Chemistry, Theoretical and Systematic. By SIR WILLIAM RAMSAY. 12mo, pp. 327. New York, The Macmillan Co. 1907. Price, 70 cents.

Sir William Ramsay's epitome of modern chemistry, issued originally by Dent as two volumes of his dainty series of Temple Encyclopedic Primers, can not fail to find many new readers in the present one-volume form. Chemists should not need to be told of its merits, but if there be any who have overlooked the book they can only be envied for the treat which its perusal has in store for them. Students of other sciences will find in the book that for which many of them have been looking. They will find an account of the science, in which the chief results of modern physicochemical work are not only described, but are so incorporated into the chemistry of our school days that the nature of the debt of the latter to physical chemistry is plainly visible. The book fulfills its purpose singularly well, for it is brief, yet admirably clear and readable. To bring the present edition up to date a few minor changes only were required. The chief of these seems to have been the addition of a paragraph on the radium emanation.

ALEXANDER SMITH

THE UNIVERSITY OF CHICAGO

Selection and Cross-breeding in Relation to the Inheritance of Coat-pigments and Coat-patterns in Rats and Guinea Pigs. By H. MACCURDY and W. E. CASTLE. Carnegie Institution of Washington, Publication No. 70, May, 1907.

The authors publish some important data concerning the heredity of the spotted coat in rats and in guinea pigs. They confirm the conclusion of previous observers that the uniform or self color is dominant to the spotted coat and the latter to the albino. Two types of spotted rats were used, the Irish, with white on the ventral side, only; and the hooded, with black head and rump and a dorsal black stripe—the remainder of the body being white. Both of these types the authors call partial albinos, although the spotted condition appears to be a different "unit-character" from that of the albino. In other words, the albino is the allelomorph of the spotted coat and not a graded condition of the latter as the term partial albino might seem to indicate, although the authors recognize the distinction just given. It has not been found possible to produce an albino by selection or otherwise from the spotted coat.

Within the range of the spotted coat the authors find that it is possible by selection to produce races that breed approximately true to any special degree of spottedness. They argue from this that selection of a continuous or fluctuating variation may produce fixed types within the limits of the variation. They contend, therefore, that their results are opposed to the conclusion of de Vries that fixation of fluctuating variations by means of selection can not take place. But do the results really establish this point. May not there be several or even many semi-stable states of the spotted coat that ordinarily overlap, *i. e.*, may there not be within the limits of apparent fluctuation certain individuals that reproduce the parent type? A comparison with Lang's results on snails and of Tower's on the potato beetle would have been a welcome addition to the paper in this connection. However this may turn out in the end—and there is clearly something peculiar in the inheritance of spotted types that does not conform to the idea of unit characters—the authors' data are a valuable contribution to the subject.

The attempt of the authors to fix certain color patterns in guinea-pigs—nose spots or head spots, or Dutch marked individuals, gave a negative result—a fact already familiar to practical breeders. The experiments led, however, also to a positive conclusion of no little interest. It was found from the study of 1,048 guinea pigs "that one can, by selection, either increase or decrease the extent of the pigmented areas, but it is impossible by selection to fix this pigmentation in a particular pattern, retaining pigment areas on certain parts of the body and eliminating them from others. As the pigmentation changes in extent, under the influence of selection, the various areas typically pigmented are affected in the following order: Shoulder, side, rump and head, the change being greatest in the first named, and least in the last named area, irrespective of what particular spots were present in the selected ancestors."

T. H. Morgan

SCIENTIFIC JOURNALS AND ARTICLES

Terrestrial Magnetism and Atmospheric Electricity for September contains the portrait of Wilhelm Eduard Weber and the following articles: "Atmospheric Electricity Observations at Battle Harbor, Labrador, during the Solar Eclipse of August 30, 1905," by J. E. Burbank; "Scientific Results of the Ziegler Polar Expedition of 1903–5," by J. A. Fleming; "Biographical Sketch of Wilhelm Eduard Weber," by N. E. Dorsey; Letters to Editors: "Atmospheric Electricity Work, Yacht *Galilee,* Sitka to Honolulu, August, 1907," by P. H. Dike; "Principal Magnetic Storms recorded at the Cheltenham Magnetic Observatory, April 1 to June 30, 1907," by O. H. Tittmann; Notes: "International Association of Academies, Vienna, 1907," "Magnetic Survey of New Zealand Islands."

SOCIETIES AND ACADEMIES

THE NATIONAL ACADEMY OF SCIENCES

The National Academy of Sciences met at Columbia University on November 19 and 20. The following members were present: Messrs. Allen, Billings, Boaz, Brewer, Brooks, Brush, Cattell, Chandler (C. F.), Chittenden, Dana, Davis, Dutton, Elkin, Emmons, Gooch, Hague, Hastings, Hill, Minot, Morse, Newcomb, Nichols, Noyes, Osborn, Pickering, Pupin, Remsen, Thomson, Verrill, Walcott, Webster, Welch, Wells, Wilson, Woodward.

The program of scientific papers was as follows:

"A New Application of Dynamics to Electrical Circuits," by M. I. Pupin.

"The Selective Reflection Characteristic of Carbonates; Wave-length of Displacement a Function of the Atomic Weight of the Base," by Leighton B. Morse (introduced by M. I. Pupin).

"Oxygen the Active Atom in the Characteristic Reflection of Carbonates, Nitrates, Sulphates and Silicates," by Leighton B. Morse (introduced by M. I. Pupin).

"A Modification of the Bjerkness Hydrodynamics Analogy," by A. P. Wills (introduced by M. I. Pupin).

"Psychophysical Investigations with the Galvanometer and Pneumograph," by Frederick Peterson (introduced by M. I. Pupin).

"On Rayleigh's Disc as an Absolute Measure of Sound," by A. G. Webster.

"On the Minimum Audible Sound," by Geo. E. Stebbins (introduced by A. G. Webster).

"Buried River Channels of the Hudson Valley," by J. F. Kemp (introduced by C. F. Chandler).

"Glacial Erosion in Wales," by W. M. Davis.

"Summary of Studies of Cambrian Brachiopods," by Chas. D. Walcott.

"On Certain Changes of Nuclei in Relation to Age," by Chas. S. Minot.

"Researches from the Psychological Laboratory of Columbia University," by J. McK. Cattell.

"Additions to the Collections of Extinct Vertebrates in the American Museum of Natural History," by H. F. Osborn.

"A Biographical Memoir of Alpheus Hyatt," by W. K. Brooks.

"Biography of Lewis H. Morgan," by W. H. Holmes.

"Drop Weight and the Law of Tate; the Determination of the Molecular Weight in the Liquid State by the Aid of Drop Weights," by Reston Stevenson and J. Livingston Morgan (introduced by C. F. Chandler).

"The Relation of the Spectra, Magnitudes and Colors of Stars," by Edward C. Pickering.

"Tables of Minor Planets discovered by James C. Watson, prepared by Armin O. Leuschner under direction of the Watson Trustees," by Simon Newcomb.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 636th meeting of the society was held on October 12, 1907, Vice-president Bauer in the chair. The evening was devoted to a paper by Mr. J. F. Hayford on "Earth Movements as Determined by Triangulation (San Francisco Earthquake of 1906)."

The 637th meeting of the society was held on October 26, President Hayford presiding.

Dr. L. A. Bauer presented papers on "The Apparent Alterations of the Mass of a Magnet as disclosed by Weighings in Various Magnetic Fields" and "The Local Magnetic Pole, Treadwell, Alaska." Both papers were treated together and were illustrated by lantern slides and diagrams showing instruments used and giving results so far obtained.

At the meeting of the American Physical Society held last April in Washington, the speaker had made a preliminary announcement that the reduction of the carefully executed observations on the magnetic survey yacht *Galilee* indicated that there might not necessarily be everywhere an exact "balancing" or "coupling" in the magnetic forces acting on the two ends of a suspended magnet. If the action of the earth on a magnetic needle does not consist solely in a couple, then, contrary to our usual ideas, the needle, if free to move, would be subject not only to a motion of rotation but also to one of translation. Accordingly a compass needle might be caused to press against its pivot, or a dip needle exert an additional pressure on the surfaces on which the pivots rest.

As far as known no further experiments to test this hypothesis have been made since the historic ones of Robert Norman, about the year 1576.

To have only a couple acting on the magnet, it is necessary that the following three conditions be fulfilled exactly: (*a*) that the forces acting on the two ends or "equivalent poles" be opposite, (*b*) that they be equal, (*c*) that they be parallel.

The non-fulfillment of any of these conditions will give a resultant force besides that of a couple. It is possible to assume magnetic systems acting on the needle in which even the first condition is not fulfilled, viz., that the acting forces on the two ends shall be opposite. And as to non-fulfilment of the second and third conditions, this occurs in every magnetic field not strictly homogeneous or uniform. An obvious case under this head would be the earth's field disturbed either artificially by the too close proximity of iron structures or of magnetic impurities in the instruments used, or naturally by magnetic iron ore deposits near the surface. A case of a magnetic system in which the forces acting on the two ends of a magnetic needle are not opposite but in the same direction is that due to a vertical electric current passing through the pivot of a compass needle. Any of these cases may occur in nature or in practise.

The hypothesis has been subjected by the writer during the past summer to a series of preliminary tests, involving careful weighings of a magnet using a non-magnetic Becker analytical balance, embracing the region of the earth from Washington, D. C., to Sitka, Alaska.

The magnet was weighed in two horizontal positions (north end towards magnetic north and next reversed so that north end was towards magnetic south) and also in two vertical positions (north end up and north end down). The weighings were made at Sitka (Alaska), Victoria (British Columbia), Baldwin (Kansas) and Washington, D. C. At these places the earth's magnetic field is approximately uniform, *i. e.*, no marked local disturbances are known to exist.

The magnet was invariably weighed in both scale pans and the weighings in general were extended over two days at each station. Invariably for each station, the result for magnet, north end south, was greater than for north end north, the average difference being nearly 1/1,000,000 part of the weight of the magnet (about 33.6 grams). The differences in the weighings for the two vertical positions ($U-D$) were sometimes positive and sometimes negative, the average, regardless of sign, being of about the same order of magnitude as for the horizontal positions.

Weighings were also carried out in the intensely locally disturbed area at Treadwell Point, Douglas Island (Alaska). Here the average difference for four points of observation was 0.07 mg. or 1/500,000 part, in the case of the two horizontal positions of magnet (weight for north end south being again greater) and for the two vertical positions, 0.25 mg. (weight north end down being the greater or nearly 1/100,000 part of the weight of the magnet). The differences are thus more pronounced—as was to be expected—

than for the comparatively undisturbed fields.

Upon return to Washington, the investigation was amplified so as to embrace another magnet of different style, make and magnetic moment, and the weighings made for eight equidistant orientations of magnet (north end towards magnetic north, northeast, east, etc.). Besides this, the balance itself was swung in order that the beam would not always be directed in the same way for the same orientation of magnet so as to exclude in every way possible any effect that might be attributed to magnetic impurities remaining in the balance, which the special tests failed to disclose. It was found that the orientation of *balance* had no appreciable effect upon the results obtained.

However, a systematic curve of differences or residuals from the mean weight, for the eight orientations of *magnet*, resulted—somewhat similar to the deviation curves which represent the effect on the compass of the iron on board a vessel. Two waves of about the same amplitude were clearly discernible—a semicircular one and a quadrantal one—the latter apparently associated with the inductive effect of the earth on the magnet in its various positions. On account of the presence of the quadrantal term, reversal of magnet does not eliminate the effect on the weight due to the outstanding residual magnetic force. Hence the mean result of weighings of a magnet in two positions 180° apart will not necessarily give the true weight, or say the weight which the same substance would have if demagnetized. This was proved also by repeated magnetizations and demagnetizations of two different magnets. To get the true weight of a magnet within the accuracy attainable with the balance used, the weighings of the substance when magnetized would have to be made for *at least* eight equidistant positions.

The observations were repeated on three days, October 10, 11 and 12 at the Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Md., and practically the same results obtained as before.

For the two stations, Washington and Cheltenham, the range in the results for the various orientations of magnet was about 0.05 mg. (1/660,000 part of weight of magnet).

The investigation is being continued.

R. L. Faris,
Secretary

DISCUSSION AND CORRESPONDENCE

VARIATION OF ENVIRONMENT

The present writer has always been an advocate of the theory that variation of organic beings is influenced by the environment, and he does not believe in the existence of so-called spontaneous or congenital variation.

Since it is a well-established fact that no two individuals of the same species are absolutely identical, variation seems to be general, and it has recently been alleged that variation, the natural diversity, organisms, is a fundamental law, and is to be observed even when the environment remains unchanged.[1] But, in my opinion, this is not correct, and I believe that *no two individuals of any organic form grow up under identical conditions.*[2]

The idea that the latter may happen, that two individuals develop under the same environment, demonstrates that those who hold it look upon environment in a very superficial way, and do not appreciate the great variety of conditions involved, and thus it does not seem to be amiss to call here attention to the variety of features which constitute environment, and we shall see, if we understand this properly, interesting correlations to certain

[1] See Cook, in Science, September 7, 1906, p. 306,. "Individual diversity persists in spite of uniformity of conditions."

[2] In Science, July 12, 1907, p. 50, Cook quotes my sentence (Science, December 7, 1906, p. 729): "*if the environment remains uniform, perfect uniformity of individuals will result,*" but misunderstands it entirely, believing that I hold the opinion that uniformity of individuals may or does actually exist. He would not have made this mistake, if he had paid due attention to the sentence immediately following this one: "but since it is practically impossible," etc. Cook's definition of *Amphimixis* in the same article is highly surprising to me, and I should like to know where it is to be found in Weismann's writings, for I have never come across it.

types of organic variation will be revealed, which are highly suggestive.

That each organic form depends on a special environment, and is able to exist only under a certain set of conditions, is generally known,[3] but a specific environment is by no means a firmly fixed, unalterable and unchangeable factor, even if we are justified in saying that in a particular case the environment has remained or remains the same. There are, indeed, certain major features in each set of environmental conditions, which remain unaltered, but there are always others which may and do vary.

To make this more clear, let us take a single factor as an example, for instance, climate. Each organic form depends on a certain climate, but climate is not a fixed, permanent and uniform factor, even within the tropics. What we call climate is an average condition resulting from positive and negative deviations of a number of factors (temperature, precipitation, etc.) from a normal value. Now we all know that these deviations from the average again are not the same in different periods: we talk of daily, monthly, seasonal changes, and even the average conditions of different years are not identical, so that we observe periods of climatic variations extending over a number of years.

The same is true of any other environmental condition, and if we keep in mind the great complexity of factors which enter into the concept of "environment," which will be best understood by those who have paid attention to the modern studies in ecology, we shall be able to correctly estimate the value of this idea, that the environment, the ecological conditions, under which a given species lives, is not a fixed set of unchangeable features. There is hardly a factor which is constant, but it generally goes at certain times beyond a certain average or optimum in one or another direction.

These deviations from the normal state we may call by the name of "fluctuations," a term which is familiar. The chief feature of fluctuation is that, when there has been, for a certain time, a deviation from the normal in one direction, it is compensated, more or less, at another time, by a deviation in another direction. Sticking to our example of the climate: the darkness and coolness of the night are compensated by the light and the heat of the day; the sun shines in the morning from the east, this is compensated by the position of the sun in the evening; cool and damp days alternate with hot and dry days; the seasonal cycle of the year is characterized by opposite conditions prevailing at different seasons. Further, there may be a series of years of unusual dryness, of excessive heat, which is counterbalanced by a series of years of the opposite character, and so forth.

Yet we know that variations of environment are not always of this character, fluctuating around an average, which remains more or less constant. We have ample evidence of variation, which tends to change the average condition in a certain direction, and to change it permanently. We know that the climate of a country changes, that it becomes, in the course of time, a different one from what it used to be. I hardly need to mention examples, since everybody knows what I am referring to: yet the change of environment brought about by the advent of the Glacial period may be quoted, and also the change caused in the environmental features of this continent by the immigration of the white man.

To one thing, however, I want to call special attention. There is no sharp line to be drawn between variation fluctuating around a certain average, and a permanent change of the latter. As we have seen, the average may change for a short time in one direction, and may go back subsequently in the other direction; but gradually the change of the average in one direction may begin to prevail, it may not entirely be compensated by the opposite movement, and finally the latter may be suppressed altogether, so that only the movement in one direction remains, which then may end in the establishment of a new set of environmental conditions. This change we may call by the name of "mutation," and the use of this term in this sense will be justified later on.

[3] See Brooks, in *Proc. Amer. Philos. Soc.*, 45, 1906, p. 75.

Under the assumption that organisms respond to or react upon variations of the environment, we see that a difference in the character of the reaction of the organism should be observed.

If an organic form responds to fluctuating variations of the environment, this response should also be of a fluctuating character. Considering the vast variety of environmental conditions, such responses to fluctuating variation should be very frequent, indeed, should be the rule, and this serves to explain the fact of the "natural diversity of individuals," which, according to this theory, is to be regarded as the consequence of the different reactions of individuals to fluctuating variation of environment, while they grow up. These reactions, however, can not be permanent, either with the individual, or with the species, for the individual, as well as the species, may come and will come, subsequently, under the opposite influence, and thus the first reaction will be paralyzed by another one. This kind of organic variation is well known, recently it has been called (by de Vries) "fluctuating variation," and it is the typical "variation," as understood by Darwin. This variation is not very apt to be transmitted by inheritance, chiefly by reason of the fact that its cause is not a permanent one: even if there should be a tendency toward hereditary transmission, this tendency is counterbalanced by the "fluctuating" character of its cause.

If, however, the environment begins to change in a definite direction, it necessarily must produce in the organisms a tendency to react again and again in the same way upon the changed environment. Thus we obtain a condition which has been called by C. H. Merriam "pressure of environment." If organisms react at all upon external influences, the change of the environment in a certain direction must act as a pressure upon them, compelling them also to show a definite direction in their variation. Thus we are to expect "definite variation," which indeed is known among organic beings under different names, for instance, "orthogenesis" (Eimer) or "mutation" (v. Waagen),[4] and if there is any possibility that the reaction upon an external stimulus may become transmissible to the offspring, this should happen under such conditions, the tendency to transmit acquired characters being not counterbalanced any more by the opposite direction in the variation of the environment, but, on the contrary, being favored and emphasized. In this way, I believe, "mutation" of species (their transformation) is rendered possible, namely, by the pressure of permanently changed environmental conditions, or by "mutation of environment."

It is interesting to note that the above considerations lead us to assume the existence of two kinds of organic variation. First, a "fluctuating variation," which is not transmitted. I deliberately do not say transmissible, for it may be transmissible; all we can safely say is, it is not transmitted. The second kind of organic variation is transmitted: it has the quality, or the tendency, to "breed true," thus changing an existing species in its totality into another one. This process is identical with v. Waagen's "mutation." However, there can not be a sharp distinguishing line between *fluctuation* and *mutation,* and these two forms of variation should run into each other, any fluctuation being capable of being transformed into a true breeding mutation, as soon as its cause becomes permanent: that is to say, as soon as the environmental conditions, to which it is a reaction, are made permanent, so that they can bring to bear their influence upon each generation.

A. E. Ortmann

Carnegie Museum,
Pittsburg, Pa.

[4] Here we see why I selected above the term "mutation" for definite changes of environment, namely, to mark the correlation to organic "mutation." This is by no means the "mutation" of de Vries, a term which should be abandoned, being preoccupied on the one hand, and ill defined, in fact ill conceived, on the other. See my articles in Science, May 11, 1906, p. 746; June 22, 1906, p. 947; August 17, 1906, p. 214; February 1, 1907, p. 185.

JOHN WESLEY AND EVOLUTION

To the Editor of Science: In a recent book on "Evolution and Animal Life" the authors, Jordan and Kellogg, attribute the following to John Wesley:

> The ape is this rough draft of man. Mankind have their gradations as well as other productions of our globe. There is a prodigious number of continued links between the most perfect man and the ape (p. 452).

As a matter of fact, these statements, selected from different connections, are not attributable to Wesley in any proper sense. That they were thus ascribed to him by the authors probably grows out of the circumstance that in a work by this author, entitled "A Survey of the Wisdom of God as Revealed in the Creation, or A Compendium of Natural Philosophy," is contained extended quotations from Bonnet's "Contemplation de la Nature," and that among these may be found the passages in question, erroneously ascribed to Mr. Wesley. That the latter author gave the views concerned some measure of approval may be inferred in that he introduces the quotations in the following cordial terms:

> This reflection upon the scale of beings, is pursued at large by one of the finest writers of the age, Mr. Bonnet, of Geneva, in that beautiful work, "The Contemplation of Nature." When I first read this, I designed to only make some extracts from it, to be inserted under their proper heads. But under further consideration, I judged it would be more agreeable, as well as more profitable to the reader, to give an abridgment of the whole, that the admirable chain of reasoning may be preserved, etc.[1]

However, not only in this indirect way may the interest of this versatile and scholarly theologian be inferred. The body of the work abounds in illustrations of intelligent sympathy with scientific activity and progress. And the authors of "Animal Life and Evolution" might have cited passages, almost as pertinent as those above, directly from Mr. Wesley. For example, on p. 148, Vol. I., may be read the following:

> Animals of the monkey class are furnished with hands instead of paws; their ears, eyes, eyelids, lips and breasts are like those of mankind; their internal conformation also bears some distant likeness; and the whole offers a picture that may mortify the pride of such as make their persons the principal objects of their admiration. These approaches are gradual, however, and some bear the marks of our form more strongly than others. In the ape-kind, we see the whole external machine strongly impressed with the human likeness; these walk upright, want a tail, have fleshy posteriors, have calves to their legs, and feet nearly like ours. In the baboon-kind, we perceive a more distant approach; . . . the monkey-kind are removed a step further, etc.

Chas. W. Hargitt

[1] Cf. *supra*, 3d American edition, Vol. II., p. 185; and for the passages in question, *ibid.*, pp. 208, 211.

TWO FLEA REMEDIES TO BE TESTED

Aside from great annoyance caused by fleas, their agency in the carriage of the bubonic plague has been so well established that it is important to test every proposed remedy or preventive. Since the publication of my circular No. 13 on this subject, I have received information concerning two remedies vouched for by careful persons, but have not had a good opportunity to test either. I hope that readers of Science having the opportunity will try these remedies and will let me know the results.

Mr. E. M. Ehrhorn, the well-known entomologist who is deputy commissioner of horticulture in California, gives me the following: Fill a soup-plate with soapsuds; in the center place a glass of water with a scum of kerosene on top; place the soup-plate on the floor in an infested room, and set fire to the kerosene at night. Fleas in the room will be attracted and will jump into the soapsuds.

Another remedy is sent me by the well-known writer on ants, Miss Adele M. Fielde, with the request that I make it widely known. Miss Fielde states that during long residence in southern China, where fleas swarm even in clean houses, she made her own house immune through many years, by dissolving alum in the whitewash or kalsomine that covered the interior walls, putting sheets of thick paper that had been dipped in a solution of alum under the floor matting and scattering pulverized alum in all crevices where insects might lodge or breed. Powdered alum, she states, may be sprinkled upon carpets already laid and then brushed or swept into their meshes with no injury to the carpets and with the certainty of banishment to many insect pests including both moths and fleas.

Sheets that have been soaked in alum water and then dried may profitably enclose those that are spread nearest to the sleeper. . . . From ten to twenty cents' worth of alum judiciously used in each room of the house will effect much good in the prevention of dangerous insects.

L. O. Howard
U. S. Department of Agriculture

SPECIAL ARTICLES

THE NEHALEM WAX

Early explorers of the Oregon coast found bits of a waxlike substance on the Nehalem beach near the mouth of the Nehalem River. In time considerable deposits of the substance were found buried in the beach sands. As early as 1846 several tons of the wax were shipped to the Hawaiian Islands and since that time many tons have found their way into the markets of the northwest.

There has been much speculation concerning the origin and nature of this wax and opinions have been divided as to whether it is beeswax or a mineral product, ozokerite.

An Indian legend tells of the wreck of a ship at the mouth of the Nehalem before the coming of the white man. The crew landed and cached the cargo as it drifted in. In confirmation of the legend the hull of a wrecked vessel was found there. It is further cited that the Spanish ship *San Jose* sailed from La Paz, Lower California, June 16, 1769, loaded with supplies for the Catholic missions to the northward, and was never afterwards heard from. Her supplies would probably include wax for candles and tapers in the missions.

The wax is found, mainly, in large rectangular blocks, bleached on the surface through exposure but of a yellowish cast within. The honey-like aroma of beeswax is plainly noticeable on a freshly cut sample.

An examination of an authentic portion of this wax was made in the Pacific University laboratory, the data on a home-made sample of beeswax being also determined for comparison. The following table gives the results obtained, the data for numbers 3 and 4 being taken from Allen, Thorpe and Dana.

	M.P.	Sp. Gr. at 15°	Per cent. KOH Required to	
			Neut. Free Acid	Saponify Esters
1. Nehalem wax	64°	.960	1.00	7.80
2. Oregon beeswax	66°	.964	1.30	7.60
3. Beeswax (miscl.)	63°–65°	.963–.969	2.00	7.50
4. Ozokerite	56°–63°	.85–.90	.00	.00

The properties of the Nehalem wax are thus seen to approach those of beeswax very closely and are not in accord with those of ozokerite.

Dr. H. N. Stokes, of the Bureau of Standards, and Professor O. F. Stafford, of the University of Oregon, have also pronounced the material beeswax.

C. E. Bradley
Corvallis, Oregon,
August 22, 1907

CONCERNING THE NAME "HAVASUPAI"

A small tribe of Amerinds living in a secluded canyon in Arizona have been variously called, Havasupai, Supai, Cohonino, Cosnino, etc., the full list being given in the Bureau of Ethnology's handbook. Gibbs wrote it Habasopi; Hodge, Agua Supai; Bourke, Ah Supai; Gilbert, Akbasupai; Gatschet, Aksuepai and Avesupai, while the first white visitor, Garces, in 1776, made it Jabesua, the "J," of course, being pronounced in the Spanish way.

During a recent visit to this tribe I inquired particularly as to the composition and pronunciation of the name. According to my understanding it is derived from "*aha*" water, "*basuga*" blue, and "*apa*" people, and is therefore *Ahabasugapa,* People of the Blue Water. This refers to the color of the stream along which they live. It is evident that, rapidly spoken, the name would take on a sound like "habasupa." The Spaniards would write the "b" a "v," as they so often did, and finally the "v" would be pronounced as a "v" in English, and "Havasupa" or "pai" would result. It is also probable that some of the people would contract the full name as is often done in Amerindian languages; for example, the Pai Ute name for Major Powell was "Cah-parats" the "cah" being a contraction of "cotch," no, and the whole meaning "No-arm" and referring to the fact that Powell had but one arm.

It would therefore seem permissible to contract Ahabasugapa, in the interest of euphony and simplicity to *Habasupa,* and I would suggest that this spelling be substituted for the incorrect one now in use, and for the further corruption "Supai." The canyon in which they live should then be "Habasu" instead of Supai. The canyon was formerly generally known as Cataract, because of the several beautiful waterfalls there, but as there is on the Colorado River a larger and more important canyon called Cataract, Habasu is a better name for the one where the Habasupa live.

The other name applied to these people, I conclude, should be spelled "Cohonino" when it is used. It seems to be the Moki name for them and Voth (1905) spells it Kohonino, while Jacob Hamblin, who visited the Moki frequently from 1857 down, always pronounced the name Cohonino.

F. S. Dellenbaugh
7 West 43d Street,
New York,
September 25, 1907

THE PROLIFICNESS OF THE ENGLISH SPARROW

While collecting the eggs of the English sparrow, early last May, in Syracuse, N. Y., for embryological purposes, I was able to gain some idea of the remarkable prolificness of that ubiquitous little pest.

Mounted upon a bicycle, I accompanied, for a little more than two hours, an electric-light "trimmer" (similarly mounted) on his rounds. During this time forty-five lamps were visited, and in every lamp an English sparrow's nest was found. The lamps were of the common type of street arc light, with a metal hood that made an excellent nesting place.

The trimmer said he never bothered to tear out the nests, as they would be rebuilt before his next round. That this was probably true was illustrated, in one case, where, after collecting the eggs, the man pulled out a handful of straws and feathers from the nest and threw them from the top of the pole to the ground; before it had reached the ground one of these feathers had been caught by the female bird, who was ready, apparently, to immediately begin the process of reconstruction.

While there was a nest in every lamp visited, all of the nests did not, of course, contain eggs; a few, though very few, of the nests were empty, and a number of them contained young birds which were not counted.

From forty-five nests one hundred and twenty-eight eggs were obtained, an average of nearly three eggs for each nest; therefore, in the eleven hundred arc-lights of the city of Syracuse there were, probably, more than three thousand eggs. If the number of young birds also had been counted the total number would have been largely increased—and this was only one brood.

Of the eggs collected only two or three per cent., possibly less, were infertile, so that there must be a fortunately heavy mortality among the young and adult sparrows or their number would be even greater than it already is.

While the arc-lights furnish the most common and easily accessible nesting places, there are, as is well known, hundreds of other places, so that the number of eggs of any one brood is much greater than the figure given above.

The greatest number of eggs found in any one nest was seven; the smallest number was two, though this was probably due to the fact that the full number of eggs had not yet been laid. The usual number of eggs per nest was five; more than three fifths of the nests that contained any eggs at all contained that number.

A. M. Reese
West Virginia University

A CASE OF TRIPLET CALVES WITH PECULIAR COLOR INHERITANCE

The attention of the writer was recently called to a case of the birth of triplet calves which was alleged to have occurred June 20, 1907, on a farm near Waldoboro, Maine. Lately this case has begun to figure in the newspapers along with other real and presumed "nature fakes." The purpose of the present note is to state some of the essential facts regarding the case, which the writer has under investigation. A complete account, with photographs, will be published elsewhere at a later date.

At the outstart it may be stated that there is no doubt whatever regarding the fact of the multiple birth. The three calves, when born, were normally formed, though considerably below the normal in size. They have all continued to live and have grown well. They have not yet, however, reached a size normal for their age. They are apparently in perfect health and condition. As to sex, one of the three is a male, the other two females. A remarkable feature of the case is that the mother of the triplets, thought but seven years old, has produced ten calves. These were distributed as to pregnancies as follows:

Pregnancy	Number of Young
1st	1
2d	1
3d	1
4th	2
5th	2
6th	3

A different bull was concerned in each of the matings.

In regard to color inheritance the condition presented by these calves is of considerable interest. The mother is a grade Guernsey, of the light yellowish-fawn coat color typical for the breed. The father is a Hereford, showing the white face and nearly solid colored body typical for that breed. In his ancestry there is a small admixture of Holstein "blood." Presumably in consequence of this arises the fact that his body coat is black instead of dark red, as in the pure Hereford. The coloration of the calves is indicated in the following scheme:

Male	Female
Typical Guernsey in respect to coat color, with a very close approximation to the precise distribution of color shown by the mother.	*Both typical Herefords,* as to both color and markings. The two are not *precisely* alike in color pattern. One resembles the father in color pattern very closely. The body color of these calves is slowly darkening.

That this case furnishes interesting material for the Mendelist goes without saying. The full discussion of it will be undertaken later.

Raymond Pearl

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CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

RAINFALL IN THE PHILIPPINES

A recent publication of the Philippine Weather Bureau deals with "The Rainfall in the Philippines," and was prepared by Rev. Miguel Saderra Masó, S.J. (Manila, 1907, 4to, pp. 31). Rainfall measurements have been made at about sixty stations throughout the islands, but with many interruptions. Over most of the archipelago the maximum rainfall comes in summer and autumn (June to October), the "rainy season." In November to February rain falls abundantly on the eastern and northern coasts. March to May are the driest months. The spring and autumn rainfall is cyclonic. The winter rains come with the northeast monsoon. There are three zones, classified according to their rainfall seasons. (1) Zone of very definite rainy and dry seasons. Annual rainfall 1,500–2,000 mm., and over. (2) Zones with a long rainy season (summer, autumn and winter), and a very short dry period. The annual rainfall is above 3,000 mm. in places, and ranges down to somewhat below 2,000 mm. (3) Zones with more or less uniform distribution of rainfall through the year. At some coast stations the annual amount is over 3,000 mm. Elsewhere it is between 2,000 and 3,000, or in places below 2,000 mm. The monthly rainfalls at all stations are tabulated, but there is no map.

RAINFALL TYPES AND RAINFALL SEASONS

An investigation of rainfall types and of their influence upon rainfall seasons has been carried out for certain German stations by G. Schwalbe ("Ueber Niederschlagstypen und ihren Einfluss auf die jährliche Periode des Niederschlages," *Met. Zeitschr.*, September, 1907). The conclusions, which are of wide application, are as follows: (1) The influence of thunder-storm rains upon the annual rainfall amount is considerable; (2) as thunderstorms occur almost wholly in summer, they tend to make the summer the season of maximum rainfall; (3) without the thunderstorm rainfalls the annual period shows a tendency to heavier rains in spring and fall, with less rain in the extreme seasons; (4) in the interior of eastern Germany the continental type of summer rainfall maximum is marked, so that the annual period is not essentially altered by thunder-storms; (5) rainfall which comes in showers is fairly equally distributed throughout the year; (6) squalls have a maximum in spring and fall; (7) general rains have a winter maximum in coast districts; an autumn maximum in transition areas, and a summer maximum in the interior.

CLIMATE AND DURUM WHEAT

"The Effect of Climatic Conditions on the Composition of Durum Wheat" is discussed by J. A. LeClerc, of the Bureau of Chemistry, in the *Yearbook of the Department of Agriculture* for 1906, pp. 199–212. Durum wheat is grown extensively in Russia, Algeria, Italy and Spain, and in the United States it does remarkably well on the great plains. The wheat grown in the drier localities of this country has a higher nitrogen content. In the humid or irrigated regions the tendency of the wheat is to become starchy or mealy. Samples of Kubanka wheat grown in less than 15 inches of rainfall showed 2.7 per cent. of protein in excess of that in samples from localities with more than 15 inches of rainfall, or irrigated. An excessive amount of rainfall, or irrigation, is followed by a crop with a very low percentage of protein. Samples were grown in Colorado and Idaho, some under dry-land farming conditions, and others under irrigation. Of these, the former showed 4.16 per cent. more protein than the latter. Hot seasons produce the most abundant crops, and the longer the growing season, as a rule, the lower the percentage of protein.

CYCLONES AND TILTING OF THE GROUND

In *Nature*, September 26, 1907, mention is made of some observations by Omori on the tilting of the ground during cyclones in Japan. On October 10–11, 1904, when a cyclone passed off to sea east of Tokio, there was a tilting of about 3½ inches towards the area of low pressure. On January 10–11, 1906, a cyclone passed close to Tokio, from southwest to northeast, and was accompanied by a tilting, first to the east, and then, as the cyclone center moved eastwards, to the west. The total change of inclination was about 2″.87. The ground rose under the cyclone in the latter case, and sank in the former. The difference is explained as being due to the fact that the sea level usually rises by more than enough to compensate for the fall of pressure, and hence the resulting pressure on the bottom of the sea is really greater with a low than with a high barometer.

MONTHLY WEATHER REVIEW

No. 7, Vol. XXXV., *Monthly Weather Review*, 1907, contains the following papers: Professor Cleveland Abbe, "The Fundamental Interval in Meteorological and Climatological Studies, especially in Charts of Isohyetal Lines"; largely a review of Hellmann's recent memoir on the precipitation over the watersheds of the north German rivers. W. H. Alexander, "A Possible Case of Ball Lightning," at Burlington, Vt., July 2, 1907. Professor F. H. Bigelow, "Studies on the Phenomena of the Evaporation of Water over Lakes and Reservoirs," deals with the proposed study of the problems of evaporation at the Salton Sea, in southern California. Professor Cleveland Abbe, "Australian Climatology," brief statement concerning the general circulation of the atmosphere in Australia and around the south pole. D. T. Maring, "The New Jamaican Weather Service," refers to the reorganization of the Jamaica weather service under Maxwell Hall.

R. DeC. Ward

Harvard University

CONFERENCE OF STATE UNIVERSITY PRESIDENTS IN THE MIDDLE WEST

One of the greatest movements in education in the nineteenth century was the establishment of state universities. The development of these institutions promises to be most significant in the twentieth century. President Harper's sentiment, expressed shortly before his death, that no matter how liberally the private institution might be endowed, the heritage of the future, at least in the west, was to the state university, received confirmation from statistics made up in connection with the conference of the presidents of fifteen state universities in the middle west, held at the University of Iowa, in Iowa City, October 31 to November 2.

The institutions in the group are the following: Ohio State, Indiana, Purdue, Michigan, Wisconsin, Illinois, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, Colorado and Oklahoma—the heads of public school systems having an aggregate school attendance of 4,573,631. All but Illinois and Missouri were represented by their presidents at the Iowa City conference, which was the fourth triennial meeting of this group of presidents. The total attendance at the fifteen state universities in 1906–7 was 34,770, or some 6,000 more than the number of students in attendance at fifteen representative eastern universities and colleges.[1]

Still more striking is the result of a comparison with the attendance of the same institutions ten years ago. The attendance at the fifteen state universities in 1896–7 was 16,414. The increase in a decade has been 112 per cent. The attendance at the fifteen eastern universities and colleges in 1896–7 was 18,331, while in 1906–7 it was 28,531, giving an increase of but 56 per cent., or just half the percentage of increase shown by the state universities. Looking at the figures in another way, in 1896–7 the representative eastern schools were 2,000 ahead of the group of state universities in attendance, while in 1906–7 they were 6,000 behind.

Thinking that the difference shown might be sectional—the Mississippi Valley against the east—instead of a difference in favor of the state institutions, a further comparison was made between the attendance at the state universities and that at the same number of representative private institutions in the states of the middle west[2] and it was found that these private institutions showed an increase of 58 per cent. in attendance during the past decade as against 56 per cent. in the eastern institutions, and 112 per cent. in the state universities.

The preceding conferences were held at the University of Wisconsin in 1897, at the University of Illinois in 1900, and at the University of Missouri in 1903. Upon

[1] The eastern institutions taken for comparison were Harvard, Yale, Columbia, Princeton, Cornell, Pennsylvania, Wesleyan, Brown, Dartmouth, Amherst, Williams, Bowdoin, Bryn Mawr, Wellesley and Vassar. The institutions were selected not only as representative but as combining universities, colleges and women's colleges, because a few of the state universities are as yet substantially in the college state and because all are coeducational.

[2] The institutions taken for this comparison were Northwestern University, Drake University, Oberlin College, Washington University, Ripon College, Hillsdale College, De Pauw University, Hamline University, Colorado College, Washburn College, Nebraska Wesleyan University, Western Reserve University, Fargo College, Dakota Wesleyan University and Yankton College.

invitation by President Angell, the next meeting will be held at Michigan.

The most prominent men at the conference were President Angell, of Michigan, with his long record of forty-eight years in educational work, including thirty-six years in the presidency of Michigan; and President Northrop, of Minnesota, for twenty-one years a Yale professor, and for twenty-three years president of the University of Minnesota. The average age of the men in the conference was 56 years; the average length of their service in educational work, 29 years; the average length of their service in college presidencies, 14 years, while their average length of service in their present positions has been 11 years. It is of some interest to note also that seven of these state university presidents of the middle west were natives of New England, and none of them were born west of the Mississippi.[3] Though the majority were graduates of small colleges, it was remarked that with a single exception they also had been students in other institutions, and among the American and European universities represented Yale led with four men.

The conference was informal, taking up in free discussion various problems which are uppermost in university administration in this section of the country. It was noticeable that whereas the first conference of this group of presidents was occasioned largely by athletic and football questions, these questions did not have to appear upon the program of this last conference.

One of the first questions considered was the securing of retiring allowances for state university professors by the inclusion of the state universities in the benefits of the Carnegie Foundation for the Advancement of Teaching. The presidents were unanimous and emphatic in their expression of the belief that the state universities and their professors were as justly entitled to the benefits of the retiring allowances provided by the Carnegie Foundation as were the professors in any other institutions; and that any exclusion of the state universities from these benefits was an unjustifiable discrimination. In accordance with this view, they will recommend to the National Association of State Universities that that association renew its request that the state universities be admitted to the full benefits of the pension fund.

The presidents were of the further opinion that if the trustees of the foundation could not see their way clear at this time to admit the state universities to the full benefits of the foundation permanently, they be urged to admit them for a period of at least fifteen years, and to enlarge their present gratifying policy of dealing with individual meritorious cases in these institutions.

The function of the university in religious education was another question that elicited a great deal of interest and discussion, which resulted in practical concurrence in the following statement of President Baker, of Colorado:

> I believe that the churches should not have the exclusive right to discuss religious questions; that the state universities should have the privilege of teaching the Bible as literature, philosophy, psychology and ethics; of teaching the history of religion and kindred subjects; that on historical and scientific and psychological grounds

[3] Those in attendance at the conference at Iowa City were Chancellor E. Benjamin Andrews of Nebraska, President James B. Angell of Michigan, President James H. Baker of Colorado, President David R. Boyd of Oklahoma, President William L. Bryan of Indiana, President F. B. Gault of South Dakota, President George E. MacLean of Iowa, President Webster Merrifield of North Dakota, President Cyrus Northrop of Minnesota, President W. E. Stone of Purdue, Chancellor Frank Strong of Kansas, President W. O. Thompson of Ohio State, and President Charles R. Van Hise of Wisconsin. President E. J. James of Illinois and President R. H. Jesse of Missouri were detained at the last moment.

the question of belief in God and of the efficacy of prayer should be freely discussed before students; that there should be a deepening of the philosophical, ethical and art thought and feeling of the country; and that the foundation work along these lines should be laid at the state universities.

The example of the establishment of a college of education in the University of Minnesota by the legislature, upon the request of the teachers and normal schools of the state, for the purpose of training teachers for the high schools and the colleges, and complementing in advanced research work the normal schools, was unanimously approved as a solution of the question of the relation of the state universities to state normals.

The other questions before the conference were of local interest chiefly, and would not concern the country at large.

The national note, inherent in the very constitution of a state university, was struck in the following remarks made by President Northrop at the convocation of the University of Iowa held in honor of the visiting presidents:

> Nothing else in the work of education has so interested me as the magnificent advance which the south is making in education. Under adverse circumstances, in the face of great difficulties, the educators of the south are showing a zeal and enthusiasm in their work, which can hardly be equaled elsewhere, and the fruits of which are most apparent and satisfactory. If there is any one thing that I especially long for, it is to see the national spirit revived everywhere, and north and south, alike, responding to the national sentiment, symbolized by our flag, and we can not have this unless we have ideals and purposes and plans somewhat in common.
>
> And in no other department in life is it possible for us to have such ideals and purposes in common to so large a degree as in the work of education. In this, north and south are seeking the same results by like methods and it is possible for us all to have hearty sympathy in our work.
>
> I appeal to you all, my brethren, representing, as you do, the educational forces in the great valley of the Mississippi, from Ohio to Colorado—I appeal to you to assist and cheer and encourage our brethren of the South in every way you possibly can, in the interest of a truer union, a nobler patriotism, and a larger and more helpful education.

George E. MacLean
The State University of Iowa,
Iowa City,
November 10, 1907

THE AMERICAN CHEMICAL SOCIETY AND SECTION C

The winter meeting of the society will be held at Chicago, Ill., December 31 to January 3, inclusive. The meeting will be a joint meeting with Section C of the American Association for the Advancement of Science.

The Society of Biological Chemists will hold joint sessions with our Biological Section, and President Chittenden will preside over both.

The following persons have consented to preside over the sections and to aid in the preparations for the meeting:

W. D. Bigelow: Agricultural and Sanitary Chemistry.
R. H. Chittenden: Biological Chemistry.
William H. Ellis: Industrial Chemistry.
A. W. Browne: Inorganic Chemistry.
Julius Stieglitz: Organic Chemistry.
Herbert N. McCoy: Physical Chemistry.

Members desiring to present papers are requested to send titles and brief abstracts to one of these persons, or to the secretary of the society.

Titles of all papers received before November 25 will appear on the preliminary program, which, with announcements, will be sent to all members on November 30. The final program will be sent only to those members signifying their intention of being present at the meeting. No title can be placed on the final program that is received later than December 15. In the preparation of papers for presentation, a clear and concise statement of results which have been obtained, and of conclusions reached, should alone be given. All essential and technical detail should be reserved for the published paper, as the time that can be allotted is limited, and papers given in this manner are always much better received.

The current year has been remarkably successful for The American Chemical Society, and the membership instead of falling off when the dues were increased to $8 has been largely augmented, and by the end of the year will be approximately thirty-five hundred. *Chemical Abstracts* thus far has exceeded all expectations, and some of the earlier numbers have had to be reprinted to meet the demand. This result is especially encouraging when we remember that a printers' strike and other delays, beyond the control of the editor and outside of his office, have made its appearance annoyingly irregular. The attention of members is called to the fact that this matter has received most careful and business-like attention, and most positive assurances have been received that the new publishers will issue both *Journal* and *Abstracts* on time beginning with the new year.

The summer meeting at Toronto was eminently successful and will be ever remembered by those present. Prospects for the Chicago meeting this winter are very bright, and all members of the society are urged to make every effort to be present. The friendships formed and "esprit de corps" gained at these meetings are of inestimable benefit to the individual and to the profession.

During the year a number of important committees have been appointed and reports made, all of which are published in the proceedings. The offices of editor and secretary have been separated, an associate editor has been engaged whose time is given to the *Journal* and *Abstracts,* and funds for a stenographer have been voted to the editorial office.

Local sections have been established with headquarters at Syracuse, N. Y., St. Louis, Mo., and Madison, Wis.

President Bogert has been especially interested and active in considering the needs and desires of our industrial chemists, and a committee of prominent chemists representing important lines of industry and headed by William D. Richardson, of Swift & Co., Chicago, is now considering the publication of a *Journal of Industrial Chemistry* for the benefit of our members. Their success will depend largely upon the size of our membership, as funds are required for all such undertakings.

Charles L. Parsons,
Secretary

THE AMERICAN PHYSIOLOGICAL SOCIETY

The American Physiological Society will hold its twentieth annual meeting in Chicago, during convocation week, beginning on December 31, 1907. Members of the society are requested to inform the secretary at their earliest convenience whether they intend to be present. The society will hold joint sessions with the American Society of Biological Chemists and with Section K—Physiology and Experimental Medicine—of the American Association for the Advancement of Science. The place of meeting will be Room 25, Physiology Building of the University of Chicago. Titles of communications to be offered at the meeting may be sent to the secretary. Inquiries regarding apparatus and other necessities for demonstrations may be addressed to Professor A. J. Carlson (for physiological apparatus), or Professor A. P. Mathews (for chemical apparatus), at the University of Chicago. Further details regarding the headquarters of the society and other local arrangements will be announced later.

Lafayette B. Mendel,
Secretary

Sheffield Scientific School,
Yale University

SCIENTIFIC NOTES AND NEWS

The committee on policy of the American Association for the Advancement of Science held a meeting in New York City on November 19. All the members of the committee were present, namely, President R. S. Woodward, chairman; Dr. William H. Welch, retiring president of the association; Professor Edward L. Nichols, president-elect; Dr. L. O. Howard, permanent secretary; Professor J. McK. Cattell, Professor H. L. Fairchild and Professor Charles L. Minot. The business transacted by the committee will be brought before the council of the association at the approaching Chicago meeting.

General Cyrus B. Comstock, Corps of Engineers, U. S. A., has given to the National Academy of Sciences, of which he is a member, the sum of $10,000, the income from which is to be devoted to the advancement of knowledge in magnetism, electricity and radiant energy.

M. Gaston Darboux, president of the first general assembly of the International Association of Academies and permanent secretary of the Paris Academy of Sciences, has transmitted to the National Academy of Sciences a copy of a plaque by the engraver M. Vernon, authorized by the French government to commemorate the first general assembly of the International Association of Academies held in Paris in 1901.

The following is a full list of those to whom the Royal Society has this year awarded medals: The Copley medal to Professor A. A. Michelson, of Chicago, For. Mem. R.S., for his investigations in optics; a royal medal to Dr. Ernest William Hobson, F.R.S., for his investigations in mathematics; a royal medal to Dr. Ramsay H. Traquair, F.R.S., for his discoveries relating to fossil fishes; the Davy medal to Professor E. W. Morley, Western Reserve University, for his contributions to physics and chemistry, and especially for his determinations of the relative atomic weights of hydrogen and oxygen; the Buchanan medal to Mr. W. H. Power, C.B., F.R.S., for his services to sanitary science; the Hughes medal to Professor Ernest H. Griffiths, F.R.S., for his contributions to exact physical measurement; the Sylvester medal to Professor Wilhelm Wirtinger, of Vienna, for his contributions to the general theory of functions.

The Royal Swedish Academy of Science in Stockholm has elected Professor Theodore W. Richards, of Harvard University, to foreign membership.

The honors announced on the occasion of the birthday of King Edward include: Professor T. Clifford Allbutt, F.R.S., has been appointed a knight commander of the Order of the Bath. The honor of knighthood has been conferred on Dr. W. H. Allchin, consulting physician to the Westminster Hospital, a member of the medical consultative board to the admiralty, and one of the representatives of the Royal College of Physicians of London on the senate of the University of London; on Dr. W. J. Thompson, physician to Jervis Street Hospital, Dublin, who is one of the committee engaged in dealing with the prevalence of tuberculosis in Ireland; and on Mr. Charles Whitehead, who is associated with scientific agriculture. Dr. A. Theiler, government veterinary bacteriologist, Transvaal, has been appointed a companion of the Order of St. Michael and St. George.

Dr. Field Halvorsen, of the University of Christiania, who has been sent by his government to study American methods of teaching technical chemistry, is attending the regular lectures and laboratory exercises at the Massachusetts Institute of Technology. For the past three years Dr. Halvorsen has been studying German methods in the technical school at Charlottenburg.

The third lecture in the Harvey Society course will be delivered by Professor David Edsall, University of Pennsylvania, at the New York Academy of Medicine, on Saturday, November 30, at 8:30 p.m. Subject: "The bearing of metabolism studies on clinical medicine." All interested are invited to be present.

Professor R. W. Wood, of the Johns Hopkins University, lectured at Lehigh University, on November 8, on "Modern Airships and Flying-machines."

Professor C. F. Binns, director of the New York State School of Ceramic Arts, Alfred University, lectured before the Syracuse Chapter of Sigma Xi on November 15. His subject was "Clays, chemical, physical and empirical."

Mr. J. S. Hunter, deputy game and fish commissioner of California, gave an address on November 19 before the Zoological Club of the University of Nebraska on the "Fauna of the Galapagos Islands." Mr. Hunter was a member of the scientific party which was sent out by the California Academy of Sciences in 1905, and spent more than a year in and about the islands. His talk was illustrated with original photographs.

At a meeting of the Philadelphia Botanical Club at the Academy of Natural Sciences, on November 21, the following resolutions were unanimously adopted:

Whereas: The Philadelphia Botanical Club has learned of the sad death of the distinguished botanist, Lucien M. Underwood, professor of botany in Columbia University, be it

Resolved, That by his death botanical science has suffered an irreparable loss, his personal character, his professional standing and his scientific attainments, particularly in his special line of work on the ferns and allied plants, having won for him the sincere admiration and regard not only of his associates, but of his fellow workers in the field of science.

Resolved, That the Philadelphia Botanical Club records its appreciation of his labors and its deep sense of the loss which American botanical science has sustained.

Professor Storm Bull, head of the department of mechanical engineering and for twenty-eight years a member of the faculty of the college of engineering at the University of Wisconsin, died at his home on November 18. He was born at Bergen, Norway, in 1856, and was eminent for his work in steam engineering.

Charles S. Magowan, professor of municipal and sanitary engineering in the College of Applied Science in the State University of Iowa, died on November 14, after an illness of some months duration. Professor Magowan had been a member of the faculty of the University of Iowa for twenty-one years.

Announcement is made that Mr. John D. Rockefeller has given securities of the value of $2,600,000 to form the endowment of the Rockefeller Institute for Experimental Research, New York City. It is understood that Mr. Rockefeller had previously given $1,200,000 for buildings and current expenses.

Dr. Thomas W. Evans, a Philadelphia dentist, long resident in Paris, who died some ten years ago, left nearly his entire estate to found in Philadelphia the Dr. Thomas W. Evans Museum and Institute Society. There has been continuous litigation which it is said is now ended, and the museum and institute will receive about $1,100,000. It appears that the lawyers in the course of the litigation have received about three times this amount, in addition to interest on the estate.

Miss Helen Culver, of Chicago, well-known as a friend and benefactor of the sciences, has endowed the Geographic Society of Chicago with the Helen Culver Gold Medal to be awarded for eminent service to geographic sciences. The first award was made to the distinguished Norwegian scientist and explorer, Captain Roald Amundsen, on the occasion of his address before the society on November 13, 1907.

The will of the late Edmund von Mojsisovics the Austrian geologist bequeathes to Vienna Academy of Sciences, of which he was a member, the sum of one million crowns.

The twenty-fifth annual congress of the American Ornithologists' Union will convene in Philadelphia, on December 9, at 8 p.m. The evening session will be devoted to the election of officers and the transaction of other routine business. The meetings, open to the public and devoted to the reading and discussion of scientific papers, will be held in the lecture hall of the Academy of Natural Sciences, 19th and Race Streets (Logan Square), commencing on Tuesday, December 10, and continuing for three days. Information regarding the congress can be had by addressing the secretary, Mr. John H. Sage, Portland, Conn.

The annual meeting of the New York State Science Teachers' Association will, as has been announced, be held on December 27 and 28 at Ithaca, N. Y. The scientific equipment of Cornell University will be at the disposal of those attending the meeting and an interesting program may be expected. All who expect to attend are urged to send suggestions as to things they would like to see, program, etc., to the chairman of the local committee, Mr. J. S. Shearer, Ithaca, N. Y. The association will be guests of the university at luncheon each day. The headquarters for the meeting will be in Rockefeller Hall, the new physical laboratory of the University. Those having mail forwarded should have it sent to Room 125, Rockefeller Hall, or to their hotel.

The Italian Association for the Advancement of Science ("Società per il Progresso delle Scienze") has been subdivided into the following fourteen sections: I. Mathematics, Astronomy, Geodesy; II. Physics, Geophysics, Meteorology; III. Mechanics and Engineering, Electrotechnic; IV. Chemistry; V. Agronomy; VI. Geography; VII. Mineralogy, Geology, Paleontology; VIII. Botany; IX. Zoology and Comparative Anatomy; X. Anthropology, Ethnography, Palethnography; XI. Anatomy, Histology; XII. Physiology; XIII. Pathology, Hygiene, Bacteriology; and XIV. Statistics and Economics.

It is stated in the English papers that the Kashmir electric scheme is expected to produce 20,000 h.p., and to be the most important undertaking of the kind in India. The current will be utilized to light Srinagar, as also to heat the silk factory there, which is said to be the largest in the world. It will likewise operate the dredging fleet on the Jhelum, will work the wool factory, and other concerns. There will then remain a balance of 8,000 to 10,000 h.p., for sale in the Punjab for lighting Abbottabad and Rawalpindi, as also for railway traction purposes. The dredging of the River Jhelum will tend to prevent the disastrous floods in the Kahmir Valley and will convert many thousands of acres of swamp into fertile land.

UNIVERSITY AND EDUCATIONAL NEWS

Under the will of Lyman F. Rhoades of Boston, bequests of $100,000 go to various educational and charitable institutions, among which are Boston University, which is to receive $20,000, and the Massachusetts Institute of Technology, which is to receive $6,000.

The Oxford congregation has by a vote of 152 to 20 established a professorship of engineering science.

In pursuance of the policy of the Schools of Mines, Engineering and Chemistry of Columbia University to have the regular courses of instruction supplemented by specialists, the following course of lectures, supplemented by laboratory demonstrations, has been arranged by Professor Adolph Black, of the department of civil engineering, in connection with the regular instruction in sanitary engineering to the third- and fourth-year students in civil engineering:

"Biological Examination of Drinking Waters, with Special Reference to Organisms other than Bacteria: Tastes, Odors, etc., Their Causes, Cure and Prevention," by Professor G. N. Calkins, Columbia University.

"Bacteriological Examination of Drinking Waters, and Standard Routine Laboratory Practise," by Dr. Daniel D. Jackson, Mt. Pleasant Laboratory, Brooklyn.

"Typhoid Fever in its Relation to Sanitary Engineering," by George C. Whipple, Assoc. M.A.S.C.E.

"Hydraulic and Sanitary Engineering in Australia: Water Supply, Water Purification, Sewage Disposal, Treatment of Special Problems," by Allen Hazen, M.A.S.C.E.

"Laboratory Demonstrations—Plating out; Different Culture Media, including Bile Salt Inhibitive Medium, Bacterial Count, etc.; Using Water before and after Filtration, Impure Water, etc.," at the College of Physicians and Surgeons, by Dr. P. H. Hiss, Jr., assisted by Professor Black.

Professor Richard C. Maclaurin, of Victoria College, Wellington, New Zealand, has been elected professor of mathematical physics at Columbia University, filling the chair vacant by the resignation of Professor R. S. Woodward to accept the presidency of the Carnegie Institution in 1905.

Professor C. F. Curtis Riley, of the Kansas State Manual Training Normal School, has been appointed director of the biological laboratory and curator of the museum of the Minnesota State Normal School, Mankato, succeeding Professor F. L. Holtz, who has become head of the biological department of the Training School for Teachers in Brooklyn, N. Y.

Mr. A. E. Collinge has resigned the chair of economic zoology at Birmingham.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, DECEMBER 6, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on Hudson, N. Y.

THE RECENT PROGRESS AND PRESENT CONDITIONS OF ECONOMIC ENTOMOLOGY[1]

FIFTY years ago, or even less, a very satisfactory and comprehensive text-book or manual of economic zoology could have been contained within the covers of a single volume of reasonable size. So great have been the advances, however, of late years, that the books and pamphlets published would in themselves make a small-sized library. The whole civilized world has contributed to the advance of economic zoology, and in its many directions it has greatly improved the condition of the human species.

It seems to be generally acknowledged that the greatest strides in one of its branches, namely, economic entomology, have been made in America, and therefore it has been thought appropriate at this American meeting to choose an economic entomologist to give the principal address, and to take economic entomology as his particular subject.

Thirteen years ago, in August, 1894, the present speaker delivered an address as retiring president of the Association of Economic Entomologists, in which he took as his subject, "The Rise and Present Condition of Official Economic Entomology." In this address (published in *Insect Life*, volume 7, pages 55 to 108) the early history of the warfare against insects was briefly discussed, the progress through the

[1] Principal address, Section of Economic Zoology, Seventh International Zoological Congress, Boston, August, 1907. Read August 23, 1907.

entire world was described, and the condition at that time in the different European countries, in the United States and Canada, in South America, India, South Africa, Australia, New Zealand and the then Hawaiian Republic, was given.

In the light of the progress of the last thirteen years it is interesting to read that address. At the time when it was written it was rather a surprise to those who read it, to see when all the facts were brought together, what an important subject economic entomology had grown to be, but from even this short distance of time it is safe to say that it was then in its infancy, and perhaps it is even now in its infancy—who can tell?

The closing words of the address were as follows:

> We have then done good work; we have accomplished results which have added greatly to the productive wealth of the world; we have justified our existence as a class (remember that the subject was "*Official* Economic Entomology"). We are now better equipped for the prosecution of our work than ever before, and it may confidently be expected that the results of the closing years of the century will firmly fix the importance of economic entomology in the minds of all thinking men of all countries.

This prediction has been more than justified. Up to 1894, the great features in this practical work had been the invasion of Europe by the grape-vine *Phylloxera* and the work done against this destructive creature by American and European scientific men; the work done by the different countries against locust invasions, the work done by the different states of the United States, and by the general government, against many species of injurious insects, notably the cotton caterpillar, of the south, and the very remarkable work carried on by the state of Massachusetts, which had then been in operation with increasing appropriations from the state for four years (at that time $325,000 had been spent), and in the address just cited it was called "one of the most remarkable pieces of work, judged by results, which has yet been done in economic entomology."

At that time the San Jose scale had just been discovered in eastern United States. It was known only in a few localities, and the discovery that it had been disseminated far and wide through nurseries had not yet been made. The tremendous effect of the spread of this most injurious species upon the popular estimation of the value of entomological knowledge can hardly be overestimated. This spread alone is responsible, probably, for more legislation in this country and in other countries, than all the other features of entomology combined—state after state on this side of the water has passed rigid laws, and country after country has issued decrees and passed laws concerning commerce in plants, all of them, nearly, of broad bearing and great importance, but all of them also incited by the dangerous habits of this pest. The San Jose scale literature published in these last thirteen years covers hundreds of thousands of pages, and hundreds of thousands of dollars have been lost through its work, but through the operation of state laws many entomologists have been employed, and through their work millions of dollars have been saved.

Although in 1894 the discovery had already been made by Smith, Kilborne and Salmon, that the Texas fever in cattle is carried by a tick, and although Laveran had already made the discovery that the causative organism of malaria is a protozoan of like habits, inhabiting the red blood corpuscles, the life history of this protozoan had not been made out, and the all-important discovery of Ross, that its primary host is a mosquito, had not been made.

When we consider the now generally recognized importance of insects as carriers of certain diseases of men and animals we realize that the discoveries of the thirteen years under consideration have been vital to the welfare of humanity, and that possibly we are as yet only on the threshold of discoveries which will prolong life and will conduce to added happiness of millions yet unborn.

The ticks and the mosquitoes of the genera *Anopheles* and *Stegomyia,* and many other biting flies, fleas, the common house fly, the bed bug and presumably other insects, are now recognized not only as nuisances, but as most serious menaces to health, and measures for the control of nearly all of them are becoming well understood, and all of this has come about in the past eight years. The enormous San Jose scale literature referred to in the preceding paragraph is exceeded by the literature of this subject. Not only have popular journals and scientific transactions been filled with articles dealing with these discoveries, but books have been written, and medical journals have been crowded with announcements of discoveries bearing upon this line of investigation.

Here, economic entomology has touched a new side of human interest; it is the health of man and not the preservation of his property that is concerned, and the interest has been a more vital one. The prime investigators, it is true, have been medical men, but the economic entomologists have done their full and most important share, and it has only been by the combination of the labor of both classes of workers, that the present results have been achieved.

In both of these last two developments of this period—namely, the San Jose scale work and the work against insects injurious to health, the whole world has been vitally interested, and in another department, which has reached the highest stage during this time, many nations are becoming interested; and that is the international work with the parasitic, or predatory, insect enemies of injurious insects. Originally suggested, and experimentally tried on a small scale, but with scanty results, very many years ago, the first successful large scale experiment was concluded in California about twenty years since, by the work of an agent of the United States Department of Agriculture, Mr. Albert Koebele. Both the state of California and the United States Department of Agriculture have carried on the work since that time, and they have been joined by the territory of Hawaii, by the colony of Western Australia, by South Africa, by the British West Indies, by Egypt, by Portugal, by Italy, quite recently by France, and at the present moment an entomologist from Chile is in the United States searching for beneficial insects to take back with him to South America.

All of this work was done on a rather small scale, although occasionally with excellent results, until three years ago, when the effort to introduce the European parasites of *Ocneria dispar,* known as the gypsy moth, and of *Porthetria chrysorrhea,* known as the brown-tail moth, into the United States was begun. In the northeasterly portion of the United States, both of these injurious insects introduced accidentally had spread enormously, and occurred in countless numbers. The percentage of parasitism from native American parasites was very small. The normal percentage of parasitism in the native homes of the injurious species was very great. There seemed to be no object in limiting the importations of parasites—the greater the number introduced, the sooner, it seemed, would success be reached; therefore, from the start the work has been done upon a very large scale. Hundreds of thousands of host insects containing parasites have been brought each year from a large part of their European geographic range; more than forty species of parasites have thus been brought over, bred and liberated; several of them have certainly established themselves in New England, and there seems every reason to believe that speedy success will be reached. The single negative chance that native hyper-parasites will interfere can not be guarded against, and even should such species attack the imported parasites, it will probably not be long before a condition of more or less stable equilibrium among the host insects, the primary parasites and the hyper-parasites will have been reached. Every possible effort has been, and is being made, to prevent the escape in this country of the European hyper-parasites. This work is now going on in a laboratory at North Saugus, near Boston, and as it is by far the largest experiment of the kind ever tried in the history of the world, it will doubtless be interesting to the members of the section of economic zoology to visit this laboratory during the present week and examine the details and methods used. The speaker, who has special charge of this work, will be greatly indebted to members of the section for suggestions which they may make after an examination of the laboratory, which may assist in making the work more efficient.

Another almost unforeseen development in economic entomology, in the period under consideration, and one of very great interest and importance, has been the spread of the Mexican cotton boll weevil (*Anthonomus grandis*) in the United States. It has presented an enormous problem in economic zoology; the enormous damage it has done, and the fears it has aroused in other cotton-growing countries, have threatened a disturbance in the balance of trade for the entire world. At the time of the former address, in August, 1894, this insect had just made its appearance across the Rio Grande in the vicinity of Brownsville, Texas. Advancing year by year since then to the north and to the east, spreading at an average rate of perhaps seventy-five miles annually, it has now reached Arkansas and the Indian territory on the north, and the valley of the Mississippi River on the east. Many millions of dollars have been lost each year by the ravages of this insect. During the seasons of its greatest abundance, this annual damage has been estimated at from $15,000,000 to $30,000,000. In this spread we see one of the most striking instances of the value of scientific prediction, and the value of scientific advice in practical matters. At the beginning of its spread, the whole situation, as developed later, was predicted; and by a very small expenditure of money the insect could have been held in check and, in fact, exterminated easily. It occurred in a circumscribed region in which the value of the cotton production was not great, and the passage of a law by the Texas legislature to enforce measures, which could not have resulted in an expense of more than $20,000 or $30,000 to the state, would have entirely prevented the loss which has resulted from the ignoring of these recommendations—the recommendations were not only made by the Bureau of Entomology of the United States, but a bill was drafted in that office, the governor of the state recommended its passage in that session of the legislature; but with fatal economy, and with the fatal ignorance of the value of expert advice, the legislature failed to pass the law, and the insect steadily spread. Large sums of money have been spent by the general government in the investigation of all the factors connected with the life history, habits, method of dispersion and methods of control, and large sums have also been spent in actual field demonstrations upon a large scale of the efficacy of the control measures recommended. Even these field demonstrations, however, have been met with a conservatism in cultural methods that has proved quite as fatal as the original failure to pass the initial control law. At the present time it seems that the further spread of the insect can not be stopped, but so soon as this crop method conservatism can be overcome, the cotton boll weevil will cease to be a pest of the first rank, and the cultivation of cotton can be carried on almost as successfully in its presence as it was in its absence. In the course of this investigation there has been accumulated a mass of information concerning this insect which has probably never been exceeded in the study of any one species. For six years a well-selected and large force of trained entomologists have been investigating every phase of its life, and this in itself has never been done to the same extent with any other species; but, curiously enough, this work has not yet been completed, and the reason is that the weevil coming from Mexico has been steadily advancing into new territory where conditions of the soil, temperature, moisture and crop methods are different. It has shown itself adaptable to changes in these particulars to an extraordinary degree; it is still advancing; it is still changing its habits, and we may reasonably expect to see marked differential developments between such radically different conditions as those that exist in the dry, sandy cotton lands of Texas and the moist climate and heavy soil of the Mississippi bottom lands. This investigation must therefore still continue.

In this work against the cotton boll weevil we see, therefore, another striking development of economic entomology. The large sums appropriated by congress and by the different states have necessitated the employment of an increasing force of trained entomologists. The agricultural colleges of the United States have been obliged to meet this demand for additional assistance; through this cause, and many others, already mentioned, or to be mentioned, the importance of training in economic entomology in these agricultural colleges has become intensified; the men at the heads of these departments of instruction have been obliged to change their methods; they have kept up with the progress of field and laboratory work and have trained their students in the newest developments. The increase in the number of scientifically trained and working economic entomologists has been remarkable, and will be referred to later in this address.

It has already been stated that the work of the state of Massachusetts against the gipsy moth was already well under way in 1894. This work has since had its vicissitudes, and it offers a remarkable example of what can be done and what should be done in face of great emergencies such as it presented, and still presents, and it offers also an extraordinary example of the shortsightedness, temporary, at least, of legislators. The work continued with excellent success down to the year 1900. The extermination of the gipsy moth at that time was almost in sight. It had actually been exterminated over considerable extents of territory. The conservative estimate of those in charge of the work placed the period of the termination of state appropriation at only a few years in advance. Mark the result. The appropriation was dropped in 1900, and for the next five years no work was done against this insect, except that done by private property owners. All of the ground gained by the former work was lost, the insect multiplied in increasing numbers, and a large extent of new territory became infested, making the problem many times more important when the state again took hold of the remedial work in 1905. In fact, so greatly had the territory increased, so greatly had the insect multiplied as to do away practically with all idea of absolute extermination. An attempt at extermination on the same scale on which the attempt was previously made would almost bankrupt so rich an organization as the Commonwealth of Massachusetts. In the meantime, also, the insect spread beyond the borders of this state into Rhode Island, Connecticut, New Hampshire, and also, as has recently been discovered, into Maine. At last the general government was appealed to, and was appealed to distinctly in the terms of aid "to prevent the further spread of the moth." The brown-tail moth had in the meantime obtained a foothold in New England and had spread far and wide, and it too was included in the terms of the act of the general government, and also in the terms of the act of the state of Massachusetts. Appropriations were made by congress for expenditure during the fiscal year ending June 30, 1907, of $82,500, and for the fiscal year ending June 30, 1908, of $150,000.

In the meantime, the state of Massachusetts had appropriated under a very wise law $300,000 to be spent in the years 1905–8, and has appropriated again, the last winter, in cooperation with infested towns.

The states of Maine, New Hampshire, Connecticut and Rhode Island have also during the past winter made small appropriations covering operations for the next year or two. Here, then, is a gigantic effort in which no less than five states are making separate appropriations and are cooperating with the general government, which also makes an independent appropriation, the whole amounting to several hundreds of thousands of dollars, in an effort which, in its present phase, is devoted to the restriction of the further spread of these two pests, and toward relieving the conditions of damage which exist in the infested territory, until such time as the large scale experiment heretofore described in the introduction of foreign parasites of both species shall have culminated in a reasonable degree of success.

No larger scale work has probably ever been done, nor has any work in economic entomology ever been done in a more efficient and practical way than this combined work of the several states and the general government being carried on at the present time. The leader in this work has been the state of Massachusetts. Aroused by the disastrous conditions brought about by the lapse of appropriations in the years 1900 to 1905, the state has taken hold of the problem with an energy and intelligence commanding the greatest respect, and it has been this attitude on the part of the state that has induced the general government to assist on the principle that "Heaven helps those who help themselves."

It is interesting that the section of economic zoology of the Seventh International Congress should hold its meeting in Boston, the center of this great piece of economic work, at a time when its results can be plainly seen, and visiting members should utilize the opportunity to familiarize themselves with the details of this work. Very wisely, the work of the state of Massachusetts has been placed in the hands of Mr. A. H. Kirkland, a trained entomologist and a man of great executive ability, and in his hands it has become a great object lesson.

While the work already mentioned has perhaps had the most important bearing upon what may be termed "the rise of economic entomology" during the past dozen years, there has been an enormous amount of other work, of almost equal importance; there have been important developments in methods; there have been important discoveries in the life histories of many species, leading to better measures of control; there have been important widenings of the field in many directions. Only a few of these can be mentioned at this time, and perhaps those chosen will not, after all, be the most important.

The demonstration work in connection with the cotton boll weevil has been mentioned, and this in itself is an important new factor in our work. It seems to be not enough to tell a man that he can accomplish certain results by doing certain things; to establish perfect confidence it is necessary to prove this, and to prove it not by laboratory work, but by field work, and by field work on a large scale. The first demonstration work of this character was probably that carried on by Mr. C. B. Simpson for the Bureau of Entomology in the work against the codling moth, in Idaho, in 1902. Here a large commercial orchard was treated according to the most approved method, and a check orchard was left untreated. The results were exhibited to apple-growers in the autumn from the states of Idaho, Oregon and Washington, and the demonstration was so perfect as to induce a wide-spread adoption of the methods used. In Texas and Louisiana this demonstration work was carried on at first by the Bureau of Entomology, and later, after the methods were shown to have been sound, by the Bureau of Plant Industry, and upon a very large scale. In the same way, during the summer of 1906, cooperative work against injurious insects and fungus diseases of fruit orchards was carried on by these two bureaus in Nebraska, and during the present summer this work is being repeated in other states. The value of this demonstration is very great, and as before stated, introduces a new element into the work.

The international work with parasitic and predatory insects referred to in my previous paragraph is of course suggestive of what may be done with parasites of injurious species in a single country like the United States, which is of broad extent, and in which the climatic and crop conditions vary so considerably.

The Hessian fly, for example, that great destroyer of wheat, has in certain seasons and in certain localities parasites which reduce it to a minimum, but it has been shown that in the spring of certain years these parasites will be competently abundant in one region and practically absent in another. Advantage has been taken of this fact by Professor F. M. Webster, of the Bureau of Entomology, and his corps of assistants, to study and import from these regions of parasite abundance, parasitized puparia of the Hessian fly into regions where the parasites upon actual examination have been found to be absent. During the present season, early in spring, two early planted experimental plats, at Lansing, Mich., and Marion, Pa., were very seriously attacked by the Hessian fly, but on full examination carefully made at a later date, 90 per cent. of the puparia were found to have been stung by a parasite of the genus *Polygnotus* and to contain its developing larvæ. A field of wheat near Sharpsburg, Md., was found to be infested by the fly, and examination indicated the absence of the parasite. On April 8, a large number of the parasitized puparia from Marion, Pa., were brought to Sharpsburg, and placed in the field. On July 8 an examination of the Sharpsburg field showed that the parasites had taken hold to such an extent that of the large number of puparia taken and brought to the laboratory at Washington for examination, not one was found which had not been parasitized. This is the most striking example of the kind which has yet been recorded, and indicates the value of further experimental work in this direction.

Another interesting and significant large scale experiment of this kind was carried on in the present year, also by Professor Webster, which, while void of practical results, is most significant and valuable as indicating limitations. A serious enemy of grains and grasses, an aphidid, known as the *Toxoptera graminum,* made its appearance in the winter time in Texas, and gradually appeared farther and farther north until in July it was found across the Canadian border. At certain periods this *Toxoptera* is always practically exterminated by a parasite of the genus *Lysiphlebus.* At the time when the *Lysiphlebus* in Texas is abundant, and is gaining control of the situation, the *Toxoptera* is doing its worst damage, and is comparatively unparasitized in more northern regions, such as Oklahoma and Kansas. It was considered that if the parasites could be collected in Texas in very large numbers, and transported to Oklahoma or Kansas, the introduction of these large numbers of parasites would hasten the destruction of the *Toxoptera,* remembering all the while that native-born *Lysiphlebus* in small numbers were already beginning to develop in the Oklahoma and Kansas fields. A number of experiments of this kind, and on a very large scale, were carried on; some work was done by Mr. S. J. Hunter, of Kansas, and much was published about the result of this work in the month of May; but the careful, large scale and check experiment carried on under Professor Webster in the same month seems conclusive proof of the failure of such work.

One experiment in particular may be described: On May 13 two fields of winter oats near Manhattan, Kans., each containing four acres, were selected for the experiment. These fields were sufficiently widely separated, and one of them was used as a check. Into the other was introduced some millions of parasites sent from Wellington, a point much farther south. Careful count showed that in the experimental fields the percentage of native parasitism at the beginning of the experiment was from 3 to 7. On May 18 the parasites from Wellington were introduced and liberated; on May 23 the parasitism in this field had increased only about 2 per cent., whereas in the check field, in which no parasites had been liberated, it had increased 12 per cent. On May 27 the percentage of parasitism in the field into which parasites had been introduced had reached 27 per cent., while in the check field it was 32 per cent. It was thus clearly demonstrated that even under weather conditions favorable for the development of parasites, an introduction to the extent of millions carried out under field conditions does not indicate enough efficiency to afford any encouragement for the use of this measure in the protection of the grain fields in case of future attacks.

One of the most important features which have come to the front of late, although often suggested in earlier writings, is the value of a variation in farm practise in its effect upon insect control: the rotation of crops has always been known to be of prime value, but further than this; even in the case of constant recropping upon the same land of the same growth, it is often found that slight variations in time of seeding, in time of harvesting and in method of cultivation will produce important effects upon insects and vegetation. Many of the state entomologists have taken up this line of thought, and have worked out practical results with farm insects, and also with insects that affect truck crops. The advances in this direction and in others are, in fact, so numerous that even a cursory summary would be difficult.

In the 1894 address the rise and the then present condition of economic entomology were treated by countries, and in the United States by states. It will be well, therefore, after this consideration of the most general important developments of this application of the science, to look over the field and gain some idea of the material advances in means and facilities—in other words, let us gain some knowledge of the appreciation which our results have brought us from control bodies.

UNITED STATES

United States Department of Agriculture.—In 1894 the entomological service of the general government was carried on by the Division of Entomology, an independent division, the head of which reported directly to the Secretary of Agriculture. This office at that time carried an annual appropriation of $30,000, and its force consisted of the chief, with eight scientifically trained assistants, and three clerks and messengers.

At the time of present writing the entomological service of the department has been given bureau rank; its budget for the present year is $340,000, and its pay-roll includes one hundred scientific assistants and two hundred and fifty other employees. Its publications are numerous, and cover the whole field of economic entomology. The general appreciation of its results is most satisfactory.

The Different States.—In 1894 the state agricultural experiment stations had been in existence for six years; forty-two states and territories had employed persons to do entomological work. The number of experiment station workers who had published entomological bulletins or reports reached seventy-seven, only twenty-eight of whom were officially designated as entomologists to their respective stations. Entomological matter, mostly compiled, has been published by the agriculturists and horticulturists, and by the botanists, by the pomologists, the veterinarians and the librarians. At the present time the number of states having experiment stations and doing entomological work, including Hawaii and Porto Rico, is 51. The number of entomologists, assistant entomologists, and so on, employed by the stations is 82.

In 1894 the entomological publications of the experiment stations reached the number of 311, of which 88 were annual reports, 213 were bulletins and 10 were leaflets and circulars. In character the bulletins and such reports as had definite titles were thrown into three categories—first, those which treated only of insecticides and insecticide machinery—40; second, those which contained compiled accounts of insects, with measures for their destruction—60; third, those which contained the results of more or less sound, original observation with compiled matter, and matter upon remedies—117. There were also two small classes, one of which was apiculture, with six publications; the second, classificatory publications, of which there were four. Down to the present time the total number of entomological publications of state and agricultural experiment stations has reached 1,300, of which 424 are reports, 839 are bulletins, 34 circulars, and 3 apicultural bulletins. The stations have issued over 900 (941) reports in all, of which about one half, on a rough estimate, are entomological, or contain some entomological matters. The bulletins and circulars may be divided as follows: insecticides and machinery, 251; compiled accounts of insects, 259; more or less original observation, 356.

As the years have gone on original bulletins have increased in number. A critical summary of the results achieved by the experiment station workers would be of great interest, but it must be remembered, as pointed out thirteen years ago, it frequently happens that compiled bulletins have a greater practical value to the constituency of the state experiment station, than the bulletins giving the results of original work. The original work bulletins advance the condition of the science; the compiled bulletins extend the knowledge of the results so as to make them more valuable to people at large. The work that has been done by the offices of the different state entomologists has been of the greatest value —Forbes, in Illinois, and Felt, in New York, have published material of the greatest value. It would be perhaps invidious to point out with any relative estimate of their value any of the many highly important publications that have been issued by the entomologists of the experimental stations; but the work done by Smith, in New Jersey, and that which he has under way in his large scale campaign against the mosquitoes of that state are of such a unique character that they force special mention. The mosquito destruction measures carried on by English workers, and especially by those connected with the Liverpool School of Tropical Medicine, in different parts of the tropics controlled by England, has been large scale work of great value. That done by the army of occupation in Cuba was of enormous value, so far as the city of Havana was concerned, and an assistant just returned from the Isthmian canal zone assures me that it is possible to sit now out-of-doors of an evening upon an unprotected veranda anywhere in the zone without being annoyed by mosquitoes, and without danger of contracting malaria or yellow fever.

These are all great pieces of work, but when we consider the condition that exists in the state of New Jersey, and the indefatigable and successful work of Smith in the handling of the most difficult problem of the species that breed in the salt marshes, and of his persistent and finally successful efforts to induce the state legislature of that wealthy but extremely economical state to appropriate a large sum of money to relieve New Jersey from its characteristically traditional pest—we must hold up our hands in admiration.

The work that has been done by the state entomologists, and the entomologists of the state agricultural experiment stations, as a whole, impresses one as being of the highest practical value. While admirable pieces of scientific investigation have been carried out, the main *facies* of the work as a whole is almost rampant with practicality. The present condition of our knowledge of insecticides and systems of inspection is due for the most part to these workers, and the reading of the reports of the meetings of the Association of Economic Entomologists can not fail to impress one, not only with the earnestness and vivid interest of these men in their work, but also of their entirely competent grasp of the subject.

The speaker has visited personally many of the European workers in economic entomology during the past five or six years, and everywhere has heard eulogistic comments upon the work of the experiment-station entomologists of the United States. Sigismond Mokschetsky said to me last May at Simferopol, in the Crimea: "I know them all—Slingerland, Smith, Forbes, Felt, Webster, Osborn—what men!"

OTHER COUNTRIES

In most of the other countries of the world conditions are so different from those in the United States as to call for a treatment differing in some degree, greater or less, from that found available in the United States. Many of the principal insect pests are cosmopolitan; many are so similar in their habits as to allow the use of identical or similar remedial measures. In each separate faunal zone, however, are individual crop pests necessitating original observation and investigation, and frequently novel remedies. In the more newly settled countries, where agricultural holdings are large, the necessities become more nearly like those of the United States; thus, in Australia many problems are similar, and the same may be said of South Africa, and especially the new colony of the Transvaal, and the same remark may be extended in all probability to those portions of Asia which are being agriculturally developed by the Russian people. But, in the older countries, and especially in the European countries, the problem is different. In the address of thirteen years ago the speaker quoted the chief of the Agricultural Section of the Ministry of Agriculture of Prussia, who in conversation with the writer in the summer of 1893 argued that Germany does not need to employ general economic entomologists, that its experiment stations seldom receive applications for advice upon entomological topics. Special insects, it is true, occasionally spring into prominence; the phylloxera is one of these, and in an emergency like the phylloxera outbreak the work is handled by special commissions. European nations can, therefore, afford to let the problem alone to a much greater extent than the United States for the reason that it is infinitely less important with them than with us.

From several recent European visits the writer is inclined to agree, in a measure, with this statement of conditions. Nevertheless, there is a very considerable need in practically all of the countries of Europe for modern, careful work in economic entomology. A certain percentage, and it may be a very considerable percentage, of many crops is lost each year through failure to carry on entomological work on a much larger scale than it was done in 1894, or than it is done at the present date. Scattered here and there through Europe, as will appear from subsequent paragraphs, there is an occasional official economic entomologist, but, without exception, these men's hands are tied for want of financial backing. Their salaries are, without exception, extremely small from the American standpoint. They are working almost single-handed, and their opportunities are discouragingly small in face of the results that might be otherwise accomplished. They all feel these conditions strongly, and they all realize the great desirability for their government's good of additional opportunities for careful work. They are appealed to so often, in fact, by agriculturists as to indicate the certain value of added facilities, and I am convinced that practically all European governments are losing opportunities to save agriculture from a sure annual loss which may be greater or smaller, according to the conditions.

In the 1894 address the writer considered the conditions in the following countries in order: Canada, Great Britain, Germany, Austria Hungary, Italy, France, Spain, The Netherlands, Norway, Sweden, Russia (including Finland), Brazil, Chili, India, South Africa, Australia, British West Indies, New Zealand and the Hawaiian republic. In anticipation of the preparation of this address the officers in these countries just mentioned were written to with the request that they send information as to the present condition of the work in economic entomology in their countries. The same request was sent to practically all of the foreign members of the Association of Economic Entomologists. Many of them have responded, and from these responses and from personal visits to some of the countries, together with some knowledge of publications which have been issued, the following statements may be made:

CANADA

Dr. James Fletcher, in 1894 holding the position of entomologist and botanist to the Dominion Experimental Farms system of Canada, with headquarters at Ottawa, still retains the same position. At that time he worked alone. Since then he has been given two assistants. He publishes annually a report, which has constantly improved in character. The agriculture of Canada has developed enormously in the intervening thirteen years. The country has become richer, and more funds have been devoted to the Experimental Farms System. The amount that has been devoted to work in economic entomology has been by no means commensurate with the demands of the situation. As was the case in 1894, Canada is little behind the United States in her knowledge of and application of methods in economic entomology, but this is due largely to the fact of Dr. Fletcher's energy, broad grasp of the subject and indefatigability as a writer and public speaker. It is in this way that Canada, in which the agricultural conditions are quite similar to the northern portion of the United States, has been able to adopt and assimilate American methods and keep herself abreast of the times. Her problems in economic entomology, however, deserve a better support from the government than they have received. Dr. Fletcher should have opportunities for research work. He is so well informed a man, and so capable of handling problems, given greater assistance and the proper funds, that it is a pity that he has not received a greater financial support from his government.

MEXICO

No work in economic entomology was done in Mexico down to the year 1900. There was then founded a Commission of Agricultural Parasitology, which included work both with injurious insects and with plant diseases. It was placed in charge of Professor A. L. Herrera, a trained man of science, who has since remained its chief. The peculiar conditions in Mexico have caused the commission to be chiefly occupied with the vulgarization of methods already known in order to combat agricultural pests, and only recently has it been occupied in perfecting these methods where possible, having ended, to a certain extent, its labor of propagandism. It would have been illogical for the commission to have been occupied with exact studies in entomology and in investigations, while the people of the country were ignorant of the most common methods of defense, such as the Bordeaux mixture, kerosene emulsion, arsenical mixtures and so on. Professor Herrera has had to deal with an unusual class of people, and he has handled the situation with great tact and efficiency. He has published many papers of practical value, and has succeeded in spreading exact knowledge of remedies that has been of great assistance to the growers of his country.

Nevertheless, entomological investigations have been made when the necessity seemed strong. The personnel of his force consists of the chief, three traveling agents, a traveling agent charged with vaccination and the distribution of vaccine for domestic animals, a curator of collections, a designer, an entomological assistant, two bacteriological assistants, two clerks and two boys. The whole amount appropriated for all of the expense of this work, including the salaries, apparatus, etc., is $31,650.50 annually. This amount is, of course, in Mexican money, and while the Mexican dollar has a relatively small value, it has in Mexico a purchasing value equivalent to that of the American dollar. Professor Herrera keeps in constant touch with the work being done in economic entomology in other parts of the world, and with his high intelligence and great scientific talents is undoubtedly one of the most valuable public servants in Mexico, and one who deserves much greater support at the hands of his government.

GREAT BRITAIN

In regard to conditions in Great Britain there have been changes since 1894. Mr. Charles Whitehead, still living at Barming-house, Blackstone, has resigned his position as technical adviser to the Board of Agriculture, and Miss Eleanor Ormerod, for many years honorary consulting entomologist to the Royal Agricultural Society, has died. Miss Ormerod's services to British agriculture were very great and her death was a distinct loss to economic entomology. Official recognition of this science in Great Britain is slight. The Board of Agriculture, with offices at No. 4 Whitehall Place, London, does not deal with this subject in a separate branch, but it is included among the other duties of the Intelligence Division. The staff of this division consists, besides the assistant secretary, of one head, three assistant heads, five clerks and three boys. There is also a zoological adviser who is paid by the division, but the whole of whose time is not occupied by services to the board. There is no laboratory attached to the board. At present the board has no statutory powers to deal with insect infestations, except those conferred by the destructive insects act of 1877, which deals only with the Colorado beetle, but a bill to extend the powers of the board to all destructive insects is now before parliament and is expected to become a law very shortly.

The sum provided by the annual parliamentary vote for advice in economic entomology is two hundred pounds. The zoological adviser is Mr. Cecil Warburton, whose headquarters are at Cambridge, England, where he has the accommodation of a zoological laboratory and a collection of economic specimens.

There is some good economic work done at the University of Birmingham by Walter E. Collinge, and at the Southeastern Agricultural College at Wye, Kent, by Mr. F. V. Theobald. Mr. Collinge's work provides a consulting and experimental research department in connection with economic zoology, and his work includes answering inquiries from farmers, identifying farm pests, the carrying out of experiments with insecticides and fungicides, investigations in life histories of insects, lectures before agricultural and horticultural organizations, inspecting orchard and farm crops and the publication of the results. The department has been well planned, and its staff will include, when complete, a director and economic zoologist, economic mycologist and clerical or other assistants.

In the Southeastern Agricultural College at Wye economic entomology was taken up in 1894. Mr. Theobald was appointed in charge, and he has since carried the work along with the help of senior students only. Mr. Theobald has a good laboratory and equipment and has a large advisory correspondence from all parts of the kingdom and empire. He publishes an annual report and lectures before farmers' clubs and at definite agricultural centers. The college at Wye trains many students in agriculture from all parts of the British empire. The result is that Mr. Theobald lectures upon tropical insects as well as upon the insects of Great Britain. Some of these graduate students have been sent out to the colonies to take charge of entomological work, and inasmuch as this work will not receive especial consideration in this address, it might be well to mention that Mr. Harold H. King has been made the entomologist to the Sudan government; Mr. Frank Wilcox has been appointed entomologist to the Khedival Agricultural

Society at Cairo, Egypt, and Mr. C. W. Mason has received an appointment in the Imperial Department of Agriculture in India. The work, however, by reason of which Mr. Theobald is most prominent in the eyes of the scientific world at present is his great monograph of the mosquitoes of the world, of which four volumes, and one volume of plates, have already been published under the auspices of the British Museum of Natural History for the immediate purpose of enabling investigators of the transfer of disease by insects to determine the culicids under investigation. From 1901 to 1904 Mr. Theobald was superintendent of the short-lived department of economic zoology of the British Museum of Natural History.

The establishment within a year or two of the Association of Economic Biologists in England, and the founding of the *Journal of Economic Biology,* should be mentioned as important steps in the work in economic zoology in England. Another important step has been the appointment of Mr. R. Newstead to the School of Tropical Medicine at Liverpool. The necessity of this appointment was early seen by Professor Rupert Boyce, Sir Patrick Manson and Dr. Ronald Ross, and in fact Mr. Newstead's appointment was the first of its nature that has been made to an institution for medical research following the discovery of the tremendous importance of insects in the carriage of disease. It may be incidentally mentioned that at about the same time the writer was appointed consulting entomologist to the Public Health and Marine Hospital Service of the United States for the same reason. At Liverpool Mr. Newstead has excellent laboratory facilities in the famous Thompson-Yeates laboratories, gives lectures upon entomology and does the whole strictly entomological work connected with the most important investigations being carried on under that admirable institution.

IRELAND

As I am informed by Mr. George H. Carpenter, of Dublin, a great advance in the work of economic entomology in Ireland resulted from the establishment of the government department of agriculture and instruction in 1900. To this department were then transferred many of the scientific institutions of Dublin where biological research was carried on, including the Museum of Science and Art and the Royal College of Science. The museum staff to which Mr. Carpenter belonged, as stated in the 1894 address, was in the habit of receiving and answering inquiries about injurious insects, and with the establishment of the department the number of these inquiries increased. Popular leaflets on common insect pests were drawn up upon request for the use of farmers throughout the country. In 1901 Mr. Carpenter was appointed lecturer on zoology at the Royal College of Science for Ireland, and entomology forms an important feature of the zoological course. In 1904 he was made a professor in the college. He now possesses good laboratory facilities and funds for the purchase of material. Mr. Carpenter still retains the post of consulting entomologist to the Royal Dublin Society, which has issued economic proceedings since 1901, and these have formed an excellent channel for the publication of Mr. Carpenter's yearly reviews of injurious animals of Ireland. One feature of the work of the Dublin Museum which it is said has been shown to be valuable is the preparation of small collections of injurious insects for circulation in schools and elsewhere throughout the country.

GERMANY

Conditions have not changed to any great degree in Germany in the past thirteen years. Dr. Holrung still remains director of the station in Halle, where he has excellent laboratory facilities, and an insectary for experimental work. At the Forest School at Tharandt excellent instruction in regard to forest entomology is given, and there is carried on a large correspondence with foresters and proprietors of estates throughout the empire. The entomologist at Tharandt is Mr. Behr. Dr. Arnold Jacoby, the former professor of zoology, has been appointed director of the zoological and ethnological museum at Dresden, and no longer gives his attention to forest zoology. He has been succeeded by Dr. Escherich.

At Eberswalde bei Berlin the Forest School is active under the charge of Dr. Eckstein, who takes a vivid interest in matters relating to forest zoology. Visiting this school in May of the present year, the writer was delighted to find the old collections of Ratzeburg preserved in the most excellent condition, and his types receiving admirable care. Questions of agricultural entomology are referred to these three stations and others, but there are no especial institutions for the investigation of the life histories of injurious insects.

The conditions that exist in Germany hold for Austria.

HUNGARY

As stated in 1894, the Royal Entomological Station at Budapest, then under the direction of Dr. Geza Horvath, was founded by the government in 1881 as a phylloxera station, and as the phylloxera problem became more and more elucidated, and the means of defense against the scourge was reduced to a practical basis, the work of the station became directed more and more towards noxious insects in general and thus became an official bureau of investigation in economic entomology, a result due to Dr. Horvath's administration and to the wisdom of the Hungarian government. Since the last address Dr. Horvath has resigned his position to accept the post of director of the Royal Natural History Museum in Budapest, and has been succeeded in charge of the Entomological Station by his able assistant, Professor Josef Jablonowski, who at present has admirably fitted offices in the viticultural station, some three miles from Pesth, and with a small corps of assistants is doing most excellent work. He has been devoting much of his attention of late to the insects injurious to the sugar beet, and to the invasions of locusts into Hungary from the south. Professor Jablonowski is an admirably informed man, and it is due to his suggestion that the writer introduced upon a very large scale the wintering nests of the brown-tail moth into Massachusetts. Prior to this suggestion it was not known or expected that these newly hatched hibernating larvæ would contain parasites; but such is the fact, and hundreds of thousands of these parasites have emerged from introduced nests in Massachusetts, and are probably breeding here now.

ITALY

In 1894 the Royal Station of Agricultural Entomology at Florence was directed by Professor Adolfo Targioni-Tozzetti, assisted by Dr. Giacomo del Guercio and Professor Antonio Berlese. Since that time there have been changes. Professor Berlese went to Portici, near Naples, to take the professorship of economic zoology in the Royal Agricultural School. While there, with the assistance of Dr. Filippo Silvestri and Dr. G. Leonardi, he did some of the best work that has been done in entomology in general, and in its application to agriculture. His publications have covered a wide field, and were admirably and thoroughly done at the expense of great labor, and with very slight remuneration from the government. With the death of Professor Targioni-Tozzetti in 1902, Professor Berlese was made Director of the Royal Station for Agricultural Entomology at Florence, and Professor Silvestri succeeded him in the chair at Portici, the latter retaining Dr. Leonardi as his principal assistant. The technical staff of the Entomological Station at Florence is now as follows: Director, Professor A. Berlese; assistants, Professor G. del Guercio and Dr. C. Ribaga; in addition Dr. Paoli is engaged for work against the olive fly, and there is a subordinate staff which consists of a curator, a preparator, a mechanic and a gardener. The funds for the carrying on of the station amount to 16,000 lire per annum. In addition to these funds the government provides separate sums for experiments in different parts of the country, and for study in the different provinces, and sometimes these funds are large. Just at present large appropriations have been made for the study of the olive fly, and means to combat it. The station is intensely occupied with this problem at the present time, and field experiments are being made in various parts of the olive regions of the kingdom. Professor Berlese informs the writer that in Maremma in Tuscany the results already are satisfactory, and this year it is expected that the work will be completed.

At Portici the work includes instruction in entomology, experimental work in cooperation with the station at Florence, and a great deal of original work of the highest character is being carried on by both Silvestri and Leonardi. The force consists of these two men, Professor Silvestri being director, as previously stated, another assistant, Dr. G. Martelli, and a preparator. The laboratories at Portici are commodious, and the historic old palace in which they are situated is surrounded with beautiful gardens.

FRANCE

In 1894 a Department of Agricultural Entomology had just been founded at the Agronomical Institute at Paris. This office has since been termed the entomological station, and Dr. Paul Marchal has been at its head working under the Ministry of Agriculture.

The headquarters of the station are still at the National Agronomical Institute, No. 16 Rue Claude Bernard. Dr. Marchal is well equipped for the important work upon which he is engaged; but he has but one assistant, who is not a scientific man, but whom he has trained himself to act as a preparator; he has one small room and two halls; no experimental field, the most of his observations having been carried on in his home garden in the suburbs of Paris, where his rearing cages are established. Dr. Marchal is also professor of zoology as applied to agriculture in the Agronomical Institute, and in this work he has a tutor (Monsieur Grénaux) who is busy with the students in the preparation for their examinations, and in the arrangement of their courses. As professor of zoology Dr. Marchal gives thirty courses, one and one half hour each, twice a week from October 15 to February 15. The greater part of these courses is reserved for insects; three lessons are given to silk culture; three to bee culture, and one to oyster culture. There are a special lecturer on fish culture, and a professor of zootechny. The work that has been accomplished by Dr. Marchal under these adverse circumstances is remarkable, his latest labors resulting in the establishment of the phenomenon of *polyembryony* in certain parasitic insects are of profound scientific value, and, as we have already found in this country, possess a most important practical bearing upon the use of parasites.

Other work in economic entomology is carried on in France under the government at several points. Professor Valery Mayet at the National Agricultural School at Montpellier still teaches economic entomology, and continues his experimental work. Here, however, is the same old story; insufficient laboratory space, and not even a single assistant; half of the time of one assistant only.

At Rennes Professor C. Houlbert also teaches economic entomology in connection with his work at the University at Rennes. At Rouen Professor Paul Noel is chief of a small station for economic entomology, supported in part by the government, and in part by the department. Here he conducts investigations of the insects of that region, has built up a large collection, and is the consulting entomologist for the agriculturists of his department.

In her north African colonies France has met with a serious problem in the invasion of locusts and crickets from the south, and has conducted for a number of years an extensive investigation that has culminated in the publication of an enormous volume of the greatest interest, prepared under the direction of the director of the work, Professor J. Künckel d'Herculais.

THE NETHERLANDS

Professor J. Ritzema Bos is still the economic entomologist of Holland. Down to 1906 he conducted a phyto-pathological laboratory in Amsterdam; this was a private institution, but had received grants from the treasury, and really constituted the governmental service in this direction for the Netherlands. In 1902 the speaker visited this laboratory, and found it well located, with interesting collections. In 1906, however, the government opened an institution for phyto-pathology in connection with the agricultural college at Wageningen. The old laboratory in Amsterdam still exists as a small private institution. The work of the new institution is in the hands of the director, who has one assistant, one temporary assistant, an amanuensis and a laborer. Their work covers every part of phyto-pathology, as well in entomology as in mycology, in relation to agriculture, horticulture and silviculture; and under this office is done the inspection work of the government.

In her East Indian colonies the Netherlandish government has done some very good work in economic entomology in the investigation of the insects injurious to sugar cane; the insect enemies and diseases of this important crop in Java have been studied with care at the Dutch experiment stations, and excellent reports have been published.

NORWAY AND SWEDEN

In these two countries the conditions have not changed, and the work goes on about as described in 1894.

BELGIUM

Belgium has long been the home of many well-known entomologists, and in the publications of the Entomological Society of Belgium are to be found many papers of interest from the standpoint of economic entomology. The administration and the Superior Council of the Forests of Belgium have been occupied for a number of years with a condition involving an unusual development of insects injurious to wooded properties and domains, and Professor G. Severin, curator of the Royal Natural History Museum of Brussels, has been officially charged by the Belgian government to study this especial situation in order to propose remedies. Professor Severin is a man of great acquirements in natural history in general, as well as a trained entomologist, and his work in this direction can not fail to be of great value to his government.

There is in Belgium an entomological service of the State Agricultural Institute, and in the Bulletin de l'Agriculture, Part II., 1907, there appears a long article upon the observations of this service for 1906, by Professor Poskin. In this report is given a comprehensive account of the whole subject of insecticides.

RUSSIA

In Russia rather more work is being done than in most of the other European countries. The necessity for work in economic entomology in this country is greater than in the small countries, as pointed out in a previous paragraph. Under the direct charge of Professor J. Portschinsky, of the Ministry of Agriculture, stations have been established in different parts of the empire where entomological work of considerable value is being carried on.

During the present year the speaker has visited three of these stations, one at Kieff in the province of Kieff, under the charge of Professor Waldemar Pospielow; one at Kischeneff in Bessarabia, under the charge of Professor Isaac Krassiltchik; and one at Simferopol in the Crimea, under the charge of Professor Sigismond Mokschetsky. All of these men are trained observers, and are doing excellent work.

Professor Pospielow is connected with the University at Kieff, and is known for his researches on the influence of certain physical conditions upon the color of *lepidoptera*. Professor Krassiltchik has a private station in Kischeneff; Professor Mokschetsky is the director of the museum of natural history in Simferopol, an institution which he has built up by his own labors. He has conducted many investigations in economic entomology, and has published a number of papers of value. Entirely through his influence the Crimea, a most fertile country, in which great attention is devoted to fruit growing, was perhaps the earliest locality in Europe in which American ideas in economic entomology were introduced. It was most interesting to walk, as I did on several occasions, through enormous orchards and see everywhere American spraying machinery, and see the crops in as good condition as they could possibly be found in the most up-to-date region in the United States.

There are other similar stations subsidized by the government in different parts of Russia, and the problem of injurious insects is handled with intelligence, with a full knowledge of what has been done in other countries, and with much ingenuity.

In addition there is at St. Petersburg a zoological laboratory and museum under the Royal Institute of Forestry, of which Professor M. Cholodkowsky, a man of high ability, is director. He has two assistants and handles all matters relating to forest zoology. The assistants are Head Forester A. Ssilantjew, and Head Forester P. Spessiwzew.

FINLAND

This administrative province of Russia had made an attempt at the time of the writing of the last address to secure the establishment of an entomological experiment station. This attempt later proved to be successful. For some years the most advanced agricultural instruction has been given at the University at Helsingfors, where economic entomology is represented by a special teacher who gives regular courses of lectures, is at the head of a special laboratory, is the government entomologist, and as such is the head of the entomological department of the agricultural experiment station. This institution thus far has had only provisional quarters, but will be more fully organized and equipped in the autumn of 1908. In the new building to be erected ample laboratory space will be given, and a spacious insectary will be erected, with an isolated building for fumigation experiments. Professor Enzio Reuter, a well-known writer on economic entomology, is in charge of this work in Finland; and with the additional facilities expected there are sure to be more than commensurate results of practical value.

SOUTH AMERICA

Outside of the field of the investigation of mosquitoes, excellent work on which has been done by Dr. Lutz and Dr. Goeldi of Brazil, the situation is much the same as it was in 1894. Since that time, however, an important investigation of the locust ravages in Argentina was made by a North American entomologist, Professor Lawrence Bruner, whose expenses were paid by an association of merchants in Buenos Ayres. An admirable report was published, which does credit to American entomology. Subsequently the well known French entomologist, Professor J. Künckel d'Herculais, was employed to continue these investigations, which he did with the success to be expected.

Quite recently the government of Chile has undertaken systematic work in economic entomology, and has appointed a young native scientific man, Professor M. Rivera, professor of entomology at the Santiago Agricultural School, to take charge of this work, and to establish a government research laboratory at Santiago. Professor Rivera has just visited Europe and is at present in the United States, informing himself as to methods, books, machinery and equipment, and is arranging for an exchange of useful insects between Chile and the other countries.

In the 1894 address the important earlier work of Mr. Edwyn C. Reed was mentioned and it is interesting to note that at the present time his second son, Mr. Charles S. Reed, natural-history professor at the Concepcion Agricultural and at other colleges, is interesting himself in economic entomology. He has written several pamphlets on noxious insects and on Chilean birds that have been published at his own expense.

SOUTH AFRICA

Great progress has been made in this part of the world since the publication of the last address. In 1895 Mr. C. P. Lounsbury, of Massachusetts, was appointed entomologist to the government of the Cape Colony. His work was excellent from the start. He has conducted investigations of a high value to the colony, and to the whole of South Africa. Governmental confidence in his ability has been shown by increased facilities; he now has four assistants, a clerk, five hands for rough work, and various other assistants when needed; this is for the ordinary work of the office. In addition legislative action provides for nursery inspection and restrictions on the transportation of plants, and in other directions. The animal diseases experiment station is entirely under the charge of the office, and sums have been appropriated for locust destruction. The work done by Mr. Lounsbury has been of most varied character, and of the most excellent quality; his investigation of the South African ticks has been of striking value, and a model for investigators in other parts of the world.

In Natal Mr. Claude Fuller ranks as government entomologist and chief locust officer; he is also a chief inspector under the plant diseases act, and the officer administering the burr-weeds and Scotch-thistle exterminating acts. He has two assistants, Mr. A. E. Kelley and Mr. von

Pelser Berensberg. Mr. Berensberg is located at Durban, and is port examining officer, inspecting and treating all shipments of fruit and fruit trees and plants entering the port for Natal and the inland colonies. The laboratory facilities are poor, but excellent work has been done by Mr. Fuller and his force.

In the newly established colony of the Transvaal a department of agriculture was immediately established, and Mr. C. B. Simpson, of the force of the Bureau of Entomology at Washington, was sent out to take the appointment as entomologist. Mr. Simpson did excellent work from the very outset; he took hold of the problems existing—and some of them were very serious—with energy, enthusiasm and tact beyond praise. His success was great; he secured the confidence of his constituency at once; he was given assistance; he conducted investigations on the ordinary crop pests, upon the malarial mosquitoes, and finally was given a large sum, amounting to $60,000, for locust destruction. In this destruction work he was very successful; in fact, it seems safe to say that his work in this direction was the most important that has ever been done against insects of this class. His death from typhoid fever, which occurred in the autumn of 1906, was a great loss to the Transvaal, and a great loss to economic entomology. I have not learned that his successor has been appointed, but whoever he is, or may be, he will find, or will have found, that his work has been made easy for him by the labors of Simpson.

AUSTRALIA

The Australian states of Victoria, New South Wales, Queensland, South Australia and Tasmania have all continued to interest themselves to a very considerable extent in economic entomology; and Western Australia has taken up the problem, though in quite a different way.

In Victoria Mr. Charles French continues to hold the office of entomologist to the government and continues his excellent work, publishing from time to time upon insects injurious to vegetation. His handbook on the "Destructive Insects of Victoria," of which the first part was published in 1891 and the second in 1893, has been continued; and the third part, published in 1903, in addition to injurious insects takes up the consideration of certain valuable insect-destroying birds.

In Tasmania the work was continued until comparatively recently, but I have heard nothing in the last few years from that state.

In South Australia Mr. J. G. O. Tepper, in charge of the entomological department of the South Australia Museum, has acted as consulting entomologist for the agriculture department, although he is not now officially connected with the subject of applied entomology in that state. In 1894 Mr. George Quinn, horticultural instructor and chief inspector of fruit under the so-called "vine, fruit and vegetable protection act," became connected with the department of agriculture for the purpose of carrying out the law and trying in a general way to place horticulture on a sound footing. This law empowered the authorities to deal with, and regulate, the introduction into the state of fruits, plants, insects and diseases, and to make regulations for enforcing attention to any which might be already found injuring plant life in the state, or which might from time to time be introduced into the state. The law has been enforced in regard to the codling moth and the red scale, and a system of supervision has gradually been initiated over all the imported fruits and plants. They have prohibited the introduction of grape vines or portions thereof, and have set aside Adelaide as the sole port of entry of fruits and plants. Plants sent by parcels post are inspected and examined. Disinfection by hydrocyanic acid gas is carried on and charges are imposed on the importer covering the expenses incurred. Demonstrations and spraying experiments have been carried on in the orchards and gardens of South Australia under Mr. Quinn's direction, and much work has been done during the last ten years in testing remedies, publishing bulletins, and in giving lectures and personal advice. Mr. Quinn has three permanent assistants dealing with exports and imports. Moreover, about nine inspectors for orchard districts have been and will be employed. These men are selected from the best informed fruit growers in each district and are employed about six months in the year. Mr. Quinn also acts an instructor in horticultural matters and expends in his branch of the service about $8,000 a year.

In New South Wales, Mr. W. W. Froggatt on the death of Mr. A. Sidney Olliff was appointed government entomologist and attends to all of the correspondence on that subject, travels through the state making investigations, lectures on economic entomology, has an insectary where the necessary breeding tests are carried on, and has a laboratory and office in Sydney. The results of his investigations are detailed in articles published in the *New South Wales Agricultural Gazette,* and a short annual report is also published in the *Gazette.* Mr. Froggatt left New South Wales as a representative of the whole Australian federation with letters of introduction from the different premiers and the different departments of agriculture of the individual states, on the eighth of July, last, for a visit to the United States and other countries. He is an admirably equipped man of broad knowledge in the whole field of natural history and has achieved admirable results in his investigations. His recently published volume on "Australian Insects" shows his very competent grasp of the subject and his industry as a worker.

At the Hawkesbury Agricultural College in New South Wales—a government institution under the department of agriculture—economic entomology is dealt with as one of the subjects, and a course of thirty-two lectures and fifteen practical exercises is gone through during the second year of the student's residence. The work covers instruction in insect structure, chief pests, useful insects and treatment, the latter being well illustrated in practise by orchard operations carried on in an up-to-date manner. This work is under the charge of Professor Charles T. Musson, who, however, covers in his work botany, vegetable pathology and nature study, with one general assistant.

During the past year a bill passed the New South Wales Legislature giving power to enforce certain action relative to the codling moth and fruit fly, and inspectors to carry out the work have been appointed. The fruit expert of the department carries on a good deal of work in fumigation and spraying, mostly for demonstration and instruction purposes in the course of his travels throughout the state, and the subject is being introduced into the schools as a part of nature study.

In Queensland Mr. Henry Tryon, whose excellent publications are well known to American entomologists, is still connected with the department of agriculture as entomologist and vegetable pathologist, as well as inspector under the diseases of plants act. He supervises all plant importations and exportations, and has no assistants. His offices are in the department of agriculture in the center of the city of Brisbane, and he has slight opportunity for field experimentation. At the time of the last address Mr. Tryon was an assistant curator in the Queensland Museum, but was appointed to the department of agriculture in 1895.

In Western Australia the entomological work is done largely by Mr. George Compere, who acts in the dual capacity of expert of the department of agriculture, and as a traveling agent of the state board of horticulture of California. Mr. Compere is an enthusiastic believer in the efficacy of introduced parasites, and pays slight attention to other remedial measures.

BRITISH WEST INDIES

The situation in the British West Indies has changed radically since the publication of the former address. The Imperial Department of Agriculture for the West Indies was organized in 1898, and Sir Daniel Morris was appointed commissioner. The department was originally established for ten years, but has since been extended for a further period of five years; that is to say, until October 1, 1913.

During 1899 an entomologist was appointed, Mr. H. Maxwell Lefroy, who has since been transferred to India. Mr. Henry A. Ballou, of Massachusetts, was appointed to succeed him in March, 1903; he has no assistants beyond a single preparator. Mr. Ballou has done good work in investigating injurious insects of the territory over which the department extends, and publishes entomological information in the various periodicals and reports of the department, as well as in a fortnightly review, known as the *Agricultural News*, which contains popular insect notes. More technical papers appear in the *West Indian Bulletin*, a quarterly journal.

In the British Atlantic Islands outside of the control of the Imperial Department of Agriculture, such as Bermuda and the Bahamas, no official work in economic entomology seems to be carried on. In Bermuda, however, at the present time, under the agricultural society of the island, a most interesting experiment is under way, as I am informed by Mr. Ambrose Goslin the president of the society, and Mr. Claude W. McCallan, an old correspondent of the Bureau of Entomology at Washington. The fruit fly of Bermuda and other places (*Ceratitis capitata* Wied.), referred to in a short illustrated article in *Insect Life*, Vol. III., pp. 5–8 (1890), has increased so greatly and has become so injurious as to warrant the most radical means of destruction. During the present year all fruit of the island known to be affected by this insect has been rigorously destroyed in the effort to leave not a single opportunity for the insect to breed this year. This is an effort at extermination and its results will be followed with the greatest interest by all persons interested in entomology and fruit culture. The only comparable experiment known to the writer was carried on some years ago in a very large but isolated and most remunerative apple orchard in South Idaho when the entire crop is said to have been destroyed for one season, with the result that the codling moth in that region was exterminated.

INDIA

In India in 1894 the principal work in economic entomology had been done by Mr. E. C. Cotes, in charge of the entomological collections of the Indian Museum in Calcutta. Some three volumes of the valuable *Indian Museum Notes* had been published at that time, and a number of special reports had also been sent out dealing with economic problems in entomology. Since Mr. Cotes's retirement the work has been continued, and although the important *Indian Museum Notes* have not been issued so frequently, they are still published. There have, however, grown up two important branches of entomological service—the one established in 1901, when Mr. E. P.

Stebbing was appointed forest entomologist to the government of India; and the other in 1903, when Mr. H. Maxwell Lefroy was appointed entomologist to the government of India, or, as appears from his later reports, "Imperial Entomologist," leaving his position in the British West Indies to be succeeded, as is shown elsewhere, by Mr. H. A. Ballou. By Mr. Stebbing have been published a series of circulars on agricultural economic entomology issued by the trustees of the Indian Museum. Under Mr. Maxwell Lefroy has been started an entomological series of the memoirs of the Department of Agriculture in India, beginning with April, 1906. Five numbers have appeared, the last one bearing the date June, 1907. Mr. Stebbing has also published certain forest bulletins dealing with tree-boring beetles. In addition to these appointments, Mr. E. Ernest Green, well known for his able studies on the Coccidæ, has been made government entomologist for Ceylon with headquarters at the Royal Botanic Garden at Peradenyia, Ceylon, an admirable step and an appointment which Mr. Green can not fail to fill in the most satisfactory manner.

CONCLUSION

Looking over the whole field, it becomes obvious that very great advances have been made in economic entomology in the last thirteen years; greater advances, in fact, than during the entire previous history of the study. It becomes obvious, also, that the greatest advances have been made in the United States of America. In spite of this fact, however, it is plain that the United States is behind most of the other countries of the world in one most important particular.

Six years ago, visiting Hamburg, I found a most perfect system of inspection of all foreign fruits, trees and fruit products in operation. Nothing containing or carrying an insect was allowed to enter Germany through that port. To-day this holds true of most other countries. Even in the colony of Natal, as has been pointed out, there is a qualified agent stationed permanently at Durban, and his work protects Natal and the inland colonies from invasion by new insect pests and new plant diseases from abroad.

In the United States we have no such protection, except the one port of San Francisco, where under the state law, that has been upheld in the courts, California is protected. A crying need in this country is the passage of a general quarantine act by which the other great seaports of the United States should be protected.

L. O. HOWARD

SCIENTIFIC BOOKS

A Text-book of Organic Chemistry. By A. F. HOLLEMAN, Ph.D., F.R.A. (Amst.), Professor Ordinarius in the University of Amsterdam. Translated from the third Dutch edition by A. JAMIESON WALKER, Ph.D., B.A., head of the Department of Chemistry, Technical College, Derby, England, assisted by OWEN MOTT, Ph.D., with the cooperation of the author. Second English edition, rewritten. New York, John Wiley and Sons. 1907. Pp. 589. $2.50.

Walker's first translation of Holleman's "Organic Chemistry" was published in 1903. It met with so favorable a reception that a reprint was made, while Walker was translating the present edition.

This book differs from other larger textbooks of organic chemistry in the restriction of the field by the omission of a great number of isolated compounds, and by the prominence given to theory. In the words of the author "this book is essentially a text-book and makes no attempt to be a 'Beilstein' in a very compressed form."

Thanks to the limitation of the field, the student's attention is fixed on the more important classes of organic compounds, and on the theory of their formation, structure and decomposition. A student who has mastered this book should find it an easy matter to gradually enlarge his knowledge by study of some larger book and by reading chemical literature and journals.

That the book is thoroughly revised and brought up to date is shown by the references to the work of Baeyer and Villiger and Collie and Tickle on oxonium compounds, of Thiele on partial valence, of Ciamician on pyrrol, of Emil Fischer on amino acids, and by the application of physical chemistry where it serves to explain reactions, as in the formation and saponification of esters.

The reviewer feels no hesitation in recommending this book as one of the best text-books—perhaps it is *the* best—extant for those students for whom it was written, students of chemistry. It is not suited to students in high schools or colleges or to medical students who are "taking a course" in organic chemistry.

E. Renouf

Die Spiele der Tiere. Karl Groos. 2 Aufl. Jena, G. Fischer. 1907. Pp. viii + 341.

This new edition is apparently different from the first chiefly in the changes that were necessary to make it appeal to the lay reader. This impression is given by its appearance in German type, and the omission of a considerable amount of theoretical discussion. The anecdotes and instances cited are almost identical with those of the first edition. The only important change in theoretical standpoint is with reference to imitation. In the former edition Groos followed James Mill and current tradition in regarding imitation as an instinct. In the present edition he takes the ground that it must rest upon individual acquirement and presupposes practise based on experimentation. Instincts imply definite reactions to definite stimuli, while imitative movements are essentially variable in response to many different stimuli. The tendency to imitate, however, is made to rest upon an inherited disposition. The only considerable change in text is found in the concluding chapter, which has been reduced about three quarters, by the omission of all controversial matter and expository statement of theories. In this edition the author limits himself to the statement of his conclusions, that play is a form of experimentation, derives its pleasure from the feeling of power in self-activity, or from self-exhibition, and is closely related to the esthetic impulses of mankind.

W. B. Pillsbury

University of Michigan

SCIENTIFIC JOURNALS AND ARTICLES

The New York Zoological Society has issued the first of a series of papers which will appear from time to time and give the results of the scientific work carried on by members of its staff. The title of the publication is, or was to have been *Zoologica,* but by an error it appears as *Zoologia.* This reminds one of the German University that proposed to issue an absolutely perfect *Festschrift,* and did issue it with a glaring error on the title page. A somewhat similar mistake recently occurred in a number of the *Bulletin of the American Museum of Natural History,* where the name of the author was misspelled.

The Museums Journal of Great Britain for October contains articles "On Preparing Artificial Ground-work for Mounting Individual Specimens, Economic Sets, etc., in Spirit," and "A Method of Utilizing Small Wall-areas in Museums for Spirit Preparations," by F. G. Pearcey, and "The Aims and Objects of Museums," and especially the Western Australian Museum, by B. H. Woodward.

A *Bulletin* on "Unutilized Fishes and their Relation to the Fishing Industries," by Irving A. Field, has just been issued by the Bureau of Fisheries. This contains some important observations on the food of the smooth dogfish, *Mustelus canis,* and horned dogfish, *Squalus acanthias,* showing that one is extremely destructive to lobsters and the other to the more important food fishes. Incidentally, attention is called to the fact that the numbers of edible fishes have been greatly lessened, nothing has been done to destroy their enemies, which have increased.

SOCIETIES AND ACADEMIES

THE AMERICAN CHEMICAL SOCIETY—NEW YORK SECTION

The second regular meeting of the session of 1906–7 was held at the Chemists' Club, 108 West 55th Street, on November 8.

The following resolutions respecting the proper interpretation of the measures enacted in the federal pure food and drug law were adopted:

Whereas: The Food and Drugs Act of June 30, 1906, is generally approved, and in the opinion of the New York Section of the American Chemical Society it is one of the most important measures which has been taken for the protection of the public; and

Whereas, on the other hand, we can not but feel that the rules and regulations published from time to time by the Department of Agriculture, for carrying out the provisions of this act are not in full accord with the knowledge and experience of some of the members of this section, who are experts in these matters, and inasmuch as there is a conscientious difference of opinion concerning the same, therefore be it

Resolved, That we respectfully request the honorable Secretaries of Agriculture, the Treasury and Commerce and Labor, who are given the authority to administer this law, to suspend the publication of these decisions temporarily, and before taking further steps in this direction to consult with a carefully-selected committee of experienced chemical manufacturers and scientists, recognized as authorities in these fields.

The following papers were read:

The Atomic Weight of Chlorine: W. A. Noyes and H. C. P. Weber.

The Effect of Coal Gas on the Corrosion of Wrought-iron Pipe buried in the Earth: W. L. Dudley.

This investigation was undertaken in connection with a study of the conditions causing the corrosion of pipe laid under the streets of Nashville.

Five samples of earth were collected as representative of the various types of earth in which the pipes are laid. The samples were analyzed for chlorin, nitrogen as nitrates, nitrites and ammonia, alkalinity and humus. Each sample was put in a separate wooden box. Five pieces of wrought-iron pipe were cleaned by immersing in a warm ammoniacal solution of ammonium citrate, washed in water, dried and weighed. Each piece was tightly plugged at one end and thrust into a box of earth. The pipes were left in contact with the earth for twelve months, during which time water was occasionally added in equal amount to each box. At the end of this time the pipes were removed, cleaned as before and weighed. A similar set of boxes and pipes were left for twelve months, during which time one half cubic foot of coal gas was admitted to each box daily. Each box of this set was moistened daily with 50 c.c. of water, the boxes being covered with canvas to prevent evaporation.

The loss of weight of the set of pipes in contact with coal gas was found to be about one half as great as in the case of the pipes immersed in the earth alone. In both cases the loss was greater in the earth containing the greater chlorine content.

Chemical Examination of Micromeria Chamissonis (Yerba Buena): F. B. Powers and A. H. Salway.

When the entire air-dried plant was distilled with steam, 0.16 per cent. essential oil and a little palmitic acid passed over. The oil had a mint-like odor, sp.g. 0.9244 at 20°, $[\alpha]_D = -22° 48'$.

The concentrated alcoholic extract of the plant, a thick, green oil, was distilled with steam. The distillate contained traces of formic, acetic and butyric acids and an essential oil: $B.P._{25}$ 80–160°, sp.g. = 0.9450 at 20°, $[\alpha]_D = -26° 44'$. The residue in the still separated into a red aqueous liquid and a soft resin. From the aqueous liquid were obtained a new alcohol, *xanthomicrol*, $C_{15}H_{12}O_6$, yellow needles, m. 225°, with phenolic properties, and i-glucose. A petrol-ether extract of the resin gave a paraffine $C_{31}H_{64}$, a phytosterol $C_{27}H_{46}O$ and behenic, arachidic and palmitic acids. From the ether extract of the resin two new alcohols, *micromerol* $C_{33}H_{56}O_6$ and *micromeritol* $C_{30}H_{50}O_6$, were isolated. Micromerol, m. 277°, very stable, occurs to the extent of 0.25 per cent. of the plant. It forms a monoacetyl and a monomethyl derivative, and is physiologically inactive. Micromeritol, m. 294–296°, gives a diacetyl and a monoacetyl derivative.

C. M. Joyce,
Secretary

THE TORREY BOTANICAL CLUB

The meeting of October 30, 1907, was held in the Museum Building of the New York Botanical Garden. The club was called to order by the secretary at 3:55 o'clock P.M., and Dr. John Hendley Barnhart was elected chairman. Twenty-two persons attended.

The following program was presented:

Botanical Exploration in Jamaica: N. L. Britton.

Dr. Britton described his recent trip to the island of Jamaica, where he spent the month of September, with Mrs. Britton, and in co-operation with Hon. William Fawcett, director of public gardens and plantations, and of Mr. William Harris, superintendent of public gardens, in exploring the south-central portion of Jamaica. Collections aggregating about one thousand field numbers were made in the vicinity of Kingston, in the vicinity of Mandeville, on the Santa Cruz Mountains and the Pedro plains, lying between these mountains and the southern coast; the coast and morasses about Black River and Lacovia were examined, and another base was made at New Market on the western border of the parish of St. Elizabeth, whence the hill country of the vicinity and of Eastern Westmoreland were explored; a stop was also made at Bluefields on the southern coast.

The region explored had been little collected in since the visit of William Purdie, an English collector sent to Jamaica from the Royal Gardens, Kew, in 1843 and 1844, and many species not collected by Mr. Harris in his recent work were obtained. Specimens of a considerable number of the more interesting trees and shrubs obtained were exhibited.

Remarks on the water-weed, Philotria: P. A. Rydberg.

The genus was first described in Michaux's Flora Boreali-Americana under the name Elodea. Unfortunately this is antedated by *Elodes* Adanson. *Elodea* is characterized as having hermaphrodite flowers with three stamens and three bifid styles. Muhlenberg in his catalogue referred the plant to the Old World *Serpicula verticillata* L., now *Hydrilla verticillata,* and characterized the plant as being diœcious with four-merous staminate flowers. Pursh in his "Flora" retains the plant in *Serpicula,* but publishes it under a new specific name, *S. occidentalis.* His description agrees in every respect with that of Michaux except that the leaves are described as linear, acute, and finely serrulate. Rafinesque, in reviewing Pursh's "Flora" in the *American Monthly Magazine* criticized Pursh's treatment of the plant and proposes a new name *Philotria,* under which the plant is now to be known. Nuttall in his genera proposes another new name *Udora,* and cites *Elodea* Michx. as a synonym; but describes the plant as being diœcious, the staminate flowers as having nine stamens and the pistillate as having three sterile filaments and three ligulate bifid stigmas. He also adds: "flowers very small and evanescent, the female emerging; the male migratory, breaking off connection usually with the parent plant, it instantly expands to the light, the anthers also burst with elasticity and the granular pollen vaguely floats upon the surface of the water." Torrey, in the "Flora of New York," describes *Udora* as being polygamous; the sterile flowers with nine stamens, the fertile ones with three–six stamens and cuneiform, two-lobed stigmas.

How are these conflicting descriptions to be reconciled? Have some of the authors mentioned given erroneous descriptions? Are there more than one species which have been confused, or is *Philotria canadensis* such a variable plant both as to flowers and leaves? If there are more than one species, are they all polygamo-diœcious with three kinds of flowers: staminate with very short perianth-tube and nine stamens, pistillate ones with long tube and no stamens or merely rudimentary filaments, and hermaphrodite flowers similar to the pistillate ones, but somewhat larger and with three–six stamens? These are questions to be answered, and botanists who have an opportunity to study the plants are invited to make thorough field study on these interesting water-weeds.

The study, as far as it has been done now, has given the following suggestions and conclusions, mostly drawn from the literature on the subject and from herbarium material. There seem to be more than one species, probably six or seven. As far as the material on hand shows, the plant with broad and obtuse leaves, originally described as *Elodea canadensis*, seems to be hermaphrodite; the others all diœcious, not polygamous. The plant which is growing in Europe, supposed to have been introduced from America, and described as *Anacharis Alsinastrum* Babington, resembles *E. canadensis* in habit, but only pistillate flowers have been found, and in these the stigmas are entire. In the North American forms with diœcious flowers the staminate sheaths are sessile in the axils of the leaves, and easily overlooked, except in the plant common in the Rocky Mountain region and one specimen from Tennessee, in which the sheaths are peduncled. In the Rocky Mountain plant the staminate flowers are apetalous.

The subject will be more fully discussed in a paper which Dr. Rydberg is preparing to publish in the *Bulletin* of the club, as soon as more material has been consulted and certain questions can be answered with more definiteness.

Both papers were briefly discussed and adjournment was at 5:30 o'clock.

C. STUART GAGER,
Secretary

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN

THE first regular meeting of the club was held in Science Hall on Tuesday, November 5. Dr. Thos. E. Will, secretary of the American Forestry Association, delivered an address on the general subject of forest preservation, with particular emphasis on the proposed forest reserves in the Appalachian and White Mountains. After pointing out the fact that the timber supply of the United States is disappearing at an alarmingly rapid rate, Dr. Will showed by a series of significant lantern slides the disastrous indirect effects which the removal of the forest-cover produces upon cultivated valleys and slopes, and explained the direct relation between deforestation and the increase in floods. The contrast between western United States, with its large area of forest reserves, and the eastern portion of the country, which has none at all, was clearly brought out by maps thrown on the screen; and the importance of immediately providing such reserves in the eastern mountains for the protection of the streams which rise among them, was made clear to all. At the close of the lecture a resolution was adopted by the club urging congress to enact a law providing the necessary reserves.

ELIOT BLACKWELDER,
Secretary

DISCUSSION AND CORRESPONDENCE

THE EQUATION FOR ONE KILOGRAM OF AIR

TO THE EDITOR OF SCIENCE: It is possible that many teachers of thermodynamics may not have noticed that the characteristic equation for one kilogram of air takes the easily rememberable form $pv = T/10$ when p is measured in standard atmospheres, v in cubic feet, and T in thermodynamic Centigrade degrees, the accuracy of the even integer being fully as great as that of the gas law itself. These units are, of course, a curious mixture of the English and continental systems, but this seldom makes much difference in actual problems, and the convenience of the formula for rough mental computations is sometimes very great.

The data upon which this computation of the gas constant is based are the statements in the third (1905) edition of Landolt and Boernstein that one liter of air under standard conditions weighs 1.2928 grams, and that an American yard is 0.91440 meters, and the value $T_0 = 273.13°$ given by Buckingham in the *Bulletin* of the Bureau of Standards for May, 1907. The value $R = 0.1$ is consistent with these assumptions within less than one fiftieth of one per cent.

The corresponding values of C_p and C_v, reduced from the mean of the results of Regnault (1862), Wiedemann (1876) and

Witkowski (1896), are $C_p = 0.3467$ and $C_v = 0.2467$ cubic-foot atmospheres.

Harvey N. Davis
Cambridge, Mass.

OCCURRENCE OF THREE SPECIES OF BEAKED WHALES OF THE GENUS MESOPLODON ON THE ATLANTIC COAST OF THE UNITED STATES

To the Editor of Science: The few specimens of beaked whales of the genus *Mesoplodon* which have hitherto been obtained on the Atlantic coast of the United States have been tacitly assigned to a single species, *M. bidens* (Sowerby). After a detailed study of the material available, I am convinced that three species are represented. These are: (1) *M. bidens,* the species most commonly found in the North Atlantic; (2) *M. europæus,* a species known hitherto only from a single specimen found floating in the English Channel about seventy years ago; and (3) a species which is apparently *M. densirostris,* of which only a few specimens from the Indian Ocean are known.

The name *M. europæus* (Gervais) will probably have to be replaced by *M. gervaisi* (Deslongchamps). The former specific name was originally published in the first edition of Gervais's "Zoologie et Paléontologie françaises" (1846–52) under the genus *Dioplodon.* I have not seen the first edition of this work, but in the second edition (1859) the name is a *nomen nudum.* The species was apparently first described by Deslongchamps in 1866, who renamed it *gervaisi* (*Dioplodon gervaisi*).

An account of the American specimens of this and other genera of ziphioid whales in the National Museum is in preparation, and will probably be published in a few months.

F. W. True
National Museum,
November 5, 1907

SPECIAL ARTICLES

SOME RECENT ADVANCES IN SOUTH AFRICAN PALEONTOLOGY

During the past year a considerable number of new fossil reptiles have been discovered in the Permian and Triassic deposits which are included in the Karroo formation. Three new Therocephalian genera have been discovered in beds which are probably Middle Permian. These are all more or less closely allied to others previously known, and do not reveal much that is new in the general anatomy of the group. In beds which are probably Lower Triassic a new type of Therocephalian has been discovered and named *Arnognathus.* Unfortunately, it is only represented by a dentary bone. The discovery is chiefly interesting from the fact that no Therocephalian has hitherto been got in beds more recent than Upper Permian. It is rather a degenerate form than one leading on to the specialized Cynodonts.

Very much more important than these is the discovery in Lower Triassic beds of the nearly complete skeleton of a small reptile which must be placed in a new suborder. Hitherto we have had no evidence throwing any light on the origin of the Therocephalian reptiles. *Pareiasaurus* and some other of the Cotylosauroid forms seemed to suggest a possible origin among these early types, while one or two points in Mammalian morphology and embryology such as the mammal-like type of the organ of Jacobson in *Sphenodon* seemed rather to favor an affinity with the Rhynchocephalians. The discovery of this new fossil reptile, which is called *Galechirus,* strongly favors the descent of the Therocephalians from an early Rhynchocephaloid ancestor. This new type is about the size of a rat and the following are its most important characters: the dentition is thecodont and homodont, there being no enlarged canine; the lower jaw is very similar to that of the Therocephalians, but there is no enlarged coronoid process; the shoulder girdle is typically Therocephalian, the precoracoid being well developed; the digital formula is 2, 3, 3, 3, 3; the pelvis is plate-like with the ilium directed somewhat backwards; and well-developed abdominal ribs are present. Unfortunately, the temporal region and palate are unknown. The affinities are undoubtedly mainly with the Therocephalians, but in none of the mammal-like reptiles have abdominal ribs hitherto been found and we may feel quite certain in concluding that in the Anomodonts at least they did not occur, and had they occurred in the Therocephalians it is likely they would have been discovered. The combination of characters seems to point to *Galechirus* being a primitive Therapsidian reptile most closely related to the Therocephalians, but with distinct Rhynchocephaloid affinities. As the American Pelycosaurs are undoubtedly Rhynchocephaloid, it seems not improbable that the common ancestor of the Pelycosaurs and the African mammal-like forms may have been an early Rhynchocephaloid reptile rather than a Cotylosaurian, as some of us had thought.

Another type which I have discovered in the last few months seems in some respects almost as important as *Galechirus* in that it is another "missing link" discovered. A few years ago I pointed out that the old order "Theriodontia" of Owen was an unnatural group including two well-marked divisions—the *Therocephalia* with a Rhyncephalian type of palate, single occipital condyle, simple molars and large angular and surangular bones in the lower jaw, and the *Cynodontia* with a mammalian type of palate, two condyles, complex molars and the lower jaws almost wholly formed by the dentary. The Therocephalians are almost entirely confined to the Middle and Upper Permian beds, the Cynodonts to the Middle and Upper Triassic beds. The new type, which I propose to call *Bauria,* was found in Upper Triassic beds, and while it must be placed among the Cynodonts it shows affinities with the Therocephalians not present in the other known genera. In general shape the skull is not unlike that of *Trirachodon,* but about one half larger than *T. kannemeyeri.* The dental formula is i 4, c 1, m 10 above and apparently the same below. The molars are remarkable by being simple uncusped teeth with flattened tops. There is a secondary palate as in typical Cynodonts, but unlike all previously discovered forms the postorbital arch is incomplete, the postorbital bone not meeting the jugal. The appearance thus produced is very mammal-like. There is apparently no parietal foramen. The squamosal is more like that of the Therocephalians than that of the Cynodonts, and the quadrate is very minute. The occipital condyle is intermediate between that of the Therocephalians and the Cynodonts in that while it is really double the two parts are so close to each other that it is practically single. The lower jaw is almost typically Therocephalian, the angular and surangular being large and the dentary only forming the anterior two thirds of the jaw. While *Bauria* is thus typically Cynodont in the structure of its palate and must therefore be placed in the *Cynodontia,* in the simplicity of its molars, the condition of the occipital condyle, and in the structure of the lower jaw it shows distinct affinities with the more primitive Therocephalians.

In the Lower Triassic beds an imperfect skeleton of a small *Mesosaurus*-like reptile has been discovered. It is less typically an aquatic form and has slender ribs. Abdominal ribs are well developed. The skull, which is imperfectly preserved, is long and pointed and, so far as can be made out, is Rhynchocephaloid in its characters. Until other specimens throw further light on the form it will provisionally be placed in the *Mesosauria.* It has been named *Heleosaurus.*

R. BROOM

VICTORIA COLLEGE,
STELLEN BOSCH, SOUTH AFRICA,
October, 1907

NOTE ON THE FERMENTATIVE REACTIONS OF THE B. COLI GROUP

IN view of the fact that Prescott[1] and others have recorded the presence of organisms resembling *Bacillus coli* on grains, it seemed to us of interest to make a somewhat careful comparison of these forms with intestinal *B. coli* in regard to their power of fermenting carbohydrates. The success of Gordon and Houston[2] in clearing up the relations of the

[1] SCIENCE, N. S., XV., 363; *Medicine,* XI., 20; "Biological Studies" by the pupils of William Thompson Sedgwick, Boston, 1906.

[2] Report of the Medical Officer to the Local

streptococci from various sources by comparison of fermentative power encouraged us to hope for results.

With this end in view, fifty-two cultures of dextrose-fermenting organisms were isolated from human feces. The procedure in all cases consisted in the inoculation, with a small portion of the material, of a fermentation tube from which litmus-lactose-agar plates were made on the first appearance of gas. Of the 52 cultures thus isolated, 5 failed to give a typical reaction in milk, 7 failed to reduce nitrates, 6 formed no indol, and 16 liquefied gelatin. Thirty-one of the 52 cultures proved to be *B. coli*, as determined by the five tests mentioned above, and 25 of them were used for comparative tests in various carbohydrates.

After the work with the intestinal *B. coli* was completed the attempt was made (in the summer of 1907) to secure similar forms from growing grains. Heads of grains and grasses of various sorts were collected from fields in eastern Massachusetts and brought to the laboratory in sterile test-tubes. Portions of perhaps an inch in length were placed in dextrose fermentation tubes and when gas formation began litmus-lactose-agar plates were inoculated. One hundred and seventy-eight samples of grain, however, showed gas in the dextrose tube only 50 times; and 40 samples of grasses failed to show gas at all. Of the 50 samples plated on litmus-lactose-agar only three showed red colonies, and of the organisms isolated all three liquefied gelatin. Time was not available to pursue this investigation further. It seemed to us, however, that our inability to isolate *B. coli* from 218 samples of grains and grasses was in itself of some interest. The experience corresponds with that of Laurent,[3] and Klein, and Houston,[4] but not with the results of Prescott (*l. c.*), and Papasotiriu.[5]

The results obtained with the intestinal *B. coli* may perhaps be of some assistance to workers along similar lines. Each of the 25 cultures studied was inoculated into 12 different fermentable media in fermentation tubes. The basis of the medium was in each case nutrient broth, to which 1 per cent. of the substance to be tested had been added, sterilization being carried out at 100° on three successive days. Two monosaccharides, dextrose and galactose; 5 polysaccharides, lactose, maltose, xylose, saccharose and raffinose; two alcohols, dulcite and mannite, two starch-like bodies, dextrin and inulin, and one albuminoid, nutrose—were used as substances to be fermented.

ACID PRODUCTION BY B. COLI (INTESTINAL)

Acidity in terms of c.c. N/20 NaOH per c.c. of the culture medium. 72 hours' incubation

Culture	Lactose	Maltose	Dextrose	Saccharose	Raffinose	Xylose	Nutrose	Dulcite	Inulin	Dextrin	Mannite	Galactose
1	.3	.2	.3	—.1	.05	.3	.1	.4	0	.2	0	.3
2	.3	.3	.3	0	0	.2	0	.25	.05	.2	.4	.3
3	.3	.35	.3	.3	.3	.3	0	.3	0	.3	.4	.35
4	.3	.25	.3	0	0	.2	0	0	0	.2	0	.25
5	.3	.4	.3	.1	.2	.3	0	.2	0	.2	.4	.4
6	.35	.25	.3	.2	.2	.3	—.05	.4	0	.2	.4	.45
7	.3	.4	.3	0	0	.3	0	.2	.1	.2	.4	.35
8	.3	.2	.3	0	0	.3	—.1	0	.05	.2	0	.3
9	.3	.3	.4	—.05	0	.3	0	.2	0	.4	.4	.3
10	.25	.3	.4	—.05	0	.3	0	.15	0	.2	0	.35
11	.3	.3	.3	—.05	.3	.3	0	.3	.05	.2	.4	.35
12	.3	.4	.3	—.05	0	.3	0	.3	.05	.2	.4	.4
13	.25	.25	.3	—.05	0	.3	—.05	.3	0	.3	.4	.3
14	.25	.35	.4	0	.25	.3	—.05	.35	.05	.1	0	.35
15	.3	.4	.4	.1	.3	.35	0	0	.05	.2	.4	.35
16	.3	.4	.3	0	0	.3	.1	.3	0	.2	.35	.4
17	.3	.25	.4	—.05	0	.25	0	.3	.05	.2	.3	.35
18	.3	.4	.4	0	0	.3	0	.3	.05	.2	.4	.35
19	.3	.4	.3	—.1	0	.35	0	.3	.05	.35	0	.35
20	.3	.4	.3	0	0	.2	0	.3	0	.4	.4	.3
21	.3	.35	.3	0	0	.4	.15	.35	0	.15	.4	.35
22	.3	.4	.3	.15	.3	.3	—.05	.35	0	.2	.4	.35
23	.3	.4	.3	.35	.3	.25	—.05	.35	.2	.2	.4	.35
24	.3	.3	.3	.35	.2	.3	—.05	.3	.05	.3	.4	.4
25	.4	.3	.3	.3	.3	.3	—.05	.4	.05	.1	.4	.45

After 72 hours' incubation at 37° the occurrence of gas formation was observed and the reaction of the medium was determined by titration against $N/20$ NaOH. Uninoculated tubes were, of course, titrated in parallel as controls. The general results of the titrations are indicated in the table below, the acidity in

Government Board for 1902–3; Report of the Medical Officer to the Local Government Board for 1903–4.

[3] *Ann. de l'Inst. Pasteur*, 1899, 13.

[4] Report of the Medical Officer to the Local Government Board for 1899–1900.

[5] *Archiv für Hygiene*, XLI., 204.

each case being the amount of $N/20$ NaOH in c.c., necessary to neutralize one cubic centimeter of the broth, phenolphthalein being used as an indicator. Gas formation coincided with acidity except in the case of dextrin. With this medium acidity was produced in every case, but gas was formed only by cultures 7, 8, 12, 14, 17 and 21.

Inspection of the table shows that all the cultures produced acid in the two monosaccharids; in the polysaccharids, lactose, maltose and xylose, and in the starch-like body, dextrin, the final acidity produced being notably uniform except in the case of dextrin. None of the cultures fermented inulin or nutrose actively, though slight acidity was recorded in one or two cases. No gas was formed in any case in these two media. The other four substances, the polysaccharids, saccharose and raffinose and the two alcohols show diagnostic differences. Seven of the cultures fermented all of these substances; one fermented all but dulcite; one all but saccharose; and one attacked raffinose and dulcite. These ten cultures may be roughly grouped together as organisms of high fermentative power. None of the other fifteen strains produced acid in either saccharose or raffinose. Smith[6] long ago pointed out that saccharose was attacked by some bacteria of the colon group, and not by others. Raffinose is evidently acted on by the same organisms which attack saccharose; and it is of interest to note that these two polysaccharides differ from lactose and maltose in lacking the aldehyde group which shows itself in the reduction of Fehling's solution. The group of organisms, which possess the power of fermenting saccharose, was distinguished by Dunham as *B. coli communior*, and by Ford as *B. communior*, the name *B. coli* being restricted to the type which fails to ferment saccharose. On this basis, Nos. 3, 5, 6, 11, 14, 15, 22, 23, 24 and 25 in the table would be related to *B. communior*, No. 11 varying in failing to act on saccharose, No. 14 failing to ferment saccharose and mannite and No. 15 failing to act on dulcite. Of these ten cultures, only No. 14 formed gas in dextrin.

[6] "Wilder Quarter-Century Book," Ithaca, 1893.

The other fifteen strains are typical *B. coli*, not attacking saccharose or raffinose; but among them several subgroups may be distinguished according to their action on the alcohols and dextrin. Six cultures, Nos. 2, 9, 13, 16, 18 and 20, fermented both alcohols but formed no gas in dextrin. Four cultures, Nos. 7, 12, 17 and 21, fermented both alcohols and did form gas in dextrin. Nos. 4 and 8 formed no acid in the alcohols. Nos. 1, 10 and 19 produced acid in dulcite but not in mannite and no gas in dextrin.

Whether these differences are of systematic significance can only be determined by the examination of a larger series of cultures. MacConkey,[7] in a study of 480 coli-like organisms from feces, found 120 which fermented neither saccharose nor dulcite, 178 which fermented dulcite but not saccharose, 110 which fermented both saccharose and dulcite and 72 which fermented saccharose but not dulcite. Our results, classified in the same way, and ignoring the action upon raffinose and mannite, show 2 cultures in the first group, 15 in the second, 7 in the third and 1 in the fourth.

C.-E. A. Winslow
L. T. Walker
Massachusetts Institute of Technology

CURRENT NOTES ON METEOROLOGY AND CLIMATOLOGY

MONTHLY WEATHER REVIEW

No. 8, Vol. XXXV., *Monthly Weather Review*, 1907, contains the following articles:

G. N. Coffey: "Influence of Temperature and Moisture upon the Rate of Growth of Tobacco"; review of Bulletin 39, Bureau of Soils, on "Effect of Shading on Soil Conditions," dealing with experiments on tobacco grown under shade at Tariffville, Conn. The conclusion is: the soil moisture was always sufficient in quantity; the relative humidity had little, if any, influence on the rate of growth, but a decided rise or fall in temperature was followed by an acceleration or diminution, respectively, in the rate of growth of the plants.

W. A. Bentley: "Studies of Frost and Ice Crystals." This paper is intended as a com-

[7] *Journal of Hygiene*, V., 333.

panion memoir to, and an extension of, the same writer's "Studies among the Snow Crystals during the Winter of 1901–2," published in the *Monthly Weather Review,* 1902, XXX., 607–616, pls. I.–XXII.

J. G. C. Cottier: "A Summary of the History of the Resistance of Elastic Fluids"; a posthumous paper, published by permission of the literary executor of Mr. Cottier.

W. P. Stewart: "Local Forecasting at Escanaba, Mich."; brings out several points of local interest, and also the fact that, owing to the protection afforded by Lake Superior, cold waves are more severe to the east and west than at Escanaba.

Dr. Irving Langmuir: "Lightning Phenomena"; note on the curious "headed trails" of several lightning flashes.

Professor Cleveland Abbe: "Salton Sea and Local Climate"; "the practical question is not how much the Salton Sea can affect climate, but how its waters can be used for irrigating the lands that surround it."

"Tornado at Maple Plain, Minn.," and "Hail-shooting in Italy"; short notes.

Dr. P. Polis: "The New Public Weather Service of Germany"; an interesting account by the head of the Aachen Observatory, who has lately been in the United States studying our weather service.

NILE FLOOD, 1906

An important report on "The Rains of the Nile Basin and the Nile Flood of 1906," by Capt. H. G. Lyons, director general of the Survey Department of Egypt (Cairo, 1907), has been received, and illustrates, in a most striking way, the progress which meteorology is making in Egypt. Here is a report of seventy pages, dealing with the rainfall of a region concerning which practically nothing was known a few years ago. And we learn from this same report that "it is also proposed to investigate the upper region of the monsoon current over the Sudan plains by means of kites carrying self-registering apparatus." The charts given by Capt. Lyons are of much interest, especially those of the seasonal and annual rainfall. These charts extend south to Lake Nyassa. Four isobaric charts cover an area between the equator and lat. 10° N., and east as far as long. 80° E.

SENSIBLE TEMPERATURES

A further contribution to the discussion concerning the "subjective" or "sensible" temperatures, *i. e.,* the temperatures which human beings actually feel, and which depend on temperature, humidity, wind, insolation, and many other factors, is contained in the *Meteorologische Zeitschrift* for October, 1907 (W. Knoche: "Die äquivalente Temperatur: ein einheitlicher Ausdruck der klimatischen Faktoren Lufttemperatur und Luftfeuchtigkeit"). This paper deals with the so-called "äquivalente Temperatur," as originally suggested by von Bezold. If we imagine the water vapor contents of unit volume (1 cu. m.) condensed, and the resulting latent heat of evaporation expended in warming a cubic meter of dry air to a certain temperature, the increase of temperature resulting from the latent heat of evaporation, added to the then prevailing air temperature, gives the "äquivalente Temperatur." This method of expressing the relation of temperature and humidity is followed out for several different stations and climates, and is found to give an excellent indication of the temperature which we actually feel.

R. DeC. Ward

TWO RECENT INTERNATIONAL SCIENTIFIC CONGRESSES[1]

In two congresses composed of members of such dissimilar outlooks as were the congresses at Heidelberg and Amsterdam the differences in the conduct of the congresses were very noticeable. It is generally admitted that in all scientific congresses there are two elements of value, the intellectual and the social. Both elements are to be combined in proper proportion to make the mixture most agreeable and profitable to the individual. In the congress of physiology most emphasis was placed on the presentation of papers; in the congress of psychiatry, neurology and psychology more time and opportunities were given

[1] Physiology, at Heidelberg, August 13–16; Psychiatry, Neurology and Psychology, at Amsterdam, September 2–7, 1907.

for meeting our Dutch hosts and the visiting delegates from other countries.

The physiological congress was composed of teachers of physiology and of other members of national physiological societies, of whom there were about 300 in attendance. Germany supplied less than one third of the members, and sixteen other countries were represented by over 200. The number of papers on the program was about 200. Over half of these were, or included, demonstrations, experiments or lantern views. There were three sections with seven or eight sittings each.

Any one interested in one or more of the subjects—neurology, psychiatry, psychology, care of the insane—could be registered as a member of the Amsterdam congress, and the number of members was correspondingly large, 800. The number of papers was small, 86, if the special papers on asylum management be excluded; with the latter there were 121. The scientific papers were divided as follows: 6 in three general sessions; 17 general discussions and 38 other papers in the section of neurology and psychiatry; seven general discussions and eighteen other papers in the section of psychology and psychophysics. Each section held five sessions.

In both congresses the projection lantern was extensively used for the illustration of results. At the physiological congress there were also many demonstrations on animals which gave to the congress a unique character. Short demonstrations were usually given as parts of the papers that could be illustrated by experiment, and one might see not only the apparatus, but also the obtaining of results by the men who were most familiar with the method. The plan just mentioned might be followed to the advantage of the members in some of our national societies, although it has the slight drawback that it entails considerable extra work on the members of the department where the meetings are held. At the physiological congress microscopic exhibits were also on view during the sessions. It was possible, therefore, to examine the stained sections at leisure, with more profit than from a single brief projection on the screen, and it gave the opportunity of discussing methods and results with the investigator or one of his assistants. This is a most efficacious way to have disputed or doubtful matters cleared up.

An arrangement at the physiological congress of considerable value for the convenience of the members was the posting in each section of the numbers of the papers being read or discussed in the other sections. This was possible because of telephone connections. This enabled the members to move from room to room, or rather from section to section, to hear papers and discussions and to take part in the discussions of the topics that were of special interest to them. At our scientific meetings, and especially at the convocation week gatherings, this method would be exceedingly valuable.

At both congresses there was about an equal number of social meetings, excursions, a dinner, etc. The impression formed by the writer was that at the Heidelberg congress the social gatherings were more formal in character, though not in dress, than at Amsterdam. The meetings were about the same general character, but in some way there did not seem to be so many opportunities of meeting the foreign members as there were in Amsterdam. The formation of country groups was most marked in Heidelberg, probably because the social side usually included sitting at table, while at the congress of psychiatry the formation of such groups was the exception. The different occupations of the members of the two congresses had probably much to do with the social character of the meetings, for the neurologists and psychiatrists must have not only an interest in things (diseases and cases), but also in people, whereas physiologists are occupied with problems dealing little with social matters. The writer would not have the impression left that each congress failed in certain respects toward the visiting members, but there is solely the matter of emphasizing more or less certain aspects of the functions of scientific congresses. At both the members were hospitably and even royally welcomed, at both the scientific papers were equal to the best. It is not intended as a reflection on the committee in either place to say that the scientific side at Heidelberg and the social side at Amsterdam were the impressive parts of the congresses.

S. I. F.

JOINT MEETING OF MATHEMATICIANS AND ENGINEERS

On the occasion of the annual convocation of the American Association for the Advancement of Science in Chicago during the Christmas holidays, 1907, it is proposed to hold a meeting of mathematicians and engineers under the joint auspices of Sections A and D of the American Association and the Chicago Section of the American Mathematical Society.

The program includes (1) a session on Monday afternoon, December 30, to consider the present status of the teaching of mathematics to students of engineering, both in this country and abroad; (2) a banquet on Monday evening for the promotion of acquaintance and good fellowship among mathematicians and engineers; (3) a symposium on Tuesday morning, December 31, on the topic "What is needed in the teaching of mathematics to students of engineering?" (*a*) What range of subjects? (*b*) To what extent in the various subjects? (*c*) By what methods of presentation? (*d*) What should be the chief aims?

The joint sessions will be held in the Ryerson Physical Laboratory, University of Chicago. Prominent engineers and mathematicians have already promised to take part in this program. It is hoped that a large number of those interested may thus be brought together to discuss these matters of the highest mutual importance. Announcements giving full details of the program and speakers will be mailed in advance of the time of the meeting.

G. A. Miller,
Secretary of Section A of the American Association

W. T. Magruder,
Secretary of Section D of the American Association

H. E. Slaught,
Secretary of the Chicago Section of the American Mathematical Society

THE CONVOCATION WEEK MEETINGS OF SCIENTIFIC SOCIETIES

The American Association for the Advancement of Science and the national scientific societies named below will meet at the University of Chicago during convocation week, beginning on December 30, 1906.

American Association for the Advancement of Science.—December 30–January 4. Retiring president, Professor W. H. Welch, The Johns Hopkins University, Baltimore, Md.; president-elect, Professor E. L. Nichols, Cornell University, Ithaca, N. Y.; permanent secretary, Dr. L. O. Howard, Cosmos Club, Washington, D. C.; general secretary, President F. W. McNair, Houghton, Mich.

Local Executive Committee.—Charles L. Hutchinson, chairman local committee; John M. Coulter, chairman executive committee; John R. Angell, Thomas C. Chamberlin, Joseph P. Iddings, Frank R. Lillie, Charles R. Mann, Robert A. Millikan, Charles F. Millspaugh, Alexander Smith, J. Paul Goode, local secretary.

Section A, Mathematics and Astronomy.—Vice-president, Professor E. O. Lovett, Princeton University; secretary, Professor G. A. Miller, University of Illinois, Urbana, Illinois.

Section B, Physics.—Vice-president, Professor Dayton C. Miller, Case School of Applied Science; secretary, Professor A. D. Cole, Vassar College, Poughkeepsie, N. Y.

Section C, Chemistry.—Vice-president, Professor H. P. Talbot, Massachusetts Institute of Technology; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

Section D, Mechanical Science and Engineering.—Vice-president, Professor Olin H. Landreth, Union College; secretary, Professor Wm. T. Magruder, Ohio State University, Columbus, Ohio.

Section E, Geology and Geography.—Vice-president, Professor J. P. Iddings, University of Chicago; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York City.

Section F, Zoology.—Vice-president, Professor E. B. Wilson, Columbia University; secretary, Professor C. Judson Herrick, University of Chicago.

Section G, Botany.—Vice-president, Professor C. E. Bessey, University of Nebraska; secretary, Professor F. E. Lloyd, Desert Botanical Laboratory, Tucson, Arizona.

Section H, Anthropology.—Vice-president, Professor Franz Boas, Columbia University; secretary, George H. Pepper, American Museum of Natural History, New York City.

Section I, Social and Economic Science.—Vice-president, Dr. John Franklin Crowell, New York City; secretary, Professor J. P. Norton, Yale University, New Haven, Conn.

Section K, Physiology and Experimental Medicine.—Vice-president, Dr. Ludvig Hektoen, University of Chicago; secretary, Dr. Wm. J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

Section L, Education.—Vice-president, Hon. Elmer E. Brown, U. S. Commissioner of Education; acting secretary, Professor Edward L. Thorndike, Teachers College, Columbia University, New York City.

The American Society of Naturalists.—December 28. President, Professor J. Playfair McMurrich, University of Toronto; secretary, Professor E. L. Thorndike, Teachers College, Columbia University, New York City. Central Branch, president, Professor R. A. Harper, University of Wisconsin; secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The American Mathematical Society. Chicago Section, December 30, 31. Chairman, Professor Edward B. Van Vleck; secretary Herbert E. Slaught, 58th St., and Ellis Ave., Chicago, Ill.

The American Physical Society.—President, Professor E. L. Nichols, Cornell University; secretary, Professor Ernest Merritt, Cornell University, Ithaca, N. Y.

The American Chemical Society.—December 27–January 2. President, Professor Marston T. Bogert, Columbia University; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

The Association of American Geographers.—December 31–January 1. Acting-president, Professor R. S. Tarr, Cornell University, to whom correspondence should be addressed; secretary, Albert P. Brigham, 123 Pall Mall, London, Eng.

The Association of Economic Entomologists.—December 27, 28. President, Professor H. A. Morgan, Knoxville, Tenn.; secretary, A. F. Burgess, Columbhus, Ohio.

The American Society of Biological Chemists.—December 30–January 2. President, Professor Russell H. Chittenden, Yale University; secretary, Professor William J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

The Society of American Bacteriologists.—December 31–January 2. Vice-president, F. D. Chester, Delaware Agricultural College, Newark, Del.; secretary, Professor S. C. Prescott, Massachusetts Institute of Technology.

The American Physiological Society.—Beginning December 31. President, Professor W. H. Howell, Johns Hopkins University; secretary, Professor Lafayette B. Mendel, 18 Trumbull St., New Haven, Conn.

The Association of American Anatomists.—January 1–3. President, Professor Franklin P. Mall; secretary, Professor G. Carl Huber, 1330 Hill St., Ann Arbor, Mich.

The American Society of Zoologists.—Central Branch. Secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The Botanical Society of America.—December 27–29. President, Professor George F. Atkinson, Cornell University; secretary, Dr. D. S. Johnson, Johns Hopkins University.

The Botanists of the Central States.—Business Meeting. President, Professor T. H. Macbride, University of Iowa; secretary, Professor H. C. Cowles, University of Chicago, Chicago, Ill.

The American Psychological Association.—December 27, 28. President, Dr. Henry Rutgers Marshall, New York City; acting secretary, Professor R. S. Woodworth, Columbia University, New York City.

The Western Philosophical Association.—Secretary, Dr. John E. Bowdoin, University of Kansas, Lawrence, Kans.

The American Anthropological Association.—December 30, January 4. President, Professor Franz Boas, Columbia University; secretary, Dr. Geo. Grant MacCurdy, Yale University, New Haven, Conn.

The American Folk-lore Society.—December 30–January 4. President, Professor Roland B. Dixon, Harvard University; secretary, Dr. Alfred M. Tozzer, Harvard University, Cambridge, Mass.

Other national societies will meet as follows:

NEW HAVEN

The American Society of Zoologists.—Eastern Branch. December 26, 28. President, Dr. C. B. Davenport, Cold Spring Harbor, N. Y.; secretary, Professor W. L. Coe, Yale University, New Haven, Conn.

The American Society of Vertebrate Paleontologists.—December 26–28. President, Professor Bashford Dean, Columbia University; secretary, Professor Frederick B. Loomis, Amherst College, Amherst, Mass.

NEW YORK

The American Mathematical Society.—December 27, 28. President, Professor H. S. White, Vassar College; secretary, Professor F. N. Cole, Columbia University.

ALBUQUERQUE, N. M.

The Geological Society of America.—December 30–January 4. President, President Charles R. Van Hise, University of Wisconsin; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York City.

ITHACA

The American Philosophical Association.—December 26, 28. President, Professor H. N. Gardiner, Smith College; secretary, Professor Frank Thilly, Cornell University, Ithaca, N. Y.

NEXT SUMMER, AT SOME PLACE TO BE DETERMINED

The Astronomical and Astrophysical Society of America.—President, Professor Edward C. Pickering, Harvard College Observatory; secretary, Professor Geo. C. Comstock, Washburn Observatory, Madison, Wisconsin.

THE ANNUAL DUES OF MEMBERS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The permanent secretary of the American Association for the Advancement of Science begs to call the attention of members to the fact that the annual dues (three dollars) for the year beginning January the first should now be sent to him. The financial year of the association will hereafter end on October 31, and the dues for the following calendar year should be paid as soon as possible after that date. The dues are so small and the membership of the association has become so large that the sending of statements involves an expenditure of time and money, which, so far as possible, should be saved. The office of the permanent secretary must be removed to the place of meeting at Chicago during the last week in December, and the dues should be paid prior to that time. If they are not paid before January 1, there are serious complications in regard to the sending of Science to members. The association can not make itself responsible for sending Science to those whose dues are in arrears, as there are some who may regard the non-payment of dues as equivalent to resignation from the association. The back numbers of Science will be sent to those who pay their dues after January the first upon the payment to the publishers of postage, so far as the edition permits, but the publishers do not guarantee that this will be done. Should the edition threaten to become exhausted, it will be necessary for those who wish to keep their sets of Science complete to pay for the numbers.

The permanent secretary takes this occasion to remind members of the desirability of assuming life membership in the association. By the payment of fifty dollars at the present time, all future trouble and expense is avoided. The fees of life members are ultimately transferred to the permanent fund, the income of which is used exclusively for the encouragement of research, and those who assume life membership thus contribute materially to the advancement of science. L. O. Howard,

Permanent Secretary

Smithsonian Institution,
Washington, D. C.

SCIENTIFIC NOTES AND NEWS

An oil portrait of Professor James Mills Peirce, Perkins professor of mathematics at Harvard University until his death in 1905, has been presented to the university by his sister.

The gold medal of the British Institution of Mining and Metallurgy, has been awarded to Sir Archibald Geikie in recognition of his services to geological science. The Consolidated Gold Fields of South Africa gold medal and premium have been awarded to Dr. T. Kirke-Rose for researches on the metallurgy of gold.

Dr. Robert Koch has been promoted to the rank of Wirklicher Geheimer Rath, with the title of Excellency, in recognition of his researches into the causes of the sleeping sickness.

Dr. J. A. Allen, curator of mammalogy and ornithology in the American Museum of Natural History and editor of *The Auk*, has been elected an honorary member of the Deutsche Ornithologische Gesellschaft; he has also been transferred from the foreign to the honorary class of members of the British Ornithologists' Union.

Dr. R. W. Wood, professor of experimental physics in the Johns Hopkins University, has been awarded the John Scott legacy premium and medal for his discoveries in color photography by the Franklin Institute of Philadelphia. The institute has awarded Mr. H. E. Ives of the physics department the Edward Longstreth medal for improvements on the method.

The Walsingham medal of Cambridge University for 1907 has been awarded to E. Mellanby, formerly research student at Emmanuel College, for his essay on the metabolism of creatinin and creatin.

At a meeting of the London Mathematical Society on November 14, the following officers were elected: President, Professor W. Burnside; vice-presidents, Professor A. R. Forsyth and Professor H. M. Macdonald; treasurer, Professor J. Larmor; secretaries, Professor A. E. H. Love and Mr. J. H. Grace.

Dr. George T. Ladd, emeritus professor of philosophy in Yale University, has returned from Japan to his home in New Haven.

The *Journal* of the New York Botanical Garden states that Professor C. F. Baker, for three years past chief of the department of botany in the Estación Central Agronómica, at Santiago de las Vegas, Cuba, has been appointed curator of the herbarium and botanic garden at the Museu Goeldi, Para, Brazil. His special work there will be the further development of the herbarium and garden at Para, and the botanical exploration of some of the most interesting parts of the Amazon valley.

Dr. C. B. Robinson, assistant curator of the N. Y. Botanical Garden, has been appointed economic botanist of the Bureau of Science of the Government of the Philippine Islands.

Professor C. L. De Muralt, of the University of Michigan, has returned from Europe, where he has been supervising the electrification of the Altberg tunnel beneath the Tyrolean Alps.

Professor Albert Perry Brigham is on leave during the present year. He has spent the summer and autumn in geological field work under Dr. John M. Clarke, of the New York State Museum, and sailed on November 28 for Genoa, to join his family in Geneva. He will spend the winter in Geneva, and the rest of the year in travel in southern Europe, attending the International Geographical Congress in Geneva in July, and returning to college duties in September.

Professor G. D. Harris, of Cornell University and state geologist of Louisiana, has begun this season's field work in the south. He plans to make a large collection of the recent and Quaternary shells of the gulf border and will collect at Cedar Keys, Tampa, Biloxi, New Orleans and Galveston. Then visiting Jennings and Beaumont and passing westward into Texas, he will complete last winter's study of the Louisiana and Texas oil fields.

Dr. Raymond H. Pond, who has been studying at the New York Botanical Garden during the past year, sailed for Europe on November 7 to spend several months in visiting German botanical laboratories.

The Hamburg Institute for Ship and Tropical Diseases is sending Drs. Keysselitz and Mayer to German East Africa to study protozoan diseases in man and animals. Their headquarters are to be at Amani.

King Edward has granted to Sir Frederick Treves, Bart., serjeant-surgeon, Thatched House Lodge as a residence. The house is one of the three lodges in Richmond Park.

The address of the retiring president of the Philosophical Society of Washington will be given by Mr. John F. Hayford, of the U. S. Coast and Geodetic Survey, on December 7. His subject is "The Earth, a Failing Structure."

At a meeting of the fern class of the Botanical Society of Pennsylvania, on November 23, the members present signed appropriate resolutions containing an appreciation of the earnest and fruitful labors of the late Professor Lucien M. Underwood, and the same have been forwarded to Professor N. L. Britton, of the New York Botanical Garden.

We regret to record the death of Professor Asaph Hall, one of the most distinguished of

American astronomers. Born in Goshen, Conn., in 1829, he became assistant at the Harvard College Observatory, and from 1863 was professor in the United States Naval Observatory, carrying on his important researches until his retirement in 1895, when he was appointed professor at Harvard University. Dr. Hall was president of the American Association for the Advancement of Science in 1902.

Dr. George F. Shrady, editor of the *New York Medical Record* since its foundation in 1866 to 1904, and the author of numerous contributions to medical science, died in New York City on November 29, at the age of seventy years.

Professor R. Kossmann has died in Berlin, at the age of 58, from the results of septic infection. He was at first a zoologist and later devoted himself to medicine, particularly gynecology.

Professor Alfred D. Cole, of Vassar College, Poughkeepsie, N. Y., secretary of Section B—Physics—of the American Association for the Advancement of Science has sent the following notice to members of the section:

The annual meeting of the American Association for the Advancement of Science will be held at the University of Chicago, from December 30, 1907, to January 4, 1908. The American Physical Society will meet at the same time and the usual arrangement for joint sessions for the reading of papers will doubtless be made. The joint meeting in New York, a year ago, was one of the most successful gatherings of physicists ever held in the country, and it is hoped that this Chicago meeting will be equally good.

The presiding officer of Section B is Professor Dayton C. Miller, of the Case School of Applied Science, and the address of the retiring vice-president will be given by Professor W. C. Sabine, of Harvard University.

A single program for all sessions will be issued on the opening day of the meeting, and it is desired to send out a preliminary program by December 15. Therefore promptness in sending in titles of all papers to be presented before Section B is urgently asked.

The organization meeting of the Illinois State Academy of Sciences will be held in the Senate Chamber, Springfield, Ill., on December 7. The preliminary program is as follows:

10 a.m.—Call to order and election of chairman.

Address of welcome, by Governor Charles S. Deneen.

"Advantage of a State Academy," by Professor T. C. Chamberlin, LL.D., University of Chicago.

"History of the former State Natural History Society," by S. A. Forbes, Ph.D., State Entomologist.

Appointment of committees and other business.

2 p.m.—Report of committees.

Symposium (ten-minute addresses), Outlook for Young Men in:

Anthropology, by Geo. A. Dorsey, Ph.D., Field Museum.

Botany, by John G. Coulter, Ph.D., Central Illinois State Normal.

Chemistry, by Wm. A. Noyes, Ph.D., University of Illinois.

Geology, by H. Foster Bain, Ph.D., State Geologist.

Physics, by C. E. Linebarger, Lake View High School.

Zoology, by Herbert V. Neal, Ph.D., Knox College.

8 p.m.—Popular lecture in the Arsenal:

"Greater Steps in Human Progress," by W J McGee, LL.D., director of the St. Louis Public Museum.

On November 21 about one hundred members of the Society of Municipal Engineers of the City of New York visited Columbia University and inspected the buildings and laboratories.

There have been ordered for the earthquake station at the University of Michigan the following instruments: A 200-kilogram pendulum of the Wiechert type and model of 1907; a 160-kilogram Wiechert pendulum of 1907 model for measuring the vertical component of the earth's motion, and a pair of 25-kilogram Bosch-Omori or Strasburg horizontal pendulums of the latest model. These instruments will be installed in the astronomical observatory of the University which is directed by Professor W. J. Hussey.

Rev. Dr. Bonney has presented to the Sedgwick Museum, Cambridge, the whole of his collection of rock slices, consisting of 2,700 specimens, of which the British examples number about 1,300. The latter represent especially the rocks of Cornwall, Charnwood, the Wrekin, the Bunter pebbles, North Wales, Scotland, and the Channel Islands. The European collection contains some 450 specimens collected from different parts of the Alps, Brittany, and the Ardennes. There is also a large collection of specimens from the Himalayas, Novaya Zemlya, Ararat, Canada, Rocky Mountains, Andes, Ecuador, Bolivia, Aconcagua district, Socotra, and the diamantiferous district of South Africa.

THE sixth annual meeting of the South African Association for the Advancement of Science will be held at Grahamstown during the week ending July 11, 1908, under the presidency of the Hon. Sir Walter Hely-Hutchinson.

THE Fourth Congress of the Bohemian Men of Science and Physicians will be held in Prague in the summer of next year.

THE foundation of the Royal Society of Medicine was celebrated by an inaugural dinner at the Hotel Cecil, London, on Tuesday, December 3.

THE dinner of the fellows and associates of the British Institute of Chemistry, to celebrate the thirtieth anniversary of the foundation of the institute, took place on November 22 at the Hôtel Métropole, London, Professor Percy F. Frankland, the president, being in the chair. The company, which numbered about 200, included the presidents of the Chemical Society, the Iron and Steel Institute, the Institution of Civil Engineers, the Royal College of Surgeons, the Society of Chemical Industry, the Institute of Actuaries, the Institution of Mining and Metallurgy, the Society of Public Analysts, and the chairman of the Board of Inland Revenue.

AN Italian Society of Radiology was founded on the occasion of the Second Congress of Physiotherapy recently held in Rome.

THE fourth volume of "Die Karcinomliteratur" (edited by Dr. Sticker, Berlin) shows that during the last five years there appeared 3,395 publications dealing with cancer. Six hundred and seven of these were in English.

FREE lectures maiutained by the Lowell Institute in the Teachers' School of Science, mainly under the auspices of the Boston Society of Natural History, will be given during the season as follows:

"Field Lessons in Botany," by Mr. Hollis Webster.

"Field Lessons in Zoology," by Mr. Albert P. Morse.

"Field Lessons in Geology," by Professor George H. Barton.

"Laboratory Lessons in Botany," by Mr. Hollis Webster.

"Laboratory Lessons in Zoology," by Mr. Albert P. Morse.

"Laboratory Lessons in Geology," by Professor George H. Barton.

"Laboratory Lessons in Geography," by Professor Douglas W. Johnson.

"Lectures and Demonstrations in Physical Chemistry," by Professor G. N. Lewis.

The British Medical Journal says: "It was stated in this column of the *British Medical Journal* of October 26 that there is a probability of the *Index Medicus* being discontinued, and that in view of this contingency it has been suggested that the card system of the Concilium Bibliographicum might be extended so as to cover the ground of medical literature. Reference was made to the fact that a similar plan was tried in Paris some time ago, but did not find adequate support. Dr. Marcel Baudoin writes to point out that during the period of occultation of the *Index Medicus*, which lasted from 1900 to 1903, its place was supplied by the *Bibliographia Medica*, published in Paris under the auspices of the Institut de Bibliographie, of which our correspondent was the directing spirit. On the reappearance of the *Index Medicus*, the *Bibliographia Medica*, finding its occupation gone, joined the snows of yesteryear. In 1906 it was followed by the Institut de Bibliographie, which, as Dr. Baudoin reminds us, was the first effort in that direction. The failure of two such meritorious enterprises is not encouraging to further adventures of the same kind. Yet the value of a general index to current medical literature is beyond question, and the need of such a guide through a labyrinth ever growing in vastness and in complexity must necessarily make itself felt more and more by workers who wish to follow the course of medical thought, and are not content to take their references at second-hand."

Statistics collected by the United States Geological Survey show that Colorado still outranks any other state or territory in the union, including Alaska, in the production of the precious metals, despite the fact that the gold production of the state in 1906 fell short nearly $2,000,000 of that of 1905, the precise figures being, output $23,210,629, decrease $1,813,344. More than half of the total gold of the state is derived from the telluride veins of Cripple Creek in Teller County. San Miguel free-milling ores contribute nearly $2,500,000. The smelting ores of Leadville, in Lake County, yielded $1,500,000 and the partly free-milling Gilpin County ores over $1,000,000. San Juan County and Ouray County both closely approached the million-dollar mark. Important diminution in the output is recorded in Teller and Ouray counties, but this was partly offset by gains in San Miguel and other counties. Siliceous and dry ores formed 67 per cent of the total tonnage and were the source of over 96 per cent. of the gold product. The placer output is comparatively small. The outlook for 1907 does not indicate the probability of great increase, if any. The production of silver, 12,216,830 ounces, showed an increase of 717,523 ounces. The smelting ores of Lake County led in the output, with nearly 4,000,000 ounces, while in their order Pitkin, San Miguel, Mineral, San Juan, Ouray and Clear Creek counties are next in importance, the first three exceeding the million mark. A higher price increased the value of the product. The increase is due chiefly to the veins of San Juan, San Miguel and Mineral counties. On the other hand, the yield of the Leadville and Aspen deposits diminished. About half of the silver product of the state is derived from siliceous or dry ores, 28 per cent. from lead ores and 17 per cent. from zinc or zinc-lead ores. No great change is expected in the production of silver for 1907. The Geological Survey will publish during December an advance chapter from "Mineral Resources of the United States, Calendar Year 1906," containing a discussion by Waldemar Lindgren, geologist, of the gold and silver production of the United States in 1906.

UNIVERSITY AND EDUCATIONAL NEWS

The memorial committee of the Alumni Association of the University of Michigan has the satisfaction of seeing the foundations laid of the future Memorial Hall. The contract which has been let calls for the enclosed building only, without the internal furnishings, for $107,103.00. The university has promised an additional $50,000 as soon as the sum raised reaches $132,000.00. The building, which stands on the southwest corner of the campus, will contain, in addition to the Memorial Hall, which is to be lined with tablets, paintings, and statues of famous alumni of the university, accommodations for the entire art collection of the university, a small but convenient auditorium, and accommodations for the Alumni Association, as well as a room for social gatherings.

Professor Cleveland Abbe, of the United States Weather Bureau, has presented to the Johns Hopkins University a collection of books and pamphlets dealing with meteorology.

Dr. Scofield, of Benson, Minn., has presented the valuable geological collection that was left him by his father to the University of Minnesota.

The botanical department of Syracuse University has announced several new courses in forestry for next year. Dr. W. L. Bray, appointed to succeed Dr. J. E. Kirkwood, as professor of botany, is interested in forestry, and it is said that the new courses will probably lead to the establishment of a department of forestry.

Docents O. Grosser and O. Stoerk have been named, respectively, an extraordinary professor of anatomy and extraordinary professor of pathological anatomy, in the University of Vienna.

Dr. Edward Baban has been named titular professor of physiology in the Bohemian University of Prague.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, DECEMBER 13, 1907

CONTENTS

ASAPH HALL

PROFESSOR ASAPH HALL, one of the most noted of American astronomers, died on November 22 at the home of his son, Professor Angelo Hall, at Annapolis, Maryland, and was buried at Goshen, Connecticut, in the family cemetery on November 25.

Asaph Hall was born in Goshen, Conn., October 15, 1829. His ancestors were among the early English settlers of New England and their names appear in the records of the colonial wars and of the revolution. His grandfather, Asaph Hall, was a captain of the company organized at Cornwall, Conn., which assisted in the defense of Ticonderoga. His father, Asaph Hall, married Hannah Palmer, of Goshen, Conn., and Professor Asaph Hall, who has just died, was the eldest of six children by this marriage.

He received such early education as the youth of his time had access to at the country school and at Norfolk Academy and, after he had become or age, attended college at McGrawville, N. Y. There he met Angeline Stickney, a student and teacher of mathematics at that college, whom he subsequently married and who, throughout her life, gave herself devotedly to him and to his scientific work. Professor Hall's choice of astronomy was largely due to her suggestion and she was the first perhaps to recognize his unusual mathematical ability. After their marriage, they went to Ann Arbor, Mich., where Mr. Hall studied under Brünnow, the well-known astronomer, at that time director of the Ann Arbor Observatory.

Professor Hall's career as an astronomer began at the Harvard Observatory, under William Bond, in 1857. His work there consisted mainly in the routine observatory work, but he quickly became an expert in the computation of the orbits of comets and began to show the admirable grasp of mathematical relations which later on made him an authority in problems of gravitational astronomy.

In 1862 he entered the Naval Observatory as assistant astronomer and in 1863 was appointed professor of mathematics in the United States Navy by President Lincoln, a position which he retained until retired, under the regulations, in 1891, on the completion of his sixty-second year.

The thirty years which Professor Hall spent at the Naval Observatory were full of fruitful work, both as an observer and in the higher sphere of mathematical investigation of astronomical phenomena. From 1862 to 1866 his work was that of assistant observer with the 9½-inch equatorial, then considered a very large instrument, and consisted in the main of observations of asteroids and comets. In 1867 he was in charge of the meridian circle; from 1868 to 1875 in charge of the 9½-inch equatorial; and from 1875 to 1891 in charge of the 26-inch equatorial, at the time of its erection the largest refracting telescope in the world. During these years he was the leader in many expeditions to distant parts of the world to conduct observations of special interest. In 1869 he went to Bering Strait to observe an eclipse of the sun; in 1870 to Sicily to observe an eclipse; in 1874 to Vladivostock to observe the transit of Venus, the voyage being made on the *Kearsarge*. In 1878 he had charge of an expedition to Colorado to observe the eclipse of the sun in that year; and in 1882 he went to Texas to observe the transit of Venus.

The contributions of Professor Hall to astronomy were so numerous that a mere enumeration of them would fill a long catalogue. Working astronomers have been familiar with his papers in the *Astronomische Nachrichten*, that universal journal of astronomical communication, for half a century.

His first discovery with the 26-inch equatorial, which was of great interest, was a white spot on the planet Saturn in 1876, by means of which a new and accurate determination of the rotation period of the planet was made.

In the summer of 1877, at the time of the near approach of the planet Mars, he made a systematic search for new satellites, which was rewarded by the most interesting discovery with which his name is connected, that of the two satellites Deimos and Phobos. Up to that time it had been believed that Mars had no moons and the discovery of two companions of this comparatively well-known planet, one of them revolving around the planet in a period less than one third of the revolution time of the planet itself, came to astronomers almost as an unwarranted innovation in the solar system. The investigation of the inner satellite has led to the most interesting results in the study of the evolution of planets and their satellites.

Next to these brilliant telescopic discoveries, the discovery of the motion of the line of the apsides of the orbit of Hyperion, one of Saturn's satellites, was perhaps Mr. Hall's most remarkable piece of work.

His long and systematic observations with the great equatorial at Washington were of special value, not only for the great accuracy with which they were made, but also for the admirable way in which they were joined to the work of other observers and made as nearly as possible comparable with them. Perhaps no observer in any nation, unless it be Otto Struve, has contributed so long and valuable a series of observations with a single equatorial as is embraced in the work of Professor Hall.

This work lay mainly in three directions: first, planetary observations, consisting in the main of determinations of the positions of the satellites, with the consequent investigations of their orbits; second, observations of double stars with numerous investigations of the double star orbits; third, determinations of the stellar parallax. In each of these fields of astronomical activity Mr. Hall's work was of the highest value and led not only to interesting observational results, but to most elegant discussions of gravitational problems in the solar and stellar systems. His observations, in particular, of the system of the planet Saturn, including those of the rings, have been of primary importance in bettering our knowledge of that interesting planet.

In all this work Professor Hall showed not only a high order of skill as an observer, but he also developed a very high order of ability in his grasp of those mathematical relations involved in the treatment of the gravitational problems of our system of planets and satellites. His papers concerning the various problems arising out of the motions of planets and satellites brought him his highest recognition and showed him to be a man possessing an order of intellectual ability of exceptional character. It is not too much to say that he is one of a group of Americans of not more than a half dozen men at most who have attained high rank as mathematical astronomers.

The recognition of Professor Hall's work by various societies and governments is most significant of the character of the work itself. He received the gold medal of the Royal Astronomical Society of London, the Lalande prize of France, the Arago medal from the French Academy of Sciences, and was made a knight of the Legion of Honor. He was a member of the more important scientific societies in this country and abroad, being an honorary member of the Royal Society in England as well as of the French Academy and of the Royal Academies of Russia and Germany. As a member of the National Academy of Sciences of America he served for many years as secretary and later as its vice-president. He received honorary degrees from many colleges and universities, amongst others the degree of LL.D. from Yale and the same degree from Harvard at the celebration of its two hundred and fiftieth anniversary.

Retiring from the Naval Observatory at the age of sixty-two, in accordance with naval regulations, Professor Hall continued his work for some years at the observatory in order to complete those matters upon which he was particularly engaged. For some years after he was in charge of the observatory at Madison, Wisconsin, and in 1896 became a member of the faculty of Harvard University with the title of professor of mathematics, which he retained until 1901.

Professor Hall's first wife, Angeline Stickney Hall, died in July, 1892. Of this marriage four sons survive. In October, 1901, he married Mary B. Gothier, of Goshen, Conn., who survives him.

Professor Hall numbered amongst his friends the leading scientific men of Europe and of America. His correspondence, running back for more than fifty years, would form of itself an interesting account of the astronomy of his day. He was in temperament, in devotion, in the simplicity and singlemindedness of his life, a true man of science. For him no distractions of social recognition or money-making served to withdraw his attention from the science to which he had given his life. No man in our generation and in our country has given a better example of that true simplicity and sincerity which are the distinguishing characteristics of the highest type of the scientific life. Those of us who worked with him as students, as assistants, as colleagues, revere his memory not less for the simplicity and sincerity of his personal life than for the work he wrought for astronomy. His career is an illustration of the possibilities open to an American boy, and his life has shed luster upon his country and upon his science.

Henry S. Pritchett

December 2, 1907

THE LIFE AND WORK OF JOSEPH LEIDY[1]

The statue just unveiled, of the late Joseph Leidy, reveals a most admirable portraiture of the greatest naturalist that this country, perhaps that any country, ever produced; for but few equalled, and none ever surpassed, Joseph Leidy in the exactness, variety and the comprehensiveness of his knowledge of natural history. Joseph Leidy, of French-German extraction, was born in this city, September 9, 1823, and died here, April 30, 1891. His whole life may be said to have been devoted to the study of natural history and was as simple, pure and noble as the objects of his lifelong study. Regarding with the spirit of a philosopher the petty incidents and annoyances that go to make up one's daily life, as only unavoidable interruptions to his life work, Leidy pursued the even tenor of his way. Happy in his domestic life, enjoying the society of his friends, generous and charitable, kindly and sympathetic to those with whom he came in daily contact, straightforward and honorable, incapable of deceit or of a mean or ungenerous thought or act, he lived his life beloved by all, and passed away without having made an enemy during his long career. Such having been the life of our distinguished fellow citizen, his eulogist, as might be expected, will have no incidents to relate such as the lives of great generals, statesmen, men of affairs afford. Nevertheless, when perhaps the latter are forgotten, the name and reputation of Joseph Leidy will be preserved in the many and valuable contributions he made to our knowledge of natural history. Well might he have said like Horace "Exegi monumentum aere perennius." Leidy's early education was obtained at private schools. He studied medicine at the University of Pennsylvania, graduating as doctor of medicine in 1844. He at once began the practise of his profession to which he devoted himself for about two years. For some time Dr. Leidy experienced that struggle with hardships and obstacles incidental to the lives of so many young physicians, but it was happily relieved by his election in 1853, at thirty years of age, as professor of anatomy in the University of Pennsylvania. This position he held with the most distinguished success till his death, a period of nearly forty years. While Dr. Leidy was universally recognized as the leading teacher of human anatomy in this country, his text-book being long a classic, he himself viewed anatomy not simply as a means to an end, of practical value to the practitioner of medicine and surgery, but as constituting only a part of the general subject of morphology; that is, of the general structure of plants and animals. As an illustration of the manner in which Leidy studied the human body may be mentioned his treatise on the "Comparative Anatomy of the Liver" which work can still be studied with advantage by the medical student. With the means of a livelihood assured through his professorship at the university,

[1] Address delivered at the unveiling of the Leidy statue, October 30, 1907, City Hall Plaza, Philadelphia.

and leisure to investigate, Dr. Leidy began that series of brilliant researches which made him, during a period of forty years, the most conspicuous ornament of the university and Academy of Natural Sciences, and that at a time when Cope, Meehan, Redfield, Cassin, LeConte, Horn, Tryon and Allen were among the active members at the regular Tuesday meetings of the academy—a galaxy of talent truly. Leidy's researches, communicated principally to the academy, and published in its *Journal* and *Proceedings,* embracing all branches of natural history and numbering over 550 contributions to our knowledge of nature, attracted the attention of this country, Europe and indeed of the whole world. Dr. Leidy's familiarity with all natural objects invariably impressed those brought in contact with him. If some minute infusorian was shown under the microscope, one would have supposed from his observation that he had devoted his life to the study of the Protozoa. A worm being submitted to him for identification his description of its structure would lead to the inference that his specialty was helminthology. One had only to see Dr. Leidy dissect a fly or a snail no bigger than a pin's head to realize that he was an admirable comparative anatomist. His drawings of the structure of insects and mollusks are made use of even at the present day by recent authorities to illustrate their text-books on entomology and conchology. While Dr. Leidy made no claim to being an authority on mineralogy, mineralogists consulted him in connection with their specialty, prominent jewelers in regard to the value of diamonds and other gems. As an illustration of the accuracy of his knowledge in this respect, it may be mentioned that on one occasion, when visiting the Centennial, Dr. Leidy recognized in one of the exhibits a mineral labeled beryl as being really topaz, and of great value. On careful examination by experts it was shown to be topaz and subsequently the specimen was sold for many thousand dollars. The speaker can testify as to his knowledge of botany, having accompanied him on a trip through the Rocky Mountains in company with one of the most critical of botanists, who was amazed at Dr. Leidy's familiarity with the western flora. He rarely if ever was at fault; if, however, he failed to identify a species correctly, with his characteristic honesty he was the first to acknowledge it. Of the innumerable streams and ponds in the neighborhood of Philadelphia visited in company with Dr. Leidy with the object of obtaining infusoria, etc., the speaker can not recall a single instance in which Dr. Leidy did not at once recognize the objects when viewed afterwards under the microscope. His work on the Rhizopoda is a monument to his skill as a microscopist. Some years ago the theory was advanced that catarrh and hay fever were produced by an infusorian animalcule, the *Asthmatos ciliaris.* Dr. Leidy having been requested to express an opinion in regard to the nature of the supposed infusorian at once recognized through his familiarity with this class of animals that the so-called infusorian animalculæ supposed to be the cause of disease were only "incomplete, deformed ciliated epithelial cells. It never crossed my mind that they were anything else than ciliated epithelial cells more or less modified by the condition of the catarrhal affection."[2] Leidy's discovery of the *Trichina* in the pig, explaining how man comes to be infested with that parasite and whereby thousands of lives have been saved, would alone have entitled him to recognition as one of the foremost helminthologists of the day—and which indeed he was considered. As is well known, Leidy was the pioneer in American paleontology.

[2] *American Journal of Medical Sciences,* 1879, p. 86.

Long before it was learned that the bad lands of Nebraska and other parts of the west constituted a veritable mausoleum of mammalian and other vertebrate remains, a fragment of a tooth was submitted to Leidy for examination, who without a moment's hesitation said it was part of a molar of an extinct kind of rhinoceros. The correctness of this determination was questioned when the tooth was brought to the academy, it being almost incredible that a rhinoceros could ever have lived in Nebraska, and further, the academy did not possess at that time the skeleton of a rhinoceros with which to compare the tooth in question. The correctness of Dr. Leidy's opinion was, however, fully sustained soon afterwards by the discovery of several entire molars with a complete skull of the animal. Dr. Leidy told the speaker that the remaining part of the tooth of which he had examined the fragment was found in situ in the skull, and that the broken fragment adapted itself perfectly to it. With the revealing of the extinct life of the west Dr. Leidy, whose almost inexhaustive knowledge of the vertebrate skeleton qualified him, and at that time him alone, to interpret fossil remains, began at the academy that series of epoch-making researches which, in his hands and those of his successors, established on paleontological evidence the doctrine of evolution so that no one competent to appreciate that evidence has since ever doubted its truth. Indeed, considering the circumstances, the few skeletons to be found in museums in this country at that time with which the remains of extinct animals could be compared, Leidy's determination of the tooth just referred to as being that of an extinct rhinoceros was as remarkable and as replete with results as Cuvier's identification of the bones found in the quarries of Mont Martre as being those of an extinct opossum. Indeed as far back as 1853—five years before the appearance of Darwin's "Origin of Species"—Dr. Leidy observed:

> The study of the earth's crust teaches us that very many species of plants and animals became extinct at successive periods, while other races originated to occupy their places. This probably was the result in many cases of a change in exterior conditions incompatible with the life of certain species and favorable to the primitive production of others. Living beings did not exist upon earth prior to their indispensable conditions of action, but wherever these have been brought into operation concomitantly the former originated. Of the life present everywhere with its indispensable conditions and coeval in its origin with them what was the immediate cause? It could not have existed upon earth prior to its essential conditions and is it therefore the result of these? There appear to be but trifling steps from the oscillating particle of organic matter to a Bacterium; from this to a Vibrio; thence to a Monas, and so gradually up to the highest orders of life. The most ancient rocks containing remains of living beings indicate the contemporaneous existence of the more complete as well as the simplest of organic forms; but nevertheless life may have been ushered upon earth through oceans of the lowest types long previously to the deposit of the oldest paleozoic rocks as known to us.

Where, may it be asked, can there be found in the whole range of biological literature a more concise statement in regard to the origin of life, the extinction of species, the survival of the fittest—in a word, of Darwinism?[3] Again, in regard to the descent of man, Leidy suggested:[4]

> That but little change would be necessary to evolve from the jaw and teeth of *Notharctus* that of a modern monkey. That same condition that would lead to the suppression of a first premolar in continuance would reduce the fangs of the other premolars to a single one. This change with a concomitant shortening and increase of depth of the jaw would give the character of a living Cebus. A further reduction of a single premolar would give rise to the condition of the jaw in the old world apes and man.

As a fitting recognition of Dr. Leidy's

[3] Smithsonian Contributions, 1853.

[4] "Extinct Vertebrate Fauna," 1873, p. 90.

services to the Academy of Natural Sciences he was unanimously elected its president in 1881, he having served the institution as chairman of the board of curators continuously for forty years. Both positions he held at the time of his death. That the value of Dr. Leidy's contributions to science have not been over-estimated by his personal friends and admirers is shown by the honors conferred on him by the learned institutions both at home and abroad, and by the marked courtesy and attention paid to him by the most distinguished savants on the occasion of his visits abroad. Among the honors conferred upon Dr. Leidy may be mentioned the LL.D. of Harvard, the medals of the Royal Microscopical and Geological Societies of London, the Cuvier medal of the Academy of Sciences of Paris, membership in all the most important learned societies in this country and in those of England, France, Germany, Russia, Italy, Norway, Sweden, Hungary, Denmark, Spain, Portugal and Brazil. Surely it was a fitting tribute to one so honored at home and abroad as Joseph Leidy that his personality should be embodied in enduring stone in his native city, even though his works were an imperishable monument to his memory.

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THE ARC AND THE SPARK IN RADIO-TELEGRAPHY[1]

The discovery by Heinrich Hertz between 1887 and 1889 of experimental means for the production of electric waves and Branley's discovery that the conductivity of metallic particles is affected by electric waves form the foundation on which, in 1896, Signor Marconi built up his system of wireless telegraphy.

Many of the early investigators certainly had glimpses of a future system of being able to transmit messages without connecting wires, for as early as 1892 Sir William Crookes predicted in the *Fortnightly Review* the possibility of telegraphy without wires, posts, cables, or any of our costly appliances, and said, granting a few reasonable postulates, the whole thing comes well within the realms of possible fulfilment.

Two years later Sir Oliver Lodge gave his memorable lecture on the work of Hertz, and carried the matter a step nearer the practical stage.

There will not be time to dwell to-night on the early history of the art and its development. It will be necessary, however, to explain some of the fundamental properties of signaling by means of Hertzian waves in order to be able to bring out clearly the relative advantages and disadvantages of the two rival methods now in practical use for producing Hertzian waves for wireless telegraphy.

The fundamental part of the transmitting apparatus may be said to consist of a long conductor, generally placed vertically, in which an alternating or oscillating current is set up by some suitable means. Such a conductor radiates energy in the form of Hertzian waves at right angles to itself into space, in very much the same way that an ordinary candle sends out light in all directions. This radiation, though it is strictly in the nature of light, is invisible to our eyes, as the frequency is too low.

If we set up any other conductor approximately parallel to the first, there will be produced in this second conductor alternating or oscillating currents having the same frequency as those in the first conductor, and which can be detected by suitable instruments.

The simplest and one of the earliest

[1] Evening discourse before the British Association for the Advancement of Science, Leicester, 1907.

methods for producing Hertzian waves for use in wireless telegraphy consisted in charging up by means of an induction coil a vertical insulated conductor, which was allowed to discharge itself to earth by means of a spark taking place between its lower end and another conductor which was connected to earth. To detect the Hertzian waves, Marconi employed an improved form of the Branley filings tubes, which is known as the "coherer."

In order to transmit messages the radiation is started and stopped so as to form short and long signals, or dots and dashes of the Morse code, out of which the whole alphabet is built up in the well-known way.

As I have already stated, the radiation takes place round the vertical conductor approximately equally in all directions. Suppose that I set up my transmitting apparatus here in Leicester, a receiving station set up either in Nottingham, Derby, Rugby or Peterborough would be able to receive the message equally well. Should I wish to send a message from here to Nottingham at the same time that Derby wishes to speak to Rugby, then the receiving station at Nottingham would receive both the message from Leicester which it should receive and the message from Derby which it was not required to receive.

To get over this difficulty, known as "interference," a large number of devices have been patented. The most successful in practise is syntony, or tuning: in this method each station has allotted to it one definite frequency or tune, and the apparatus is so arranged at each station that it will only be affected by messages which are radiated by other stations on its own frequency or tune, and not by any other radiations. To take a musical analogy, supposing I had somebody who was either deaf to all notes of the piano except, say, the middle C, or had such a musical ability that he could tell at once when I struck the middle C; then I could transmit to that person a message in the ordinary Morse code by playing on the middle C, and that person, whom I shall call Mr. C, would not take any notice of the fact that I might also be playing on the notes D, E, F, G, etc., but Mr. C would confine his attention entirely to what is being done with the middle C. It is conceivable that I might find a series of persons or train them so that they could each pick out and hear one note only of the piano, irrespective of what was being played on the other notes or of any other noises that were taking place. Taking an ordinary seven-octave piano and neglecting for a moment the black notes, this would give me fifty-six distinct notes on which I could transmit messages; so that, transmitting from Leicester, I might send messages simultaneously to fifty-six different towns.

The number of possible simultaneous messages depends on the number of octaves there are on the piano used, and on how close together the different notes are which can be used without producing confusion. For instance, it might be quite easy to train someone to distinguish with certainty between C and E, and pick out signals on C at the same time that signals are being sent on E. It is certainly more difficult to do this with two notes that are closer together, say C and D, and still more difficult if the half-tones are used as well. The problem, therefore, in wireless telegraphy is to arrange the receiving apparatus so that it can hear, or perhaps I should say, more accurately, so that it can only see, notes of one definite frequency or pitch, and not be affected by any other notes, even though of but slightly different pitch. Another requirement to obtain good working is that we should use as little power as possible at our transmitting station consistent with obtaining enough power in our receiving instruments to work them with certainty.

I have a mechanical model to illustrate how we are able to make our receiving instruments very sensitive to one frequency and only slightly affected by frequencies which differ but slightly from its proper frequency.

The transmitter in the model consists of a disc that can be rotated slowly at any speed I like, with a pin fixed eccentrically on its face. This pin can be connected to a vertical wire which moves up and down as the disc rotates. I shall assume that the movement of this wire corresponds with the movement of the electricity in the vertical conductor. As a receiving apparatus I have a pendulum, and representing the ether between the transmitter and receiver I have an elastic thread connecting the pin in the disc to the pendulum.

When I set the disc rotating slowly the elastic thread is alternately stretched out and relaxed and the pendulum is a little affected. If I gradually increase the speed of the disc at one definite speed it will be found that the pendulum is set into violent oscillation, and by observation it will be found that when this is the case the disc makes one complete revolution in exactly the same time that the pendulum would make one complete swing if left to itself; that is to say, that the disc and the pendulum make the same number of swings per second or have the same frequency; in music they would be said to be in tune with each other. If instead of allowing the disc to rotate continuously I allow it to make only half a dozen revolutions, then the pendulum will be affected, but much less strongly. The greater the number of revolutions the disc makes up to a certain maximum number the more the pendulum will be caused to swing.

Instead of starting and stopping the disc I can keep the disc rotating and start and stop the pulls on the elastic thread by moving the pin in the face of the disc in and out from the center, which produces a movement which much more nearly corresponds with the actual current in the vertical wire as used in spark telegraphy.

It is necessary here to explain the relationship that exists between the wave-length, the frequency and the velocity of propagation of Hertzian waves. The waves travel with, as far as we know, the same velocity as light, namely, 300,000,000 meters, or 186,000 miles, per second. Between these quantities we have the relationship that the product of the wave-length by the frequency is equal to the velocity of propagation, or, as I have already mentioned, the velocity of light.

The wave-lengths which are of practical use in wireless telegraphy at the present time range between 100 and 3,000 meters, though, of course, it is quite possible to use for special purposes wave-lengths outside these limits. The corresponding frequencies in practical use are therefore between 3,000,000 and 100,000 complete periods per second. We require, therefore, to produce in the vertical conductor alternating or oscillating currents of any frequency within this range, and to have a sufficient number of oscillations following one another without interruption to allow of good syntony being obtained.

There are three methods of producing these currents—namely, the alternator, the spark and the arc methods.

There are great difficulties in the way of constructing an alternator to give such high-frequency currents, and I can best illustrate this by taking an example. Suppose that it is required to build an alternator to work at the lowest frequency, namely, 100,000 periods per second, and let us assume that we can drive this alternator by means of a turbine at the high speed of 30,000 revolutions per minute. This alternator could not have a diameter much above six inches for fear of bursting; and, as it makes 500 revolutions per second, it would have to generate 200 complete periods for each revolution, so that the space available for the windings and poles for one complete period will be less than one tenth inch, a space into which it is quite impossible to crush the necessary iron and copper to obtain any considerable amount of power. In spite of the small space that we have allotted to each period, as there are 100,000 periods per second, the speed of the surface of the moving part works out at over 500 miles per hour. A small alternator has been built to give over 100,000 frequency, but the amount of power it produced was extremely small. Several experimenters have stated lately that they have built alternators giving these high frequencies and a considerable amount of power, but, so far as I am aware, there is no reliable data available as to the design of these machines.

If it should prove possible to construct alternators for these very high frequencies, we shall be able to obtain a sufficient number of consecutive oscillations of the current in the aerial of definite frequency to enable very sharp syntony to be obtained. Not only will this greatly reduce interference troubles in wireless telegraphy, but such alternators will be of the greatest value for wireless telephony.

The earliest method of producing high-frequency oscillations was proposed by Lord Kelvin, who pointed out that if a Leyden jar or condenser be allowed to discharge through a circuit possessing self-induction or electrical inertia, then under certain conditions the discharge of the jar is oscillatory, that is to say, that the electricity flows backwards and forwards in the circuit several times before the jar or condenser becomes finally discharged. I think that perhaps the best way to make this matter clear is by demonstrating experimentally with an oscillograph the nature of the discharge of a condenser, and how it is affected by the resistance and self-induction in the circuit. As a mechanical analogy one may look upon the charged condenser as a weight attached to a spring which has been pulled away from its position or rest. To discharge the condenser we let go the weight and it begins to oscillate backwards and forwards, and, after making a greater or less number of oscillations, finally comes to rest. The number of oscillations per second will depend upon the strength of the spring and the mass of the weight, which correspond with the capacity and self-induction in our electrical circuit. The number of oscillations before the weight finally comes to rest is determined by the friction which tends to stop the weight, or by the resistances and other losses in the electrical circuit.

In practise the aerial conductor acts as a Leyden jar or condenser. It is charged with electricity and allowed to discharge, the current oscillating backwards and forwards in the aerial during the discharge. In many installations Leyden jars or condensers are electrically connected to the aerial, so that the oscillations taking place in them are transmitted to the aerial. Any remarks, therefore, that I may make as to the oscillations which may be set up in condensers apply equally well to the oscillations in the aerial in wireless telegraphy.

For wireless telegraphy it is usual to charge the condenser or aerial by means of an induction coil or an alternator to a very high voltage, and it is allowed to discharge by means of a spark between the two electrodes which form the ends, so to speak, of a gap in the electrical circuit. As long as the pressure is low the spark gap is a perfect insulator; when the pressure becomes high enough the air between the electrodes breaks down and a spark passes the gap, becomes conducting, and allows the condenser to discharge. The property of the spark-gap of passing almost instantaneously from a condition of being an insulator for electricity to being an extremely good conductor for electricity is of the utmost value in the spark method of wireless telegraphy. The more perfectly the spark-gap insulates before the discharge takes place, and the more perfectly it conducts after the discharge has taken place, the better it is for our purpose.

If I take two electrodes sufficiently far apart in air and gradually raise the electrical pressure between them, the first indication that anything is going to happen is the formation of fine violet aigrette on the more pointed or rougher parts of the electrodes. This is known as the brush discharge. By gradually raising the pressure, this brush discharge extends further out into the air, until finally the air between the two electrodes becomes so strained that it breaks down and the real spark passes.

The long thin spark that occurs in this case is not very suitable for wireless telegraphy, as its resistance is too high. Ordinary lightning flashes are good examples of long sparks on a very large scale. If instead of working with the electrodes far apart they are placed nearer together, and if the electrical pressure is supplied from a very powerful source, then directly the spark passes it forms a thick discharge having the appearance of a flame in which the nitrogen of the air is actually being burnt; a process which, it is hoped, in the future may have immense importance in the supply of artificial nitrates for agriculture. This flame-like discharge has a low electrical resistance, but has the effect that it so heats or modifies the air that it is difficult to get the air to insulate again, after one discharge, ready for the next.

If a large quantity of electricity is discharged through the spark-gap, and if the spark lasts a very short time compared with the interval between successive sparks, then a highly conducting spark can be obtained, as well as a good insulation between the sparking terminals when no discharge is passing.

In order to help to bring the gap back to its insulating condition after each discharge, many devices are employed, such as subdividing the spark into several shorter sparks, cooling the electrodes, blowing air across the spark-gap, etc. When the condenser, or antenna, discharges through the spark-gap, oscillations are set up which radiate Hertzian waves.

In practise in wireless telegraphy it is difficult to obtain a large number of oscillations during each discharge as corresponding with each oscillation; the antenna radiates energy. A large number of oscillations means, if we keep amplitude of each the same, that we are radiating a large quantity of energy. Besides this radiated energy, which is useful for transmitting messages, there is also energy wasted in heat in the spark-gap, in the conductors, in the glass or other insulation of the condensers. It is this useless part which we require to make as small as possible.

I have lately had an opportunity to determine how many oscillations actually take place in a certain wireless transmission. The experiment was made by photographing the spark as seen in a mirror rotated at a very high speed, and it was found that each spark consisted of nine or ten complete oscillations.

If all the oscillations had been of equal strength or amplitude, and if the receiving circuit had been similar to my pendulum in my mechanical model, then there would be very little to be gained by increasing the number of oscillations. As the oscillations die away in the spark method, two or three times this number would probably be required for the best effect. As a matter of experiment very good tuning was obtained with the wireless transmission referred to above.

As an example of the sharpness of tuning obtainable by the spark method the following test carried out on the Lodge-Muirhead installation at Hythe may be of interest.

The station at Hythe had to receive messages from Elmers End at a distance of fifty-eight miles over land, in spite of the fact that the Admiralty station at Dover, only nine and one fourth miles distance, was transmitting as powerfully as it could, in order to produce interference, and that the regular communications were going on in the channel between the shipping. It was found possible with a difference of wave-length of 6 per cent. to cut out the interference from the Dover station.

In the arc method of producing continuous oscillations we employ, as before, a condenser and self-induction; but, instead of charging the condenser to a high voltage and allowing it to discharge by means of oscillations which die away, and then repeating the process over and over again, we actually maintain the condenser charging and discharging continuously without any intermission, so that we practically obtain a high-frequency alternating current in the aerial.

To impress the difference on your minds, I have an incandescent lamp, which I switch on and off rapidly about ten times, and then after a short time I repeat the same flickering of the light, and so on. The flickering of the light corresponds with the oscillations in the ordinary spark method, and the time spaces between the flickers represent the times during which the condenser or antenna is being charged ready to produce a fresh series of oscillations. In practise we may have as many as, say, a couple of hundred discharges of the condenser a second, and during each discharge we may get, say, ten complete oscillations, each oscillation lasting one millionth of a second, if the wave-length is 300 meters; thus the total time that the condenser is discharging is only one one-hundred-thousandth of a second, or one five-hundredth part of the interval of time between two successive discharges. My lamp here flickers about five times per second, and makes ten flickers before it goes out; the total time that it is flickering is two seconds, and the time before it should start to flicker again to correspond with the practical wireless case is therefore 1,000 seconds, or rather over a quarter of an hour. If now I represent continuous oscillations, such as are obtained by the arc method with this lamp, I shall simply keep the lamp flickering continuously, and there will be no intervals whatever.

The arc method of producing continuous oscillations is founded on my musical arc. In order to explain this I must demonstrate some of the properties of the direct-current arc. If I vary the current flowing through the arc very slowly and note the potential difference corresponding with each value of the current, keeping everything else constant, I obtain a curve generally spoken of as the characteristic of the arc. These curves under different conditions have been very thoroughly investigated by Mrs. Ayrton.

With the carbon arc between electrodes in air the voltage decreases very rapidly when the current is gradually increased, starting from very low values. As the current becomes larger the rate of decrease of the voltage becomes less and less until it is, comparatively speaking, quite small, with a current of ten or twelve amperes. With the arc between metal electrodes similar results are obtained, except that the discontinuity in the curves, called the hissing point by Mrs. Ayrton, takes place at very small currents, generally well below an ampere.

With arcs burning in hydrogen, Mr. Upson has found that the curves are generally much steeper for the larger values of the current than for the corresponding arcs burning in air. This point is of great importance as explaining the value of the hydrogenic atmosphere used by Poulsen and referred to later.

In general, I may therefore say for the above arcs that increase in current through the arc is accompanied by decrease of the potential difference between its electrodes, and *vice versa* decrease of the current causes increase in the potential difference; on the other hand certain arcs, such as the arc between cored carbons, behave in an opposite manner, that is to say, current and potential difference increase and decrease together.

I demonstrated in 1900 that if I connect between the electrodes of a direct current arc (or other conductor of electricity for which an increase in current is accompanied by a decrease in potential difference between the terminals) a condenser and a self-induction connected in series, I obtain in this shunt circuit an alternating current. I called this phenomenon the musical arc. The frequency of the alternating current obtained in this shunt circuit depends on the value of the self-induction and the capacity of the condenser, and may practically be calculated by Kelvin's well-known formula.

Besides the condition that an increase of current must be accompanied by a decrease in potential difference, it is necessary that the relative decrease in potential difference produced by a given increase in current, that is to say, the steepness of the characteristic, shall exceed a certain minimum value which depends on the losses in the shunt circuit. It is also necessary that an increase in current shall be accompanied by a decrease in potential difference, even when the current is varied very rapidly.

Let us consider what takes place when I connect this shunt circuit to an arc. At the moment of connection a current flows from the arc circuit into the condenser circuit, which tends to reduce the current flowing through the arc. This reduction of the current through the arc tends to raise the potential difference between its terminals, and causes still more current to flow into the condenser circuit, and I now have a condenser charged above the normal voltage of the arc. The condenser, therefore, begins to discharge through the arc, which increases the arc current and decreases the potential difference, so that the condenser discharges too much; the reverse process then sets in; the condenser becomes successively overcharged and undercharged, due to the fact that, instead of the potential difference between the terminals of the arc remaining constant and allowing the condenser to settle down with its proper corresponding charge, the potential difference actually decreases when the condenser is discharged and increases when it is charging, so as to help to keep up the flowing backwards and forwards of the current indefinitely.

The oscillograph wave forms show what is going on very clearly, and they show that in general the swing of the current in the condenser circuit attains such a magnitude that when the condenser is charging it takes the whole of the current away from the arc, so as to make the arc, although burning on a direct current, a pulsatory arc. The pulsation of the current through the arc causes the vapor column to grow bigger and smaller, and the light to vary. When the vapor column grows bigger and smaller it displaces the air around it and produces a note the pitch of which is determined by the frequency of the current in the shunt circuit.

The values of the capacities of a series of condensers have been calculated by

Kelvin's formula to give the frequencies corresponding with a musical octave, and the nearest values in an ordinary laboratory box of condensers have been taken and connected to a keyboard. The result shows how nearly Kelvin's law is obeyed.

With this apparatus I can demonstrate the importance of tuning in electrical circuits and perform electrically some experiments which I have already performed mechanically earlier this evening. I use the large coil which forms the self-induction in the circuit shunting the arc as a transmitting circuit for wireless telegraphy by the magnetic induction or Preece method, and I have a receiving circuit consisting of a coil of wire connected to a small lamp and not connected in any way to the transmitting circuit. At a certain short distance between the transmitting coil and the receiving coils the indicating lamp lights if I cause my arc to sound *any* one of the notes of the octave, and so produce an alternating current of corresponding frequency in the transmitting coil. If I now tune the receiving circuit, by connecting a condenser in it, the lamp on the receiving circuit will light at about five times the distance; but it will only light when one definite note is sounded by the arc. These are the two distinct advantages of tuning, namely, greater distance and syntony, or responding to only one definite note.

For wireless telegraphy by means of Hertzian waves, based on my arc method, we require much higher frequencies in the shunt circuit. If we attempt to obtain this higher frequency from the ordinary arc burning between solid carbons in air, we find that above a certain limit the oscillations will no longer take place. This is due to the fact that we are varying the current through the arc at this higher frequency too quickly for an increase in current to be accompanied by a decrease in potential difference. I have demonstrated that if I only vary the current through the ordinary current arc sufficiently rapidly, then an increase in current is accompanied by a proportionate increase in the potential difference, and the arc behaves just like an ordinary resistance. If we work with very small current arcs we can obtain high-frequency musical arcs burning in air either between carbon or metal electrodes.

In a paper read before the International Electrical Congress at St. Louis in 1904 Mr. Poulsen showed that by placing the arc in a flame it was possible to obtain higher frequencies than when the arc was burning in air. Following this up Mr. Poulsen came to the conclusion that the best results were obtained when the arc was burning in hydrogen, or a gas containing hydrogen; and he further added a magnetic field around the arc somewhat similar to that which has been previously used by Elihu Thomson.

The arc burning in coal gas in a powerful transverse magnetic field was used by Poulsen in his early experiments to produce the high-frequency current necessary for wireless telegraphy between Lyngby and Esbjerg in Denmark. This apparatus has been further improved, and is now employed by the Amalgamated Radio-Telegraph Company in their station at Cullercoates and the other stations that they are erecting.

In both the arc and the spark methods of wireless telegraphy we employ a high-frequency alternating current in the aerial conductor. The essential difference between the two methods lies in the fact that with the spark method our alternating current in the aerial conductor first increases to a maximum value and then dies away rapidly, making only a limited number of oscillations, whereas in the arc method the oscillations are maintained continuously of unvarying amplitude.

With the arc method we are further able to choose the number of consecutive oscillations which make up each signal sufficiently great to obtain the very best syntony. On the other hand, improvement in the arrangement and construction of the apparatus for the spark method has so increased the number of oscillations corresponding with each spark that it may be that we shall be able to obtain a sufficient number in each train to give as good syntony by this method as that obtained with the arc method.

The arc method seems eminently suitable for very high speeds of working. As the oscillations are quite continuous, we can cut them up into groups to form the dots and dashes of the Morse alphabet, just as if we were working with a continuous current such as is used on land lines, so that there seems no reason why as high a speed of working should not be obtained from the arc method of wireless telegraphy as is obtainable by automatic signalling on land lines; for it is to be noted that the dot or shortest signal of the Morse alphabet, even at a speed of three or four hundred words per minute, will last long enough to consist of many hundreds of oscillations of the current in the aerial, so that there will be plenty of oscillations in the group forming the dot to give good syntony.

Turning to the spark method for high working speeds, we find a difficulty in that the dot of the Morse alphabet must at least occupy the average time required to charge the condenser or aerial and produce one spark, and preferably sufficiently long for several. We are therefore obliged in the spark method to use a high rate of sparking for high-speed signaling. This difficulty has not become very serious with the present low speeds of sending. When we come to use considerable amounts of power to transmit messages over long distances, and we also require a high speed of working, the practical difficulty in constructing apparatus suitable for sufficiently rapid sparking will become serious.

Mr. Marconi in 1905 claimed to have already reached a speed of 100 words per minute by the spark method, and lately there has appeared in the technical press examples of high-speed signaling by the British Post-office over a distance of fifteen miles in which readable signals were received at a speed of seventy words per minute.

Turning to the receiving end, almost all the receivers that have been used in the spark method can be equally well used for the arc method; for it must be remembered that the transmission in either case is affected by Hertzian waves traversing space, and that the only fundamental difference consists in the number of oscillations in each train of waves. It must be noted, however, that in those methods in which a telephone receiver is used it is necessary to break up the continuous oscillations of the arc method into groups succeeding one another sufficiently rapidly to produce an audible sound in the receiver; for in the spark method the sounds we hear in the receiver correspond with the succession of impulses of the diagram, one for each spark at the transmitter. This chopping up of the continuous wave-train so as to produce audible signals in the receiving apparatus can be done either at the transmitting end or in the receiving apparatus. An example of this latter method is Poulsen's ticker.

The question whether receiving apparatus can be arranged so as to receive messages from stations equipped with the spark apparatus and from stations equipped with the arc apparatus is a matter of enormous importance at the present moment in view of the probable ratification of the Berlin Convention, which imposes an obligation on all commercial stations to intercommunicate without regard to the make or system of transmitting apparatus employed. I am of the opinion that there will be no difficulty in carrying this into effect provided that the stations using the spark method send out long trains of waves, as they should do to obtain syntonic working, which is also called for by the Berlin Convention.

An extremely interesting development which is now progressing rapidly owing to the possibility of producing continuous oscillations by the arc method is wireless telephony. Suppose that we can vary the intensity of the oscillations in a manner corresponding with the vibrations of the air which constitutes sound and speech, then we should obtain at the receiving stations a train of Hertzian waves whose amplitude varies in a corresponding way; by allowing these waves to act on a telephonic receiver which is sensitive to the intensity of the waves we shall obtain in the telephone a reproduction of the sounds. This has actually been carried into effect by employing an ordinary microphone to modify the current through the transmitting arc so as to vary the intensity of the oscillation current produced, and by employing what is known as a point-detector and a telephone at the receiving station.

Another method which may be used consists in causing the microphone to vary the frequency of the oscillations of the generator, and by arranging the receiver so that it is more or less strongly affected according to the frequency of the received waves.

I am informed that such good results have already been obtained on the experimental stations for wireless telephony that it is proposed to equip stations at Oxford and Cambridge for the further perfecting of this application.

It is greatly to be desired that wireless telephony may develop rapidly, as it seems to me that for the purpose of communicating with ships wireless telephony will have great advantages over wireless telegraphy.

I am deeply indebted to Mr. Colson for all the facilities that he has placed at my disposal, and to his engineers for their assistance, which has enabled me to carry out the experiments in the lecture; and I have also to thank the tramway department for the special supply of current.

W. Duddell

SCIENTIFIC BOOKS

Experimental Zoology. By Thomas Hunt Morgan. New York, The Macmillan Co. 1907. Pp. xii + 454.

The field of experimental zoology has of late years been greatly extended and includes problems of widely different nature. The title of this book justifies the expectation of finding between the covers an attempt to bring together the results of experiment in the various fields and at the same time raises in the mind of the reader the question as to how the author has found it possible to treat adequately in some four hundred and fifty pages the data and problems involved. This question is answered in part, however, by the preface and table of contents, from which it appears that experimental embryology, regulation and animal behavior are not included within the scope of the book because, as the author states, they have recently received full consideration and, furthermore, would require too much space to be included in a single volume.

In short, the book treats primarily of those subjects and problems of experimental zoology which have not been considered in other books. This limitation necessarily defines its scope in a somewhat arbitrary manner and without relation to the problems involved. It is a fair question, therefore, whether the subject-matter of the book justifies its title: it would seem that some less inclusive title would have been more fitting.

In the preface the author states that

> The central problem of morphology—the causes of changes in form or at least the determination of the conditions under which changes of form occur—will furnish the main theme of this treatise.

On reading this, one is forced to ask how any adequate consideration of this problem is possible without reference to experimental embryology and form-regulation. As a matter of fact the book treats almost solely of those fields in which the results of experimentation can not as yet be analyzed nor definite conclusions reached concerning the relation between conditions and the complex effect. Consequently the consideration of the morphological problem is of necessity very general and in certain respects rather barren of results.

The subject-matter of the book is treated under six heads or sections, viz.: Experimental Study of Evolution, Experimental Study of Growth, Experimental Studies in Grafting, Experimental Studies of the Influence of the Environment on the Life Cycle, Experimental Study of the Determination of Sex, Experimental Study of Secondary Sexual Characters.

The first of these sections, "Experimental Study of Evolution," comprises about half the book and includes chapters I.–XIV. Briefly stated the principal subjects considered are: the influence of external conditions on animal structure and the inheritance of changes thus produced, the inheritance of acquired characters, hybridization and the behavior of the germ-cells in hybridization, inbreeding and selection.

Only a few points can be taken up here. As regards the inheritance of acquired or somatic characters Professor Morgan points out that experimental data have not, up to the present, supported the hypothesis and maintains that until some positive evidence is presented we can not accept it as a well-established theory.

In the chapters on hybridization special stress is laid on the importance of Mendel's law and much space is devoted to an account of the experiments which bear upon it. In conclusion the author holds:

> That Mendel's law accounts in many cases for the results and is therefore an invaluable acquisition to our method of interpretation; yet in some other cases it is evident that the inheritance is not strictly Mendelian. Used with discretion the law may still unlock many problems (p. 166).

At various points, however, notably on pp. 77 et seq. and again on p. 169, Morgan questions the so-called purity of the germ cells and points out that in various cases it is possible to bring out certain characters which should not be present if the germ cells are pure in the Mendelian sense. He suggests the hypothesis of an alternating dominance and recessiveness in the germ cells instead of purity as a means of accounting for the results.

As a matter of fact neither this suggestion nor Mendel's law contains any solution of the problems involved. Both are merely attempts to state in general terms what takes place in certain cases of hybridization and as such constitute only a formulation of the problems. Moreover, the chapters on hybridization show very clearly that work along this line has not yet attained the point where the problems involved can be clearly and consistently stated. Even Mendel's law, which is commonly regarded as the most important generalization attained thus far in this field, applies at best only to certain cases and Morgan disputes the correctness of one of its fundamental assumptions, viz., purity of the germ cells.

In a discussion of the phenomena of maturation of the germ cells in relation to Mendel's law attention is called to the arbitrary character of the assumptions required as regards the distribution of characters, and the fact that the chromosomes have not been demonstrated to be the sole bearers of hereditary qualities is emphasized. Incidentally it may be noted that maturation is considered as involving in all cases a transverse and a longitudinal division of the chromosomes, no mention being made of those cases in which two longitudinal divisions are believed to occur, although they constitute an argument in support of the author's position.

While the Mendelian terminology is freely used, we find no attempt to discuss or analyze the terms employed. Much has been written of late regarding dominance, recessiveness, latency, etc., and it is highly desirable to keep in mind the fact that all these abstractions are really expressions of our ignorance.

Although the terms "character" and "unit-character" are frequently employed no definitions are given nor do we find any discussion of the possible nature of characters except in the section on sex determination, where morphological and physiological conceptions are briefly contrasted (pp. 420–422), the author favoring the physiological.

As in earlier writings, Morgan follows de Vries in drawing a sharp distinction between mutations and fluctuating variations and inclines toward the view that species arise by mutation and that selection does not originate but merely eliminates.

The second section, "Experimental Study of Growth," is rather brief, comprising an introductory chapter, in which normal growth, senescence, length of life, and absorption of parts are briefly discussed; a second chapter, on "External Factors that Influence Growth," and a third, on "Growth and Regeneration." Any treatment of the subject of growth on an experimental basis from which the data of experimental embryology and form-regulation are excluded must of necessity be incomplete and in certain respects unsatisfactory, and this section does not escape these disadvantages of limitation.

In the introductory chapter growth is defined as "an increase in the volume of the living material" (p. 240). According to this definition the increase in volume of bone, shell and other skeletal structures is not growth. Morgan himself is not consistent in his use of the term; within half a page of the definition he speaks of "steady and rapid growth due to imbibition of water" (p. 241) and on page 258, in discussing the effects of salts on growth, the experiments of Herbst and Maas on the relation between certain salts and the development of the skeleton in sea-urchin larvæ and sponges are cited.

Moreover, since it is expressly stated in connection with the definition that change of form is not necessarily associated with growth, this section, according to the author's position, has no connection with the main theme of the book, "the determination of the conditions under which changes of form occur" (p. v, preface).

The chapter on "Growth and Regeneration" is not, as its title might lead one to expect, a consideration of the relation between normal and regulatory growth, but a discussion of certain experiments on the rate of regeneration at different levels and the author's pressure-tension hypothesis. Since this is the fullest statement of this hypothesis that Morgan has presented, portions of it are given here in his own words:

What factor determines that the *terminal* organs are those that are first laid down in the new part? . . . A number of considerations, that I can not enter into more fully here, have led me to suspect that this relation of the parts can be accounted for as due to a condition of stratification or polarity, due to the mutual pressure of the parts on each other, which acts as the stimulus for the differentiation of the cells. By these same assumptions we can, I think, also give a fairly consistent explanation of the difference in the rule of growth at different levels (p. 280).

And again in discussing the formation of head and posterior end from anterior and posterior cut surfaces in Lumbriculus he says:

Since the development of these new parts seems to be largely a centripetal phenomenon, we can not assume that the influence of the old part on the new, a centrifugal influence, determines the result; but since the order or sequence of the differentiation in the new part is the same as that in the old part this may determine whether a head or a tail develops. . . . The centripetal influence acting on the new material at the anterior end determines therefore that this is a head, and acting on the new material at the posterior end determines that this is a tail. The centripetal influence is, according to my interpretation, nothing more than the tension of the outer layer of cells and the pressure relations in general, in the rounded dome-shaped mass of new materials. In this way we can give a formal solution of the development of a head in one case and of a tail in the other.

Let us see whether the same hypothesis will explain the different rates of growth of the posterior end according to the level of the cut, as seen in the earthworm, salamander and fish. A growing region is present near, but not quite at, the tip of the tail. From this region new material is continually being produced, out of which the new part is differentiated. The way in which the new part differentiates is determined by the pressure relation of the neighboring parts. This pressure relation is the result of the differentiation with its concomitant pressure relations, that has already taken place in the old part on the one side and of the tension of the new material at the tip on the other side. The new part differentiates therefore into something that is less than the former and more than the latter. In consequence there will be an ever-decreasing stimulus and differentiation as the new parts are formed, until finally no further stimulus for growth and differentiation is present or is strong enough to act and the growth comes to an end (pp. 280, 281).

To sum up: I have attempted to account for certain phenomena of regeneration by a process of growth in which the following factors appear to enter: (1) the differentiated material as a factor in limiting the character of new parts; (2) the relation of the cells to each other as a factor in their differentiation, and assume that this relation is due to the mutual pressures or tensions of the cells on each other; (3) the differentiated cells also determine the existing tension in that part, and this may in turn react on the new cells with which they are in contact. Remove a part and the pressure relations are upset, but this leads ultimately to the reestablishment again of the same relations of pressure (p. 282).

While space does not permit a critical discussion of this hypothesis, one must admire the author's audacity in putting forward so remarkable a hypothesis without a vestige of evidence to support it. At present his own criticism of Geddes and Thomson's theory of sex seems to apply most aptly:

So vague and general are most of the statements . . . that their interpretation belongs to that class of hypothesis, so common in much of our biological speculation, in which the issue is obscured by the appeal to phenomena as uncertain and little understood as the problems that they pretend to explain (pp. 387, 388).

In the following section, "Experimental Studies in Grafting," the attempt is made to apply this pressure-tension hypothesis to certain phenomena observed in grafts of lower animals. The data presented in this section comprise only a small part of those existing. Only the briefest mention is made of the experiments on the higher vertebrates.

"Experimental Studies of the Influence of the Environment on the Life Cycle" form the subject of the fourth section. Here the influence of food on the life cycle in Lepidoptera, the effect of environment on ripening of the sexual organs, alternation of sexual and parthenogenetic forms in aphids and phylloxerans, the influence of environment on the life cycle in the lower Crustacea, in Hydatina and in the Hymenoptera are considered. The section is merely a résumé of facts and includes much that is descriptive rather than experimental.

The facts and theories bearing on the problem of sex determination are presented in the fifth section. Here, too, there is much that is, properly speaking, not experimental, though of value in consideration of the subject in hand. The factors in sex determination are treated under two heads, the external and internal, food being the only external factor discussed. None of the factors discussed prove certainly upon examination to be real factors in sex determination, for the evidence in all cases is either negative, conflicting or of uncertain value.

In discussion of the relation between the accessory chromosome and sex two possibilities are suggested: the one that the accessory chromosome contains the elementary characters, pangenes, determinants, or whatever we may prefer to call them, of the female sex, the other that it produces its results quantitatively. Morgan points out the difficulties involved in the first alternative and maintains that the second affords a much simpler and more plausible basis for interpretation. He suggests that sex may be determined not in the egg or sperm, but "later by the quantitative relation resulting from the activity of the chromatin in the cells of the embryo." This hypothesis meets difficulties in those cases where the accessory chromosome has a mate of equal size, for here, as Morgan points out, the quantitative difference does not exist.

As a matter of fact, there is a third possibility which Morgan does not mention, viz., that the visible nuclear phenomena, *e. g.*, size and behavior of chromosomes, etc., are results or incidents of processes which are themselves the real determinative factors. If we adopt and consistently maintain a physiological as opposed to a morphological point of view, we are, it would seem, forced to this position.

In conclusion, morphological and physiological conceptions of sex are contrasted, the author favoring the latter:

> The average equality of males and females indicates, I think, that external conditions do not regulate the result, but that some internal physiological mechanism exists that determines the sex. This physiological mechanism does not involve the separation of male and female elements or units in the egg and sperm, but only involves the production of those conditions that determine whether one or the other sex will develop. In some cases the initiatory process may exist in the egg, in others in the sperm, and in still others after the union of egg and sperm (pp. 422, 423).

The final section of the book, on secondary sexual characters, comprises a brief account of the data on the correlation between these characters and the ovary and testis, and a discussion of the theories of the origin of secondary sexual characters.

The book as a whole is largely, as any such book must be, a compilation of facts. The author deserves the commendation of all biologists for his attempt to bring together the scattered data in so many different fields of experimental zoology. But the concentration of material within the limits of a single volume has necessarily resulted in a rather summary treatment of various subjects and entire omission of others. Moreover, since the author has felt himself obliged to omit all consideration of experimental embryology, form-regulation and animal behavior, his consideration of certain subjects is somewhat one-sided. Many of the facts in all these fields have a most important bearing on the problems of heredity and evolution and one which still awaits consideration.

The material which is presented is not always fully digested. Many of the chapters read like a part of some "Jahresbericht" and in many cases the reader is left to go over the data of the experiment and work out the results for himself instead of finding them presented clearly and briefly.

Bibliographies are appended to the various chapters, but no direct references to these bibliographies are made in the text. The disadvantages of this omission are obvious. In many cases also the bibliographies are far from being complete.

As regards the numbering of the figures confusion exists in several cases. Many of the figures are groups of separate figures: the groups are designated "Fig. 1," "Fig. 2," etc., and the single figures are also numbered, beginning with "1" in all cases except in Figs. 3 and 5, where the numbers continue from the preceding figures. In referring to the figures no distinction is made in most cases between the group and the single figure, so that a reference to Fig. 4, for example, may mean either the group Fig. 4 or the single figure 4 in any of the groups. The explanations of the figures make this confusion less serious than it would be otherwise, but some other system is certainly preferable.

Style and method of presentation present certain features which can be due only to haste or lack of care. Repetition is not infrequent; for example, the two following sentences appear within two pages of each other and in reference to the same experiments of Weismann:

> He believed that his observations and experiments show that external factors do not determine the appearance of the sexual generation (p. 337).
>
> Weismann carried out some experiments which show, he thinks, that external conditions do not regulate the alternation of generations (p. 339).

And again in the account of the work of Kellogg and Bell on sex determination in silk-worms these two sentences are half a page apart:

> The chief interest of their work is their examination of the possible effects of nourishment on the second generation (p. 377).
>
> The possible influence of food in determining the sex of the egg (or sperm) was also examined (p. 378).

Various errors in construction seem also to have escaped the author's notice and deserve mention for correction in a second edition:

The order is so different from that given by Yung that, although done on different animals, the interpretation of the real influence of light is probably open to question (p. 264).

He found that when the tadpoles of *Rana temporaria* . . . were fed on a mixed vegetable and meat diet that 95 per cent. of them were females and 5 per cent. were males (p. 381).

The potentialities of producing both sexes is present in all eggs and in all sperm (p. 422).

The development of Cowper's gland seems to be correlated with the development of the prostate and after castration remains undeveloped (p. 436).

With pimprennelle, which also gives an abundant nourishment, but not so well as the preceding, the caterpillars that showed the female type of marking were in excess (p. 437).

Typographical errors are most frequent in scientific names. We find, for example, the following: "pollychloros" for polychloros (p. 16), "fasceata" for fasciata (p. 24), "macchaon" for machaon (p. 29), "ingra" for nigra (p. 34), "rectvoctris" for rectirostris (p. 40), "hortenses" for hortensis (in the explanation of Fig. 15), "*Lymnœa*" for *Limnœa* (p. 263), "nemorales" for nemoralis (p. 273), "*Hormaphs hamamelistes*" for *Hormaphis hamamelidis* (p. 328), "*Hydratina*" for *Hydatina* (p. 348), "*Rhoditis*" for *Rhabditis*, throughout the table on p. 371, and *Rosii* for *Rossi* (p. 374).

Some other typographical errors are: "subjects of 'Formative Reiz'" (p. vi, preface), "25,000 grams" for 2,500 grams as the weight of the adult rabbit, "birth-rate" for birth-weight (pp. 255, 256), "extensive" for extensively (p. 317), "temperate" for temperature (p. 338), "dandylion" for dandelion (p. 380), "capulatory" for copulatory (p. 408), "primoidia" for primordia (p. 421). On p. 374 the specific name "*Rossi*" (spelled *Rosii*) is capitalized, while on p. 438 we find "*fraissei.*"

The book will undoubtedly prove of value especially to the younger students of experimental zoology and to the more general reader who desires to know something of the work that has been done along these lines.

C. M. CHILD

Chemical Pathology. By H. GIDEON WELLS. Philadelphia, W. B. Saunders Co.

While only a comparatively short time has elapsed since the appearance of Virchow's "Cellular Pathology," yet it is significant of the steady progress of pathology that meanwhile new and infinitely finer means for its advancement have been developed and many new fields within its territory have been opened to investigation.

The cell is essentially chemical in its functions. Normal and pathological processes as well as bacterial influences in their relation to higher forms present so many problems that can be solved only by chemical agencies and explained only in chemical terms, that any book dealing adequately with chemical phases of pathology offers an important addition to the means at hand for acquiring a mastery of the subject.

In his "Chemical Pathology," Professor Wells addresses himself to three classes of readers: the student of medicine, the physician and the investigator, but it seems evident, as one reads his book, that it is the medical student whose interest he has sought chiefly to attract. For reference reading on the chemical side of pathology in the same way that the student would use his Orth for morphology, the book is well designed. The exposition of fundamental chemico-pathological changes, such as inflammation, cell necrosis, etc., is clear and concise, and is well designed to enable the student to grasp a larger concept of pathology than he could well obtain without such an aid. Of the chapters dealing with the problem of immunity one may not speak so unreservedly. The elucidation of the theories and the experimental evidences pertaining to that extensive subject are not so well put as in some other works of this kind. It is also to be regretted that in dealing with the problems of bacteriology the author did not go into the physical chemistry of the subject in more detail—a field that has become particularly fruitful, in recent years, in its yield of data pertaining to all phases of chemical biology.

The clinician will find in Professor Wells's book not only much that is very instructive, but also, if he be so minded, much that will stimulate him along lines of individual investigation. The chapters devoted to the diseases of metabolism, such as diabetes, while less exhaustive than they might be, are excellent in the compact, condensed style in which they are written. Preceding the study of each disease is given a short description of the chemistry of related normal metabolic changes and the various pertinent theories of importance. It is a question whether future editions of Professor Wells's book might not be improved if more space should be devoted to such diseases as gout than they receive in this edition. While it is true that there are exhaustive works on such subjects, Minkowski's, for example, they are not much read by practising physicians nor by students, perhaps because they are too full of details, while a book like Professor Wells's is almost sure to be in large demand.

One is often led to wish that the author were less reticent in stating his own ideas relative to many questions. The writer of a book like this steps out of proximity to any one problem and, by virtue of his apartness, he is apt to have a correct perspective of the results of its investigation and of the relations that such results bear to each other and related data. From such a vantage point, the criticisms of a man who has himself been a laboratory worker are valuable to student and investigator alike. As Professor Wells says, what the investigator in scientific fields most requires is effective guidance, and ready access, to original publications. The excellent bibliography in the book under discussion affords that.

When one considers the extent of the field that must be covered by a book dealing with chemical pathology, it is surprising to note the large amount of matter that Professor Wells has compressed into a relatively small volume. It is our opinion that the demand for Professor Wells's book will be a cumulative one and that his successful authorship will induce him to include, in future editions, discussions of various additional pathological matters of importance that could not be encompassed in the original volume.

Nellis B. Foster

Columbia University,
November 18, 1907

Physiography. By Rollin D. Salisbury. American Science Series—Advanced Course. New York, Henry Holt and Company. 1907. Pp. 770, plates, figures, maps.

Object.—As Professor Salisbury states in the preface of his "Physiography," the book is intended for students of early college or normal school grade who have received elementary instruction in the subject, but who do not expect to pursue the study further. There are a number of text-books on this subject which have been published from time to time within recent years but none of them has been devoted especially to this class of students. Professor Salisbury's book, therefore, meets a real want and the character of its compilation, based as it is, on many years of experience in teaching, gives the book a completeness far beyond any other physiography published up to this time.

Plan.—The book is a companion volume to "Geologic Processes" which appeared in 1905, and much the same plan of treatment is adopted in both. In the "processes" the emphasis is thrown on the discussion of the agencies which have brought about changes in the earth's crust. In the "Physiography" topographic forms are brought into greater relative importance and less discussion given to the processes which have produced them. Part I. is devoted to the Lithosphere, part II. to the Earth Relations, part III. to the Atmosphere, part IV. to the Oceans. Each one of these major divisions is subdivided into appropriate chapters.

Illustrations.—The "Physiography" is as fine an example of text-book making as has yet appeared on the subject, and it is difficult to see where it could be improved. The figures which are both halftones and line engravings, are well selected, numerous, and beautifully reproduced. The maps are in great measure lithographs, in three colors, of typical localities within the United States. Such charts as are used to illustrate weather conditions are well selected. Nearly every phase of the subject has its appropriate figure or map to aid the student in gaining a correct idea of the matter in hand.

Exercises.—One of the most important features of the book is the portion devoted to original exercises at the end of each chapter. By the use of these exercises the student is induced to think for himself and apply what is discussed in the text. As far as is practicable the student is led up into the subject rather than led down out of it. Numerous well selected references are given. These serve a double purpose. Not only do they place the student in touch with more important publications bearing on the subject but they also furnish a list of books which might well be placed in every school library for the use of science teachers. It is a gratification to have such a text-book to work with and it will be appreciated by every teacher of physiography.

George Burbank Shattuck

SOCIETIES AND ACADEMIES

THE NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY AND MINERALOGY

At the first regular meeting, October 7, 1907, the following papers were read:

On the Pebbles at Harwich (Cape Cod), Mass., and on Rude Arrow-heads found among them: Dr. Alexis A. Julien.

Along the south shore of the apron-plain at Harwich the glacial deposits show abundant sections of layers of gravel, often coarse, and at one point huge angular boulders, up to eight feet in diameter, similar to those in the moraine along the north side of the cape. The pebbles consist almost altogether of crystalline rocks in considerable variety, in which, however, three types predominate. The principal one is a coarse binary granite, sometimes porphyroidal, passing by addition of hornblende into monzonite. Its sheared form seems to be represented by pebbles of granite-gneiss or aplite-schist, without mica, and very rarely of a fine biotite gneiss.

This rock appears to have been cut by intrusive dikes, both of an acid rock and of another of intermediate character, occurring in abundant pebbles. The one is a pinkish quartz-porphyry, a white felsite or finely striped rhyolite, whose sheared form appears to be a white phyllitic gneiss, with minute augen-structure. The other, a rather finely granular gabbro, made up of white feldspar and a greenish black hornblende-like mineral. This rock by shearing has passed into a hard greenstone, often decidedly schistose, and perhaps into a banded schist. Besides these three types, several varieties of fine crystalline schists, probably metamorphic; rarely small grains of serpentine; and occasional flakes of blue-black argillite. A marked feature in all these rocks is the almost entire absence of mica of any kind and that mineral does not occur even in the sands and clays, at least in scales visible to the naked eye.

By contrast, the characteristic rocks of the adjoining coast along the mainland of eastern New England have not been found, in spite of constant search, *e. g.,* the mica-gneisses and mica-pegmatites north of New Bedford, the granite of Quincy, Mass., the Dorchester conglomerate, the pyroxenic rocks and basic mica-diorites of Nahant, the porphyritic biotite granites of the Maine coast, etc. The conclusion is that the pebbles at Harwich have been transported from some other mica-less region.

Among the pebbles in ploughed fields many rude stone implements may be found, such as tomahawks, scrapers, lance-heads, and particularly arrowheads of the simplest form, probably left by Indians of the Massaquoit tribe, of whom several small kitchen-middens have been found in the neighborhood. These tools have been made from the local materials above described, chiefly from pebbles of the harder and finer schists, rhyolite, quartz-porphyry and often granite. Their dull edges and rounded points may imply that in many cases they have never been sharpened, but used for stunning birds and small animals. Many show mere traces of human workmanship, perhaps but one or two artificial faces, as if their owners had been content to use the simplest flakes for arrow-points.

The Sylvania Sandstone—A Study in Paleography: Dr. A. W. Grabau.

The speaker described field work carried on in company with Professor Sherzer in southern Michigan for the state survey. The special object of study was the Upper Monroe formation and the Sylvania sandstone. The evidences of the eolian (anemoclastic) origin of this rock were presented. An interesting new fauna of late Siluric age and with Devonic affinities was found in the higher beds. Evidence of the disconformable relation of the Monroe and the overlying Dundee (Onondaga) was obtained.

After discussion of both papers, the members of the section contributed observations made during the summer. Professor J. F. Kemp stated the general results of study of the petrography of the Adirondack region, and Dr. E. O. Hovey gave an account of excursions of Section E of the American Association for the Advancement of Science in the vicinity of the Adirondacks. Professor C. P. Berkey reviewed his recent investigations in the Highlands of New York, the difficulty of correlation of the Manhattan schists on the south with the Cambrian sedimentaries on the north, but reported the passage of the latter into crystalline condition eastward toward the Connecticut line.

Alexis A. Julien,
Secretary

THE AMERICAN MATHEMATICAL SOCIETY

The one hundred and thirty-fifth regular meeting of the society was held at Columbia University on Saturday, October 26, a single morning session sufficing for the usually brief program. The attendance included twenty-eight members. Vice-president P. F. Smith occupied the chair. The council announced the election of the following persons to membership in the society: V. R. Aiyar, Gooty, India; P. P. Boyd, Hanover College; Charles Haseman, Indiana University; C. A. Proctor, Dartmouth College; I. M. Rysgaard, University of North Dakota; C. A. Toussaint, New York City College. Thirteen applications for membership were received. A list of nominations of officers and other members of the council was adopted to be placed on the ballot for the annual meeting.

The following papers were read:

R. D. Carmichael: "A certain class of quartic curves."

R. D. Carmichael: "Geometric properties of quartic curves possessing fourfold symmetry with respect to a point."

Oswald Veblen: "On magic squares."

L. E. Dickson: "On triple algebras and ternary cubic forms."

G. H. Darwin: "Further note on Maclaurin's spheroid."

J. T. Coolidge: "The equilong transformations of space."

Edward Kasner: "Note on isothermal systems."

R. L. Moore: "A note concerning Veblen's axioms for geometry."

Joseph Bowden: "Proof of a formula in combinations."

The annual meeting of the society, at which the annual election of officers takes place, will be held at Columbia University on Friday and Saturday, December 27–28. The Chicago Section will meet on December 30–31, in affiliation with the American Association for the Advancement of Science. The annual meeting of the Southwestern Section was held at St. Louis on November 30.

F. N. Cole,
Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

There was presented at the meeting of November 5, 1907, a report on "Recent Explorations and Excavations in Colorado, Utah and New Mexico," by Edgar L. Hewett, director of American archeology for the Archeological Institute of America. The paper was illustrated with lantern slides. Professor Hewett was able, with the aid of volunteer students, to carry on an extensive reconnoissance of ruins on the San Juan River in Utah and Colorado, and interesting views were shown of this work in Mesa Verde Park, McElmo Canyon, Monument Park and Grand Gulch, the latter containing several hundred cliff-dwellings of the "Basket Makers." The work in New Mexico was concentrated on a large ruin in the Puye, where 120 rooms were cleared out and a collection secured numbering 3,500 artifacts. The paper was discussed by the president, Dr. Hrdlicka, and Mr. Robinson.

Walter Hough,
General Secretary

THE CHEMICAL SOCIETY OF WASHINGTON

The 177th regular meeting of the Chemical Society (Washington Section) convened at the Cosmos Club, November 14, at 8 p.m., President Fireman presiding. Two councilors, L. M. Tolman and F. K. Cameron, were elected to represent the section at the general meeting of the society.

The following paper by C. A. Crampton and L. M. Tolman, "The Changes taking Place in Whiskey during Storage in Wood," was read by Mr. Tolman. Graphic illustrations showed the chemical changes in whiskey during nine years' study. The attendance was about eighty.

J. A. LeClerc,
Secretary

DISCUSSION AND CORRESPONDENCE

THE HOLOTHURIAN IN DREW'S INVERTEBRATE ZOOLOGY

The laboratory guide written by Dr. Gilman A. Drew with the aid of members of the zoological staff of instructors of the Marine Biological Laboratory at Woods Holl, like its predecessor by Dr. Bumpus, has many excellent features. Since it is probable that a number of teachers will place this work in the hands of their students before a new edition can be issued, I venture to make a few suggestions concerning the description of *Thyone,* the type representing the Holothurioidea.

On page 69 the paragraph numbered 2 relates that "Ten forwardly directed canals leave the water-ring and pass into the tentacles." Some of the older text-books affirm this error, while others do not state clearly the origin of the tentacles but most of the newer works on zoology like Parker and Haswell, Delage and Hérouard, Goodrich in Lankester, Lang and others properly describe the tentacular canals arising from the *radial canals.* Ludwig, in 1891, demonstrated in the embryology of *Cucumaria planci* that the tentacles arise from the radial canals and not, as previously given, from the circular canal (water-ring). The student should be directed to inject the water vascular system with Ranvier's Prussian blue through one of the Polian vesicles. After cutting away the œsophageal wall he can see the tentacular canals branching from the radial canals just before the latter bend over the radial pieces of the calcareous ring. He will thus understand that the tentacles are simply modified pedicels.

Since in the study of holothurians it is important to distinguish the ambulacral appendages with suckers, as *pedicels,* from those without, as *papillæ,* it would be better, on page 67, to substitute *cylindrical pedicels* for "papilliform ambulacral suckers." The term sucker could then be limited to the terminal sucking disc.

Under Digestive System (p. 68) *the calcareous ring* should be substituted for "a cartilaginous structure."

Under Reproductive System (p. 68) the gonad should be described as made up of two brushes, one on either side of the dorsal mesentery.

It is to be regretted that no mention is made of the paired bands of longitudinal muscles, so characteristic of holothurians, and of the five powerful retractor muscles possessed by *Thyone* and the other members of the family Cucumariidæ. For comparison with the skeleton of the other Echinoderma described by Drew something should be said of the spicules, in the form of *tables,* found in the walls of the pedicels of *Thyone.* The student can easily examine these spicules under the microscope after placing a few pedicels in caustic potash for a short time.

Charles L. Edwards

THE "CENSUS OF FOUR SQUARE FEET"

Concerning Nathan Banks's recent notice[1]

[1] Science, N. S., XXVI., p. 637.

of the article[2] on a "Census of Four Square Feet," the writer desires to state that he had hoped to anticipate such criticism by the statement in the opening paragraph that the results detailed are not held applicable to any classes of surface other than those examined. The scope of the article was further restricted by noting that all of the material was collected in winter months (November and March), on the surface of the ground and in the ground itself to the depth a bird can scratch. Moreover, the limits of the inquiry were again emphasized in next to the last paragraph, where it is referred to as an investigation of the surface fauna. In view of these facts, my statement that the population of the meadow is much more dense than that of the woods should not have been misinterpreted. By frequent reference to the special character of the investigation it was intended to leave no doubt that a survey was attempted of only the surface life. Hence all of Mr. Banks's comment on the fauna of above-ground growths, while interesting as showing what would be the nature of a census including these objects, has no bearing on the subject in hand.

Mr. Banks says of meadows and woodlands: "the two regions are so variable that a comparison from selected spots has little significance." The use of the term "selected" here is unfair, as it applies only in the sense that necessarily some spot must be chosen (indeed the plot of forest floor was designated by another person), but it is not more unfair than the efforts made to discredit the results of the "census," by instances every one of which in a very special sense is selected. Each instance, moreover, characterizes the summer, not the winter fauna, which alone was studied. For these reasons the writer fears that Mr. Banks has a mistaken conception of the paper he criticizes.

W. L. McAtee

[2] Science, N. S., XXVI., pp. 447-449.

PROFESSOR ANGELO HEILPRIN AS AN ARTIST

To the Editor of Science: The Pennsylvania Academy of the Fine Arts has at present on exhibition eight oil paintings by the late Professor Angelo Heilprin. Their subjects are: The Ash Cloud; Mont Pelé and the Ash Cloud; Looking into the Crater, June 1, 1902; The Tower of Mont Pelé; Mont Pelé in eruption with a graveyard in the foreground; A View into the Crater; An Eruption; Afterglow on the Ash Cloud.

Scientists undoubtedly know how much good work Heilprin accomplished in exploration, in natural history, in geography and in geology. But few of them realize as yet that Heilprin was a great landscape painter.

His painting is distinctly art, the art of a painter, not the art of a scientist. His pictures are not diagrams, they are not illustrations of any science—they are purely color records, memory sketches of phases of nature, which in the case of some of these Mont Pelé pictures, he saw at the risk of his life.

He seems to have had the technique of oil painting at his fingers' ends: his drawing is good: values understood; gradation of light and atmospheric perspective accurate: the quality and handling of the paint masterly.

These eight pictures, grouped together on one wall, have a jewel-like glow of color. They are all more or less in somber tones, except the Tower of Mont Pelé. Clouds, fire, darkness, smoke, have never been so painted before. And all of these pictures have the first and underlying art requisite—beauty.

It would be a boon to science and a boon to art, if these pictures could be kept together, and placed either in the American Museum of Natural History or the United States National Museum.

Edwin Swift Balch

Philadelphia,
November 23, 1907

BADGES AT MEETING OF THE AMERICAN ASSOCIATION

To the Editor of Science: The prospectus for the forthcoming meeting of the American Association for the Advancement of Science is now out. Will you allow me a few words in Science?

To me, and probably likewise to a large part of the attendance, meeting friends and seeing eminent men is very attractive. We gather very largely for this purpose—to see and be seen. At the meetings in Indianapolis and Washington, the last ones I attended until recently, it was very easy to find out who were present from day to day, and generally possible to identify each member. The contrast in this respect was very great in New York last winter. It was very difficult, if not impossible, to learn who were in attendance, and equally to identify the members—quite a disappointment to me and I feel sure also to others. When I saw how things were at this meeting I asked a seemingly energetic member standing by me: "Wherefore this trouble? Why not post an alphabetical list in a conspicuous accessible place on the wall so we can tell, all of us, at a glance who are here." He seemed quite pleased with the idea and asked me why I did not patent it. I took this reply seriously until I learned that my companion was the learned permanent secretary of our association and then I saw he was poking fun at me, for how absurd to think there could be improvement on what such a man arranged! Perish the thought!

Our identification by buttons was very unsuccessful, apart from the absence of a list of names; the figures were far too small for most eyes. In fact the inability to make out the figure on a button placed me in the above absurd position of criticizing the management to our learned secretary himself. Moreover, the buttons were not quite fairly distributed. I came early and was assigned a low number, below fifty, I think, but I could not get that button throughout the whole meeting though I applied for it every day. I saw plenty of higher figures, way up into the hundreds. Members arriving much later were served much more promptly. Why not have the numbers on ribbons with large conspicuous figures, say scarlet ground and one inch black figures. These we could see. Then if in addition a daily list of members present were distributed, I for one should find happiness right at this part of the meeting, but I fear on account of the expense—what are our dues for—and because I see in the notices sent out that no daily program will be issued, I shall have to seek happiness elsewhere.

Clarence L. Speyers

Rutgers College,
New Brunswick, N. J.

SPECIAL ARTICLES

ON THE DISCOVERY OF REPTILIAN REMAINS IN THE PENNSYLVANIAN NEAR PITTSBURG, PENNSYLVANIA

In the vicinity of Pittsburg, the Ames Limestone rests upon a bed of almost structureless red and green clay which forms the upper part of the Pittsburg Red Shale. The thickness of this bed varies, but usually ranges from eighteen to about forty feet. At a locality about one mile west of Pitcairn and fifteen miles east of Pittsburg, the writer was fortunate enough to obtain a number of bones which appear to represent the remains of animals of at least two groups, namely: theromorph reptiles, and amphibians.

In this preliminary notice it is intended merely to describe these bones in a general way, and to show the stratigraphic position of the bed in which they were found. The bones have been examined and provisionally identified by Professor E. C. Case and Dr. W. D. Matthew, to whom my thanks are due. A detailed description of these fossils will be given by Professor Case in the forthcoming number of the Annals of the Carnegie Museum.

The "Crinoidal" (Ames) Limestone of western Pennsylvania is the youngest of the fossiliferous limestones of marine origin in that region, and is located at about the middle of the Conemaugh Series (Lower Barren Measures). In the vicinity of Pittsburg it lies 315 feet below the Pittsburg coal. At Pitcairn, the section extends but a short distance above the Pittsburg coal, but in the more complete sections farther south, the Monongahela Series, about 380 feet in thickness, overlies the Conemaugh. Above the Monongahela Series is the Dunkard Series, usually referred to the Permian. The horizon of the vertebrate fossils is at least 725 feet below the base of the Permian (Dunkard Series), and about an equal distance above the top of the Mississippian.

At Pitcairn the red clay beneath the Ames Limestone is 37 feet in thickness. Three feet above the base is a layer of somewhat nodular limestone, full of small worm-tubes (*Spirorbis carbonarius* Dawson). The teeth of the diadectid reptile described below were weathered out, and found lying on this layer of limestone where it projects from a rather steep bank at the roadside. All of the other bones were found imbedded in the clay about a foot above the layer of limestone, and about ten feet from the spot where the teeth were lying. All the bones were at the same level, and were recovered from an area about three feet in length and one foot in width.

The bones are in a good state of preservation and though somewhat brittle, are easily freed from the rather soft clay matrix. Many of the bones are fragmentary, apparently having been broken before they were imbedded. Very few of them are distorted, though the clay which contains them is full of slickensides. No other fossils have yet been found in this bed. About twenty-five entire or fragmentary bones have been found. The most complete are an ilium, some ribs, and the pleuro-centra, hypocentra, and neural arches of vertebræ of the rachitomous type. All these appear to belong to amphibians, probably much like *Eryops*, from the Permian of Texas.

The reptilian remains consist of several chevrons, and a fragment of a jaw containing four small transversely elliptical, long-rooted teeth. These are evidently from a reptile belonging to the family Diadectidæ.

Age of the Beds containing the Vertebrates.—The Ames Limestone is not a local stratum, but can be "traced from Central West Virginia in Lewis County northward into Pennsylvania and continuously through Greene, Westmoreland, Allegheny, and Beaver Counties into Ohio, whence it can be followed without a break across that state to where it reenters West Virginia near Huntington in Cabell County, to disappear finally under water level at the Kentucky line in Wayne County, eight miles above the mouth of the Big Sandy River" (West Virginia Geological Survey, Vol. II., p. 259). The red clay and shale below the limestone seem to be coextensive with it. There is therefore no doubt of the position of the bed containing these fossils.

All of these vertebrates have evident affinities with Permian species, no reptiles having been found in strata known to be older than the Permian. Similar fossils have been found in beds on the border line between the Permian and the Carboniferous on Prince Edward's Island, and in Illinois, Kansas, New Mexico and Arizona. The formations containing the reptiles in those localities have been referred to the Permo-Carboniferous (*i. e.*, the base of the Permian).

The Conemaugh series of southwestern Pennsylvania has always been considered as Upper or true Carboniferous. Recently Dr. I. C. White has suggested that the Monongahela Series and that part of the Conemaugh Series above the base of the Buffalo Sandstone, should be removed from the Carboniferous and placed in the Permo-Carboniferous. He cites in favor of this action a change in the fauna and flora, and the introduction into the section of "red-beds" above the base of the Buffalo Sandstone (West Virginia Geological Survey, Vol. II., 1903).

The discovery of reptiles in the Pittsburg Red Shale, at a horizon about 150 feet above the base of the beds ascribed by Dr. White to the Permo-Carboniferous, presents an argument in favor of this suggestion. It should be noted, however, that the remains so far found indicate smaller and more simple animals than those found in the Permian of Texas, and thus suggest their somewhat greater antiquity.

The evidence obtained from the invertebrate fossils of the Conemaugh Series, so far as they have been studied, is not of great value in the correlation of these beds, for the fauna consists mostly of long-lived species.

No distinctly Permian fossil plants have yet been found below the Dunkard Series, and the preponderance of the evidence at the present time seems to be in favor of regarding the Conemaugh Series as Pennsylvanian.

Percy E. Raymond

Carnegie Museum,
November 19, 1907

THE TUSKS AND SIZE OF THE NORTHERN MAMMOTH

The last report of the Smithsonian Institution is accompanied, as has become customary, by an "appendix" consisting of a selected number of scientific papers of very general interest. One of these, by E. Pfizenmayer, deals with the northern mammoth and while very interesting, contains what I believe to be two very serious errors. The first one of these relates to the shape of the tusks, which are discussed at considerable length, the author concluding that the tips pointed forwards and downwards and were used in digging. To support this contention we are given figures of several tusks and a copy of a drawing in a cave at La Mouthe.

It seems a sufficient reply to this last bit of testimony to note that there are many other figures of the mammoth in existence, including various carvings, and in none of these are the tusks depicted as shown in the cave of La Mouthe.

Tusks of the mammoth exist in Alaska in large numbers and many have been brought from there during the past few years. None of them shows the great spiral twist and final downward curvature of the tusks figured by Dr. Pfizenmayer. Tusks of the mammoth, like those of the mastodon, vary very greatly in the amount of curvature and of their spiral twist. As a general rule the curvature is at first downwards and outwards, and then upwards and inwards. The tusks figured by Dr. Pfizenmayer are very evidently those of old individuals and are abnormal in shape. The tusks of the Beresovka mammoth do not exhibit the great spiral curvature of the specimen from Cracow and there is no reason to believe that, *as a rule,* the tusks of the mammoth pointed downwards and forwards. When in exceptional cases they did, it would be quite natural to use them for digging.

The second error is in ascribing to the northern mammoth a greater size than that of existing elephants. Unless I am mistaken, no Siberian mammoth has yet been found having greater height at the shoulders than nine feet six inches, a height occasionally equalled by the Indian elephant and exceeded by the African species, which stands eleven feet high and occasionally slightly more at the shoulders. Dr. Swanton, indeed, has recently recorded a specimen of the Indian elephant having a height of eleven feet, but this seems somewhat questionable. It must not be forgotten, however, that few elephants are allowed to reach their full age and size, much less to develop tusks of the greatest possible length, and this partly accounts for the comparatively small size of the tusks of modern elephants.

There is no tusk of the northern mammoth in existence so heavy as the heaviest examples of tusks of the African elephants and there are few tusks much longer than the greatest recorded length found among this species. The tusks of the northern mammoth average somewhat longer than those of either of the existing species of elephants, but they did not reach so great a diameter as the best specimens of tusks of the African elephant which measure from nine feet to eleven feet six inches long and weigh from 125 to 239 pounds for a single tusk.

It has frequently been shown that the northern mammoth was no larger than existing elephants, as a matter of fact it did not stand so tall as the Soudan elephant, but it seems difficult to effectually dispose of the belief that it was a creature of gigantic size.

The true giants among fossil elephants are *Elephas meridionalis* of southern Europe and *E. imperator* of our western and southwestern states, which stood from twelve feet six inches to possibly thirteen feet six inches high.

F. A. Lucas

CURRENT NOTES ON LAND FORMS

A PENEPLAIN IN THE GRAND CANYON DISTRICT

The existence of an uplifted and dissected peneplain in the Grand Canyon district of Arizona has been recognized for some years, and its relation to the great folds and faults of the region has afforded a subject for interesting discussions. Little has been known in detail, however, regarding the peneplain remnants. Dr. H. H. Robinson, of Yale University, recently offered a contribution to this subject in an account of "The Tertiary peneplain of the Plateau district, and adjacent country, in Arizona and New Mexico" (*Amer. Journ. Science,* XXIV., 1907, 109–129). He concludes that after the occurrence of the principal displacements the greater part of the region was reduced to a peneplain "of practically no relief." The broad uplift of this peneplain has given opportunity for the deep erosion of the Colorado canyon, and for a moderate dissection of the weaker parts of the uplifted area. Presumably before the time of uplift, wide-spead eruptions of basalt occurred in the southern part of the area; it is to the capping of lava thus supplied that remnants of the peneplain are preserved in the localities studied by the author. At Black point in the Little Colorado valley, a monoclinal fold involving compact sandstone and weak marls is bevelled across by a very perfect plain of erosion, upon which the basaltic cover rests. In Anderson mesa, southeast of Flagstaff, Arizona, a lava cap rests upon a similar smooth surface, which bevels across slightly inclined beds of resistant Upper Aubrey limestones and weak overlying shales. The lava sheet of Black mesa rests upon Upper Aubrey limestones and sandstones along the western border of the mesa, but upon the overlying red beds farther east, thus indicating a bevelling similar to that of the other examples. Other localities afford evidence of the same kind. The several peneplain remnants thus identified are believed to represent parts of a once continuous and extensive peneplain. Lava-capped baselevelled surfaces in the Mt. Taylor district of New Mexico farther east and in the Basin region of Arizona farther west, are correlated with the great peneplain of the Grand Canyon district.

The latter part of the paper is concerned with a discussion of the drainage system of the plateau district, with the conclusion against the antecedent origin of the Colorado River. There is much to be said in favor of this conclusion, but the author's arguments for it appear much less cogent than those already cited regarding the peneplain.

D. W. J.

THE ISTRIAN PENINSULA

An elaborate study of the Istrian peninsula at the head of the Adriatic by Dr. Norbert Krebs of Vienna ("Die Halbinsel Instrien: Landeskundliche Studie." Geogr. Abhandlungen herausg. von Professor Dr. A. Penck in Berlin—formerly Vienna—Band IX., heft 2, 1907) shows that it is a good-sized block broken out of a well-worn-down mountain system of close-folded Mesozoic limestones and Tertiary sandstones with northwest-southeast trend. A pretty good peneplain was formed on the limestones, while the sandstones were reduced to low rounded hills and ridges; then the Istrian block was uplifted and tilted westward, with a strong fault along the eastern (Quarnero) border; and in this position it was submaturely or maturely dissected in later Tertiary time, with abundant development of karst features on the limestone areas; recently the dissected block has been somewhat depressed, so that the sea now enters its lower valleys in river-like bays.

To European geographers, who are already familiar with these facts, Krebs' essay will be easy and profitable reading, by reason of the great body of pertinent details that it presents concerning matters of structure and form. But to more distant readers, many of whom must be unacquainted with the local names and the physiographic history of the peninsula, the essay will be difficult reading, because the explanatory descriptions of the larger features are almost lost in the wealth of details concerning the minor features. Only after reading nineteen pages, most of which are given to geological matters, does this geographical essay state the elementary and essential fact that the surface of the peninsula is not a structural ("geological") surface, but the final work of a process of abrasion (das Endergebnis eines Abrasionsvorganges); not until the twentieth page is the inner and higher part of the peninsula explicitly described as a monotonous plateau, surmounted by rounded and isolated hills and ridges; and not until the thirty-fourth page is the lower western part of the peninsula stated to be a slightly arched abrasion surface, which may be regarded as a less elevated extension of the higher eastern part.

W. M. D.

STRUCTURE, PROCESS AND STAGE

It would be an immense assistance to the distant reader—and perhaps an aid to some nearer readers as well—if substantial physiographical essays were opened with a brief general statement, giving the essence of the whole story in terms of structure, process and stage of development; and if the later pages then proceeded, following the scheme and the sequence thus outlined at the beginning, to present the details. The Istrian peninsula would seem to lend itself admirably to such treatment. Its larger structures are reducible to a very simple statement, upon which all sorts of details as to pitching folds and overthrusts may be afterwards embroidered. The deformed mass without question reached well-advanced old age in the first recognizable cycle of erosion, as is clearly indicated by the even surfaces which transect the folded strata over large areas. It is equally evident that irregular movements of faulting and tilting interrupted the first cycle before the more resistant strata were completely worn down. In the new cycle thus introduced revived erosion gained a good advance, with characteristic development of karst features on the limestones, before a moderate submergence drowned the borders of the dissected block at so recent a date that the present shore line is still very young. Upon the framework of such a statement all details can be most conveniently placed in good order for easy understanding; but if no general framework is presented at the beginning, the reader must be embarrassed as he comes on page after page of unrelated details.

There is, however, a certain unevenness of treatment in Krebs' essay on the Istrian peninsula which seems to indicate that the author is perhaps not yet ready to adopt the concise scheme of "structure, process and stage," above suggested. The even uplands are repeatedly spoken of as the work of "abrasion," thus implying that the first cycle of erosion was accomplished chiefly by marine processes; yet there is no discussion of this debatable point; it appears to be accepted as a traditional truth; and this in spite of the frequent occurrence of rounded residual reliefs which surmount the uplands and which are much more suggestive of subaerial than of marine erosion in the first cycle. Furthermore, while no sufficient space is given to an adequate discussion of the origin of the chief features of the peninsula, space is allowed (p. 66) for a brief refutation of the obsolete ideas that the typical drowned valleys on the west and south (Canali di Leme and dell' Arsa) are due to (marine) abrasion or to faulting. There is no need of such a refutation; but there is much need of a critical consideration of the postulated marine planation of the district.

W. M. D.

THE TWENTY-FIRST SESSION OF THE MARINE BIOLOGICAL LABORATORY, JUNE 1 TO OCTOBER 1, 1908. PRELIMINARY ANNOUNCEMENT

On account of considerable changes proposed for the season of 1908, the following preliminary announcement is made. Attention is directed particularly to the statements concerning the addition of the Wistar Institute of Anatomy and Biology to the list of cooperating institutions, to the change of personnel in the staff of instruction in zoology, to the reinstatement of the course in embryology and to the introduction of a new course in the general morphology of plants. The final announcement will be ready in March or April, 1908, and will be sent on request to all desiring it.

The Marine Biological Laboratory is an institution for the promotion of research in biology by the cooperative endeavors of biologists from all parts of the country. The laboratory is a national institution on an absolutely independent foundation, and it solicits the cooperation of all students of biology.

I. *Research.*—The laboratory will be open for research from June 1 to October 1, 1908. Facilities for research are offered in zoology, embryology, physiology and botany. Fifty-five private rooms are reserved for investigators, and those assigned to such rooms are supplied with reagents, glassware and service in the collection of material. The majority of these rooms are reserved for members of the staff and for subscribing institutions. The charge for the remaining rooms is $100 per season and applicants should state the time of desired occupancy and any special needs;

application should be sent to the assistant director (Frank R. Lillie, University of Chicago) before May 1.

Subscribing institutions for the year 1907 were as follows:

Academy of Natural Sciences, Philadelphia.
Bryn Mawr College.
Mount Holyoke College.
Rochester University.
Smith College.
Syracuse University.
University of Chicago.
Columbia University.
University of Pennsylvania.
University of Cincinnati.
Vassar College.
Wellesley College.
Woman's College of Baltimore.
Kansas University Woman's Table supported by Mrs. Robinson.
Vassar Brothers' Institute.
University of Michigan, Bryant Walker Scholarship.
United States Department of Agriculture.

It is hoped that this list may be increased. The laboratory carries out work of interest and importance to all biological departments, and provides facilities for marine work that would cost such departments acting independently many times the rental of a room at the Marine Biological Laboratory. Institutions that favor this cooperative plan are requested to aid by subscribing for rooms, prices for which are $100 per season. The subscription carries with it the right of nomination of the occupant of the room, who receives services and supplies as stated above.

An important addition to the list of cooperating institutions for 1908 is the Wistar Institute of Anatomy and Biology, which subscribes for five rooms. Four of these are available for qualified investigators in anatomy and zoology. Applications may be sent directly to the Wistar Institute of Anatomy and Biology, Philadelphia, Pa., or to the assistant director of the Marine Biological Laboratory.

The staffs of the various departments constitute a permanent nucleus of investigators and center of interest for research in all departments. It is expected that the research staffs in zoology and physiology will be substantially the same as in 1907, viz.:

ZOOLOGY

E. G. Conklin, professor of zoology, University of Pennsylvania.

C. W. Hargitt, professor of zoology, Syracuse University.

George Lefevre, professor of zoology, University of Missouri.

Warren H. Lewis, associate professor of anatomy, Johns Hopkins University.

Frank R. Lillie, professor of embryology, University of Chicago.

T. H. Morgan, professor of experimental zoology, Columbia University.

C. O. Whitman, professor of zoology, University of Chicago.

E. B. Wilson, professor of zoology, Columbia University.

PHYSIOLOGY

Albert P. Mathews, professor of physiological chemistry, University of Chicago.

E. P. Lyon, professor of physiology, University of St. Louis.

Ida H. Hyde, professor of physiology, University of Kansas.

R. S. Lillie, instructor in comparative physiology, University of Pennsylvania.

A. J. Carlson, assistant professor of physiology, University of Chicago.

Edward G. Spaulding, assistant professor of philosophy, Princeton University.

Oliver P. Terry, instructor in physiology, Purdue University.

Horatio H. Newman, instructor in zoology, University of Michigan.

BOTANY

The research staff in botany for 1908 will include the following:

John M. Coulter, professor of botany, University of Chicago.

B. M. Duggar, professor of plant physiology, Cornell University.

Henry Kraemer, professor of botany, Philadelphia College of Pharmacy.

George T. Moore, Water Mill, New York.

Hermann von Schrenk, pathologist, Missouri Botanical Garden.

Erwin F. Smith, in charge of Laboratory of Plant Pathology, United States Department of Agriculture.

M. B. Thomas, professor of botany, Wabash College.

A limited number of private rooms is available for other investigators in botany. Applications for use of these rooms should be made to Dr. George T. Moore, Water Mill, New York.

Subjects for investigation in zoology, physiology or botany will be assigned to those whose previous training qualifies them to begin research. The student may select his teacher in investigation, subject to the approval of the latter.

II. *Instruction.*—The courses of instruction are six weeks each, including about four weeks in July and two in August. Each course requires the full time of a student. They are so graded that the student may supplement his college instruction by courses leading up to research, or he may take the more elementary courses in zoology or general morphology of plants. Credit for courses taken in the Marine Biological Laboratory is generally given by colleges and universities and also by boards of education of various cities, on certificate of the instructor in charge. It has been decided to add two courses to those given in recent years, viz., a course in embryology and one in general morphology of plants (see below).

1. Zoological instruction, season of 1908, will be in charge of Winterton C. Curtis, assistant professor of zoology, University of Missouri, assisted by Paul M. Rea, professor of biology, College of Charleston, and director of the Charleston Museum; Max Morse, tutor in natural history, College of the City of New York; Lawrence E. Griffin, professor of biology, Missouri Valley College; Edward E. Wildman, instructor in biology, Central High School, Philadelphia, and John W. Scott, Westport High School, Kansas City.

Although Dr. L. L. Woodruff, instructor in biology, Yale University, is leaving the staff in zoology for that in embryology, he has consented to give the lectures on protozoa in 1908.

The conduct of the work in this subject will not differ substantially from the plan which has proved successful in recent years. Lectures and laboratory work are supplemented by extensive collecting trips, during which the student has opportunity to observe the methods of marine collecting and to study a wide range of marine forms in their natural surroundings.

2. The course in embryology will be in charge of Professor Gilman A. Drew, of the University of Maine, Orono, Maine, assisted by Dr. L. L. Woodruff, instructor in biology, Yale University, and Dr. W. E. Kellicott, professor of biology in the Woman's College of Baltimore.

It is the aim of this course to meet the needs of those who desire to get an insight into fundamental problems, and to serve as a basis for those who desire to begin independent investigation. It will supplement the usual college course in embryology, laying special weight on questions of general importance that can best be approached by the study of living marine material.

The work will include the study of organization, maturation and fertilization in the egg, the early development, types of gastrulation, and the effects of different conditions on development. The advantage of following the actual process of development in the living egg, instead of comparing a few preserved stages of development, can not be overestimated.

The course will be accompanied by lectures delivered by members of the staff and by other investigators working at the laboratory. For the course in embryology, the course in zoology or its equivalent is a prerequisite.

3. The course in comparative physiology will be in charge of members of the same staff as in 1907, viz.:

Albert P. Mathews, professor of physiological chemistry, University of Chicago.

E. P. Lyon, professor of physiology, University of St. Louis.

Ida H. Hyde, professor of physiology, University of Kansas.

R. S. Lillie, instructor in comparative physiology, University of Pennsylvania.

A. J. Carlson, assistant professor of physiology, University of Chicago.

Edward G. Spaulding, assistant professor of philosophy, Princeton University.

Oliver P. Terry, instructor in physiology, Purdue University.

Horatio H. Newman, instructor in zoology, University of Michigan.

Changes in the staff for 1908 will be announced later. The course will include study of the physico-chemical constitution of protoplasm, physics of cell-division and contractility, phenomena of inheritance from a physico-chemical standpoint, the physical basis of conduct, comparative physiology of the heart and circulation and comparative physiology of the central nervous system. Lectures will be given by members of the staff and others.

IV. The following courses will be offered in botany:

1. Morphology and Taxonomy of the Algæ, conducted by Dr. George T. Moore, assisted by George R. Lyman, assistant professor of botany, Dartmouth College, and R. R. Gates, fellow in botany, University of Chicago.

A general course upon the algæ, designed to give a detailed knowledge of the habits, structures and life histories of this group.

2. Morphology and Taxonomy of the Fungi, conducted by Dr. Lyman and Mr. Gates. A general course upon the fungi similar to that outlined for the algæ.

3. General Morphology of Plants.

No prerequisites are stated for this course, which will be conducted either by Professor John M. Coulter or Professor C. J. Chamberlain, of the University of Chicago, with assistants: an outline of the plant kingdom, based upon the study of selected types. Emphasis will be placed upon the facts connected with the evolution of plants, such as the origin of sex, alternation of generations, heterospory, origin of the flower, origin of the seed, etc. The general relationships and classification of the flower groups will also be discussed, including the history of the groups as developed by paleobotany.

It is expected that Mr. W. R. Maxon, of the United States National Museum, will act as collector in botany. The usual lectures and seminars will be offered.

Frank R. Lillie

University of Chicago

CHARLES P. MATTHEWS

Charles P. Matthews, professor of electrical engineering at Purdue University, died at Phoenix, Arizona, on Saturday, November 23, 1907. Professor Matthews was of Vermont stock, his family going from that state to New York in 1852, where, at Fort Covington, he was born September 18, 1867. At the time of his death he was, therefore, a little more than forty years of age.

He attended the St. Johnsbury Academy at St. Johnsbury, Vermont, graduating there in 1887. He then entered Cornell University, graduating from Sibley College with the degree of mechanical engineer in 1892. In 1901 he received the degree of doctor of philosophy from his alma mater.

Immediately after graduation he became instructor in physics and applied electricity at Cornell, serving in that capacity four years, until 1896. At that time he was called to Purdue and was appointed associate professor of electrical engineering. In 1905 he succeeded Professor Goldsborough as head of the School of Electrical Engineering and from this time until his death he was continuously a member of the Purdue faculty.

During Professor Matthews's connection with the School of Electrical Engineering, it has grown to be the largest in the country in point of numbers. In this development he has had a large share. His instruction was of the highest order not only on account of his professional ability and training, but quite as much on account of his exceptional personality and gifts.

He made valuable contributions to his science, his chief work being an investigation of photometric standards for arc lamps. This was done in connection with the National Electric Light Association. In this, he directed all the experimental work, designed the apparatus and prepared four reports aggregating about two hundred pages. In this connection he devised and patented an integrating photometer. This instrument received a gold medal at the Louisiana Purchase Exposition. He was also collaborator in the production of text-books in physics and electricity with Professors Nichols and Shearer, of Cornell, and with Professor Esterline, of Purdue, and he had published a number of papers on electrical subjects. He was a member of the honor fraternity, Sigma Xi.

THE SMITHSONIAN INSTITUTION

A regular meeting of the board of regents of the Smithsonian Institution was held on December 3, 1907, at ten o'clock, at the institution, the chancellor, Chief Justice Fuller, presiding, and the following regents being present: Vice-president Charles W. Fairbanks, Senator Shelby M. Cullom, Senator Henry Cabot Lodge, Senator Augustus O. Bacon, Representative John Dalzell, Representative James R. Mann, Representative William M. Howard, Dr. Andrew D. White, the Hon. John B. Henderson, and the secretary of the institution, Dr. Charles D. Walcott.

The secretary presented his report for the year ending June 30, 1907, to the board, which was accepted. Statements were received from the executive and permanent committees. The secretary presented a statement of the affairs of the institution since the close of the fiscal year. Considerable attention was given to the National Gallery of Art, and a resolution was adopted urging congress to make an appropriation for adapting the large hall of the Smithsonian building to the purposes of a gallery of art. A resolution was also adopted tendering the thanks of the regents to William T. Evans for the gift of his valuable collections of paintings by American artists, and to the trustees of the Corcoran Gallery of Art for their courtesy in providing temporarily for the exhibition of this collection.

THE AMERICAN FEDERATION OF TEACHERS OF THE MATHEMATICAL AND THE NATURAL SCIENCES

The second annual meeting of the American Federation of Teachers of the Mathematical and the Natural Sciences will be held in Chicago on January 1, 1908, at 2 p.m., in room 20 of the Kent Chemical Laboratory, University of Chicago. The purpose of the federation is a more unified and concentrated effort on the part of its members to better the teaching of mathematics and of the natural sciences. The membership of the federation consists entirely of associations, each member being represented by delegates at the meetings. At the last meeting, a tentative organization was formed by the following associations: The Association of Teachers of Mathematics of the Middle States and Maryland; The New York State Science Teachers Association; The Central Association of Science and Mathematics Teachers; The Association of Teachers of Mathematics of New England; The Physics Teachers Association of Washington City; The Missouri Society of Teachers of Mathematics and Science; The New Jersey State Science Teachers Association.

Since the last meeting, the following associations have signified their intention of being represented at the coming meeting in Chicago: The Michigan Schoolmasters Club; The New England Association of Chemistry Teachers; The New York Physics Club; The Indiana Association of Science and Mathematics Teachers; The Association of Ohio Teachers of Mathematics and Science. At this meeting on January 1, the final form of the organization will be decided. All organizations whose leading purpose is the betterment of the teaching either of mathematics or of the natural sciences are invited to send delegates to this meeting and thus to take part in the organization of the federation. By joining this body, an association will lose in no way its individuality or its right to work in its own field in its own way; but it will gain an official means of keeping in touch with the work of the other associations, and will receive from the federation suggestions as to the ways in which all the associations may work together on their common problems.

C. R. Mann,
Secretary

University of Chicago

THE CONVOCATION WEEK MEETINGS OF SCIENTIFIC SOCIETIES

The American Association for the Advancement of Science and the national scientific societies named below will meet at the University of Chicago during convocation week, beginning on December 30, 1906.

American Association for the Advancement of Science.—December 30–January 4. Retiring president, Professor W. H. Welch, The Johns Hopkins University, Baltimore, Md.; president-elect, Professor E. L. Nichols, Cornell University, Ithaca, N. Y.; permanent secretary, Dr. L. O. Howard, Cosmos Club, Washington, D. C.; general secretary, President F. W. McNair, Houghton, Mich.

Local Executive Committee.—Charles L. Hutchinson, chairman local committee; John M. Coulter, chairman executive committee; John R. Angell, Thomas C. Chamberlin, Joseph P. Iddings, Frank R. Lillie, Charles R. Mann, Robert A. Millikan, Charles F. Millspaugh, Alexander Smith, J. Paul Goode, local secretary.

Section A, Mathematics and Astronomy.—Vice-president, Professor E. O. Lovett, Princeton University; secretary, Professor G. A. Miller, University of Illinois, Urbana, Illinois.

Section B, Physics.—Vice-president, Professor Dayton C. Miller, Case School of Applied Science; secretary, Professor A. D. Cole, Vassar College, Poughkeepsie, N. Y.

Section C, Chemistry.—Vice-president, Professor H. P. Talbot, Massachusetts Institute of Technology; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

Section D, Mechanical Science and Engineering.—Vice-president, Professor Olin H. Landreth, Union College; secretary, Professor Wm. T. Magruder, Ohio State University, Columbus, Ohio.

Section E, Geology and Geography.—Vice-president, Professor J. P. Iddings, University of Chicago; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York City.

Section F, Zoology.—Vice-president, Professor E. B. Wilson, Columbia University; secretary, Professor C. Judson Herrick, University of Chicago.

Section G, Botany.—Vice-president, Professor C. E. Bessey, University of Nebraska; secretary, Professor F. E. Lloyd, Desert Botanical Laboratory, Tucson, Arizona.

Section H, Anthropology.—Vice-president, Professor Franz Boas, Columbia University; secretary, George H. Pepper, American Museum of Natural History, New York City.

Section I, Social and Economic Science.—Vice-president, Dr. John Franklin Crowell, New York City; secretary, Professor J. P. Norton, Yale University, New Haven, Conn.

Section K, Physiology and Experimental Medicine.—Vice-president, Dr. Ludvig Hektoen, University of Chicago; secretary, Dr. Wm. J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

Section L, Education.—Vice-president, Hon. Elmer E. Brown, U. S. Commissioner of Education; acting secretary, Professor Edward L. Thorndike, Teachers College, Columbia University, New York City.

The American Society of Naturalists.—December 28. President, Professor J. Playfair McMurrich, University of Toronto; secretary, Professor E. L. Thorndike, Teachers College, Columbia University, New York City. Central Branch, president, Professor R. A. Harper, University of Wisconsin; secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The American Mathematical Society. Chicago Section, December 30, 31. Chairman, Professor Edward B. Van Vleck; secretary Herbert E. Slaught, 58th St., and Ellis Ave., Chicago, Ill.

The American Physical Society.—President, Professor E. L. Nichols, Cornell University; secretary, Professor Ernest Merritt, Cornell University, Ithaca, N. Y.

The American Chemical Society.—December 27–January 2. President, Professor Marston T. Bogert, Columbia University; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

The Association of American Geographers.—December 31–January 1. Acting-president, Professor R. S. Tarr, Cornell University, to whom correspondence should be addressed; secretary, Albert P. Brigham, 123 Pall Mall, London, Eng.

The Association of Economic Entomologists.—December 27, 28. President, Professor H. A. Morgan, Knoxville, Tenn.; secretary, A. F. Burgess, Columbus, Ohio.

The American Society of Biological Chemists.—December 30–January 2. President, Professor Russell H. Chittenden, Yale University; secretary, Professor William J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

The Society of American Bacteriologists.—December 31–January 2. Vice-president, F. D. Chester, Delaware Agricultural College, Newark, Del.; secretary, Professor S. C. Prescott, Massachusetts Institute of Technology.

The American Physiological Society.—Beginning December 31. President, Professor W. H. Howell, Johns Hopkins University; secretary, Professor Lafayette B. Mendel, 18 Trumbull St., New Haven, Conn.

The Association of American Anatomists.—January 1–3. President, Professor Franklin P. Mall; secretary, Professor G. Carl Huber, 1330 Hill St., Ann Arbor, Mich.

The American Society of Zoologists.—Central Branch. Secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The Botanical Society of America.—December 27–29. President, Professor George F. Atkinson, Cornell University; secretary, Dr. D. S. Johnson, Johns Hopkins University.

The Botanists of the Central States.—Business Meeting. President, Professor T. H. Macbride, University of Iowa; secretary, Professor H. C. Cowles, University of Chicago, Chicago, Ill.

The American Psychological Association.—December 27, 28. President, Dr. Henry Rutgers Marshall, New York City; acting secretary, Professor R. S. Woodworth, Columbia University, New York City.

The Western Philosophical Association.—Secretary, Dr. John E. Bowdoin, University of Kansas, Lawrence, Kans.

The American Anthropological Association.—December 30, January 4. President, Professor Franz Boas, Columbia University; secretary, Dr. Geo. Grant MacCurdy, Yale University, New Haven, Conn.

The American Folk-lore Society.—December 30–January 4. President, Professor Roland B. Dixon, Harvard University; secretary, Dr. Alfred M. Tozzer, Harvard University, Cambridge, Mass.

Other national societies will meet as follows:

NEW HAVEN

The American Society of Zoologists.—Eastern Branch. December 26, 28. President, Dr. C. B. Davenport, Cold Spring Harbor, N. Y.; secretary, Professor W. L. Coe, Yale University, New Haven, Conn.

The American Society of Vertebrate Paleontologists.—December 26–28. President, Professor Basbford Dean, Columbia University; secretary, Professor Frederick B. Loomis, Amherst College, Amherst, Mass.

NEW YORK

The American Mathematical Society.—December 27, 28. President, Professor H. S. White, Vassar College; secretary, Professor F. N. Cole, Columbia University.

ALBUQUERQUE, N. M.

The Geological Society of America.—December 30–January 4. President, President Charles R. Van Hise, University of Wisconsin; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York City.

ITHACA

The American Philosophical Association.—December 26, 28. President, Professor H. N. Gardiner, Smith College; secretary, Professor Frank Thilly, Cornell University, Ithaca, N. Y.

NEXT SUMMER, AT SOME PLACE TO BE DETERMINED

The Astronomical and Astrophysical Society of America.—President, Professor Edward C. Pickering, Harvard College Observatory; secretary, Professor Geo. C. Comstock, Washburn Observatory, Madison, Wisconsin.

SCIENTIFIC NOTES AND NEWS

Mr. Andrew Carnegie has added two million dollars to the endowment of the Carnegie Institution of Washington. Mr. A. J. Montague of Virginia and Mr. W. B. Parsons of New York have been elected trustees of the institution.

Nobel prizes have been awarded as follows: In physics to Professor A. A. Michelson of the University of Chicago; in chemistry to Professor Eduard Buchner of the Berlin Agricultural School; in medicine to M. Laveran of Paris; in literature to Mr. Rudyard Kipling, and for the promotion of peace to M. Renault and M. Moneta.

Mr. Alexander Agassiz and Professor Adolf von Baeyer have been elected honorary members of the Vienna Academy of Sciences.

Miss Florence Nightingale, now in her eighty-eighth year, has been decorated by King Edward with the Order of Merit.

Professor E. B. Titchener, of Cornell University, has been appointed non-resident lecturer on psychology at Columbia University for the academic year 1907–08.

At the sixtieth anniversary meeting of the New York Academy of Medicine on November 29, Col. W. C. Gorgas, chief sanitary officer of the Isthmian Canal Commission, delivered an address on the sanitary problems encountered in the canal zone.

The regular meeting of the Columbia Chapter of the Society of Sigma Xi was held with the department of chemistry on December 12. Professor C. F. Chandler addressed the society on Recent Progress of Electrochemistry. The lecture was an exposition of the theory and practise of electrochemistry as employed in the great industries built up during the last few years at Niagara Falls, and was illustrated by a collection of specimens of both materials and products.

The annual meeting of the New York Academy of Sciences will be held on Monday, December 16, at the Hotel Endicott, corner of Columbus Avenue and Eighty-first Street, at 7 p.m. After the annual dinner Professor N. L. Britton will deliver his address as retiring president of the academy, on "The New York Botanical Garden, its organization and construction."

A Journal Club in General Science has been organized at the New York City College with membership consisting of the instructors in the science courses. Professor Alfred G. Compton has been elected president and Dr. George G. Scott secretary.

Professor C. A. Ewald has announced his intention of retiring from the editorship of the *Berliner klinische Wochenschrift* on January 1.

The recent opening of a new laboratory of botany at Wellesley College was made the occasion of a reception to Professor Emeritus Susan M. Hallowell, at the head of the department of botany from the opening of the college in 1875 to 1902.

Lieutenant Frank H. Lahm, of the United States Army, is in Germany on leave of absence from the War Department to study German aeronautics.

Dr. Paul Haupt, of Johns Hopkins University, honorary associate in historic archeology in the U. S. National Museum, has been designated by Secretary Walcott as the representative of the National Museum and the Smithsonian Institution at the fifteenth international congress of orientalists to be held in Copenhagen during the second half of the month of August, 1908.

A statue of the late Professor Tillaux is to be erected in the school of practical anatomy of the University of Paris at Clamart. The statue is by M. Chaplain.

Bernard J. Harrington, Ph.D., professor of chemistry in McGill University, died on November 29 in Montreal. We learn from a notice in the *Yale Alumni Weekly* that he was born on August 5, 1848, at St. Andrews, P. Q., and was graduated from McGill University in 1869, taking first honors in natural science and winning the Logan gold medal. Pursuing a graduate course at Sheffield Scientific School, Yale University, he received the degree of doctor of philosophy in 1871 and the prize in mineralogy. He was appointed in the same year lecturer in chemistry at McGill, and in 1872 succeeded Dr. T Sterry Hunt as chemist and mineralogist to the Geological Survey of Canada. He filled both posts for seven years, retiring from the Geological Survey in 1879 in order to devote his entire time to teaching, giving lectures in mining and metallurgy in addition to his regular courses. In 1883 Dr. Harrington was appointed Greenshields professor of chemistry, but continued to hold the lectureship of mining and metallurgy until 1891. He was for many years editor of *The Canadian Naturalist,* and was the author of numerous monographs on the mineralogy of Canada. He published in 1883 "The Life of Sir William Logan, First Director of the Geological Survey in Canada."

We regret to record the deaths of Dr. Georg Sidler, honorary professor of astronomy at Bern, of Dr. Maurits Snellen, director of the Meteorological Institute at Utrecht, and of Dr. Pietro Pavesi, professor of zoology at Pavia.

The Central Branch of the American Society of Zoologists will unite with Section F of the American Association for the Advancement of Science in a joint program at the meeting to be held at the University of Chicago during convocation week. The Central Branch of the American Society of Naturalists, Professor R. A. Harper, University of Wisconsin, president, will hold no separate meeting, but will unite with the society in a program already announced.

THE next meeting of the Department of Superintendence of the National Educational Association will be held in Washington, D. C., on February 25, 26 and 27, 1908.

THE next meeting of the Pathological Society of Great Britain and Ireland will be held at the Pathological Laboratories of the Royal Army Medical College, London, on January 3, at 2 P.M., and will be resumed on the following day at 10 A.M. The members will dine together on the evening of January 3.

THE chief justice, presiding at a meeting of the National Preservation Society, at Cape Town, on November 23, urged the need of stronger measures to preserve rare flora and fauna from extinction. The gnu, or wildebeest, the gemsbok, the mountain zebra, the eland, and the giraffe were all nearly extinct. He said he remembered when a barrister on circuit seeing great herds where now there were railway stations. He also hoped that if the Table Mountain Railway were sanctioned proper safeguards would be taken against desecration.

WE learn from the London *Times* that the meeting of the Second International Conference on the Sleeping Sickness, which was to have assembled at the British foreign office on November 1, has been deferred in deference to the wishes of the German government, which has pointed out the advantage which would be gained if their delegates were in a position to submit to the conference the fruits of the recent labors of Professor Koch. Professor Koch has lately been engaged in an exhaustive inquiry into this question on the spot and has now returned to Berlin, where he is at present engaged in the preparation of his report. As this work must necessarily occupy a considerable time, the conference is unlikely to assemble before the middle of February. Meanwhile, however, meetings of the British delegates to the forthcoming conference are being held from time to time at the foreign office to consider various points connected with the work of the conference.

FROM the same source we learn that there has been formed in Liverpool, with Sir Alfred Jones as chairman, an independent sleeping sickness committee. It has for its object the collection of information dealing with sleeping sickness, the stimulation of research into the cause, method of transference and cure of the disease, and the publication from time to time of communications with reference to it. The committee comprises, in addition to Sir Alfred Jones, the Lord Mayor of Liverpool; Professor Moore, director of the biochemical department of Liverpool University; Professor Salvin-Moore, director of the cytological department; Professor Annett, director of the comparative pathology department; Professor Sherrington, director of the physiological department; Dr. Stephens, Walter Myers lecturer in tropical medicine; and Dr. Anton Breine, director of the Runcom Research Laboratories. The corresponding secretaries include Professor Sir Robert Boyce, F.R.S., dean of the Liverpool School of Tropical Medicine.

UNIVERSITY AND EDUCATIONAL NEWS

BY the death at Boston of Silliman Bladgen (Yale '69), Yale University will obtain $50,000. Mr. Bladgen was a nephew of Benjamin D. Silliman (Yale '24), of Brooklyn, who died in 1901. By his will he gave his nephew a life interest in $50,000, which now reverts to the college without restrictions.

UNDER the will of Mrs. James Nichol of North Amherst, Oberlin College receives approximately $25,000, which will be used for general endowment. For several years the college has had a small fund toward the erection of a men's building to serve as the center of their interests, both religious and secular. Twenty-five thousand dollars more has recently been pledged for this purpose.

THE new building containing the laboratories for zoology, botany, physics and chemistry in Kentucky University, toward the erection of which Mr. Andrew Carnegie contributed $25,000 some time ago, is nearing completion, and will be ready for occupancy in a short time.

The National Educational Association has appointed a committee to investigate the entrance requirements to the technical schools of the country, and to consider the question of establishing uniform entrance requirements. The members are: President Atkinson, Brooklyn Polytechnic Institute; Dean Cooley, University of Michigan; Professor Tyler, secretary of the Massachusetts Institute of Technology; Dean Marston, University of Iowa; Professor Kimbel, Cornell; Professor Baker, University of Illinois, and Dean Goetze, School of Applied Science, Columbia University.

The faculty of the Cornell University Medical College announces that in and after 1908 candidates for admission to the college must be (1) graduates of approved colleges or scientific schools; or (2) seniors in good standing in Cornell University or in any other approved college or scientific school whose faculty will permit them to substitute the first year of a professional course for the fourth year in arts and science, and which will confer upon them the bachelor's degree upon the satisfactory completion of the first year of the course in the Cornell University Medical College; or (3) persons who, while not possessing a bachelor's degree, give evidence by examination that they have acquired an equivalent education and a training sufficient to enable them to profit by the instruction offered in the Medical College. In and after 1909 all candidates for admission to the Medical College must have at least such knowledge of physics and inorganic chemistry as may be obtained in college by a year's course in these subjects when accompanied by laboratory work. In and after 1910 all candidates for admission must possess a similar knowledge of biology.

The total number of doctorates of philosophy conferred by the University of Chicago has now reached four hundred and seventy.

By a decree of the Oxford convocation any student who has obtained the degree of Ph.D. at a university of the German empire, the Austro-Hungarian empire, or Switzerland, may be admitted to the status and privileges of a junior foreign student; and if he has obtained it with distinction (*cum laude*) to those of a senior foreign student.

It is said that the number of American students at the University of Berlin has fallen to the smallest figure on record. Only sixty-eight men and twenty-seven women from America are enrolled, as compared with a total of more than two hundred three years ago and more than four hundred ten years ago. A similar state of affairs is said to exist at Heidelberg, Göttingen, Jena, Leipsic, Halle and other prominent universities.

Rev. George Alexander, D.D., Union, '66, pastor of the University Place Presbyterian Church of New York City, will be the next president of the Union College, succeeding Rev. Dr. Andrew V. Raymond, who resigned last Juue to accept a Buffalo pastorate. Dr. Alexander was offered the presidency of the college at that time, but consented only to become acting president.

Professor John C. Shedd, who has held the chair of physics in Colorado College, has resigned to accept the office of dean in Westminster University, Denver, Col.

B. M. Walker, Ph.D. (Chicago), who has for some years been connected with the Mississippi Agricultural and Mechanical College, is now director of the school of engineering and professor of mathematics in that institution.

John C. Hessler, Ph.D. (Chicago), has been appointed professor of chemistry in James Millikan University, Decatur, Ill.

William J. Moore, assistant professor of electrical engineering at the Stevens Institute of Technology, has resigned to accept a professorship in the North Carolina State College of Agriculture and Mechanical Arts.

Professor Walden, of Riga, has declined a call to succeed Mendelejef at St. Petersburg.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, DECEMBER 20, 1907

CONTENTS

STATE RESPONSIBILITY IN UNIVERSITY EDUCATION *

IT is not without trepidation that a son of alma mater appears before you to-day to speak upon a subject whose complicated relations will be apparent to the most casual observer. Even the evidence of maternal interest expressed by the invitation to return to the bosom of the family for a brief visit fails to give assurance in the face of a memory calculated to inspire awe rather than loving remembrance because in the eighties the "propitious mother" restricted her family responsibilities to a periodical and very formal enquiry into the limitations of the student's knowledge. Each of us was left to acquire his sustenance at the breast of a foster mother—the college—for whom love was developed by individual memories not to be expected from the impersonal relations borne to an unnatural, but none the less real and disciplinary, parent. Our university bore us her children, but did not mother or rear us.

Familiarity with the early history of the province and university, a practical knowledge of the workings of the English and German universities and a somewhat lengthy experience in different capacities in an American state university, whilst affording a basis for comparison of view points, methods and educational results, may not, it is true, qualify one to draw deductions as to the responsibilities of the state in university education. The citizens of all

* The second annual opening address delivered by invitation of the faculty of science of the University of Manitoba, at Winnipeg, October 25, 1907.

free countries are, however, encouraged to believe that each has a right to an opinion and to give voice to his opinion.

Manitoba is unique, not in her provincial or state university, but in the fact that she has limited the power of conferring degrees to that university, and it is eminently fitting when a state decides to establish an educational mechanism that she should control the situation. This assumes what should be the case, that the state is stronger and better able to do what she undertakes than private individuals or corporations and the chief advantage lies in the avoidance of duplication of effort and expense and in the possibility of maintaining a universal high standard throughout the confines of the state.

The education of succeeding generations of students is a matter of great and vital public interest and therefore one with which the state may deal directly if it sees fit. That Manitoba was far-sighted when nearly thirty years ago she decided to place the responsibility and control of education in the hands of the state, is a matter of gratification to us all. That she is still striving for the highest ideals and greatest practical efficiency is indicated by the recent appointment of a royal commission to investigate and make recommendations on university affairs. She naturally wishes to see the limits of her educational responsibilities in order to approach the problem in a business-like way but if her university is to be what the name university implies, namely, a center for the *dissemination* of all phases of human knowledge, it must be first of all a center for the *accumulation* of all phases of human knowledge. It is therefore apparent that limitations can not be set nor the future of education be forecast, since it goes hand in hand with or rather should precede and inspire social and economic progress. Indications should be available, however, in ample time to anticipate development along important lines.

Manitoba should and doubtless will avoid the pitfall of young universities which are suddenly confronted with the necessity of having available the most accurate and exhaustive information on every conceivable matter of human interest. Many universities content themselves by meeting their responsibilities on paper and publish multitudinous, awe-inspiring, polysyllabic courses of instruction all out of proportion to the number and qualifications of their staffs. Such dangers may be met by provision for the groundwork of the humanities and the basic sciences with later departmental specialization first along lines which present the most pressing practical and local necessities, or where conditions furnish local opportunities especially valuable to any one branch of knowledge.

A university presupposes, however, that there shall be a continual intake of knowledge on the part of those who are to give it out. This can best be done by a combination of two methods, both of which should be utilized to the fullest extent. The first is stimulation to research and the second is opportunity to know practically and at first hand what has been done and is in the process of completion by other workers along similar or even widely divergent lines.

Research is only possible where ample facilities and time are available in a sympathetic environment. In these days of gauging results in financial terms, the value of research is apt to be overlooked unless it has an immediately practical application. Imagination is often sadly lacking in the so-called *practical* man who is so likely to be limited in his field of vision if not short-sighted. Ideal results are to be obtained by the cooperation of the man who thinks with the man who works.

Many people use the word research so

frequently and with such a superior air that it has become hackneyed and the use of the word is apt to provoke a smile. The value, however, of studies or researches in the solution of purely local and commercially assessible problems pertaining to engineering, agriculture, mining, fisheries and matters of public health and animal industry appeals to all. It is when we approach abstruse questions dealing with physics, chemistry, astronomy and the biological and other sciences, that we have difficulty in interesting the general public and demonstrating to localities the need of provision for research. We need not remind ourselves to-day of the contributions of astronomy to practical navigation; of chemistry to commerce, where in many lines, particularly in Germany and even in America, trained chemists, graduates of universities and technical schools are employed; of the recent developments in relation to X-rays; of practical knowledge concerning the causation of disease, resulting from the study of bacteria and the animal parasites; of increased fertility of soil; of cross-breeding in plants and animals; and of other commercial benefits directly traceable to university researches in these sciences, because even if there seems to be no immediate or remote possibility of practical application to human affairs, the mere stimulus of an atmosphere of investigation in a teaching institution is inestimable. No teacher can inspire students like an investigator and recognized authority whose life is spent in building stones into the foundation wall of the subject which he professes, and students who have daily opportunities to see new facts brought to light, new methods employed and new conclusions reached are able to secure a vital and definite grasp of important knowledge and find their mental faculties quickened in a way quite impossible to the human sponge who soaks himself full of information, the original source of which is quite unknown and indifferent to him, but which he learns from a book or lecture. We remember and utilize in after life what we get from actual personal experience or see demonstrated in a practical way, not that which we are dogmatically told by parents, teachers or writers. As has already been said, the professors and staff of a university can not be continually giving out information unless they are continually taking it in. The teaching will be efficient and the reputation of the institution great in proportion to the opportunities which are afforded the instructing staff to advance its own knowledge, of which the most important is individual research.

The second stimulus necessary to the continued growth of the university staff is opportunity to know what is already known. This is not alone to be found in books. Much can be ascertained from books and the current journals, and the absolute necessity of ample provision for a library should need no exploitation, although many universities which do not seem to spare expense in building and equipment are apt to be niggardly in supplying these tools which are essential alike to staff and student. Both teacher and pupil should always refer to the original. It is not enough to know a thing when one may know who said or did it and the conditions under which it was given to the world. A personal acquaintance with the workers of the past can only be secured through their writings and the views which others have had of them. Of present-day workers a knowledge may be had by reading their books, monographs and journal articles but a far more real idea of their methods and view points and of the actual results obtained by them may be secured by personal contact at association meetings, by visiting them in their own environments and working with them in their laboratories. Universities should provide opportunities for members of their own staffs to visit other universities and for other teachers and workers to avail themselves of their own local advantages. This is not luxury; it is essential to progress and is demanded, recognized and met by commercial, social and political interests in their own lines of work.

A university professor should not be a compendium of useless information, but the recognized authority in his locality upon the subject professed. He should have ample expert and other assistance.

If the department is railway engineering, the staff should know more about it than any railway interests in the land, so as to be able to advise the state, or, when called upon, the railways. The chemical department should know more than any chemist engaged in commercial pursuits and should be encouraged to develop methods and processes which will be of economic utility to the state. The geologist and botanist should be of great assistance in the practical working out of state interests, particularly in the newer communities. The economists should not be theorists alone, but should be used to the utmost in solving economic questions relating to taxation, banking and business in general. The medical department in each of its specialties should be represented by men preeminently fitted and trained and practical in their temperaments. Law departments should be manned by staffs which have the respect of the bench, bar and general public.

It is apparent that the professor of today must be keen, alert and thoroughly trained and can only be brought and kept up to date by the most strenuous exertion on his own part and liberal opportunity on the part of the university with which he is connected. He must know his own locality thoroughly in order to know how other methods employed in other countries may be applied with advantage to the local problems. He must know facts in books and out of them. He must be able to draw correct conclusions. He must teach and he must have books, and other tools, facilities and assistance. If he is to be an authority on what he professes he must specialize, and to-day we do not have and cannot expect to have a professor of more than one branch of knowledge, although it is not long since a *so-called* college of the far west advertised in its calendar a "professor of Greek and dancing."

Conditions which govern humanity may be improved in thousands of different ways, and it should be the aim of the state, through its university, to improve the condition of its citizens in every way. The university should lead, not follow. The state should afford a moderate degree of education to every one of its citizens through funds derived from the pockets of all. Whether university training should be given gratuitously to all citizens of the state who have made themselves eligible by a previous course of study is very questionable since in the absence of proper initiative, good judgment and ability to work hard, individuals may be educated out of their sphere, that is, given a knowledge of more facts and methods than they find themselves mentally able to digest and assimilate or to utilize in the ordinary every-day practical affairs of life.

All educational, which *must* mean research, institutions will probably be run at a loss so far as returns in immediate applicability to the problems of life are concerned. It is therefore necessary for the state or some other force to endow such institutions adequately so as to meet the deficit which results from insufficient payment by those who are taking advantage of opportunities afforded, but whose later labors may return to the state many times over the initial cost. It is very questionable indeed whether the citizens of a state should be pauperized by being educated without cost, unless we go to the extreme of communism and leave the state to select early in life the line of activity in which it is to utilize the individual and prepare him for his life work without cost, demanding in return the exercise of the abilities which have been fostered in him by the state. This is a development in socialism to which we shall probably not attain for many generations. In the meantime a middle course may be selected whereby the individual will be required to make personal sacrifice and expend his own resources in fitting himself for the walk of life selected by him, but for which adequate training will be provided at a financial loss by the university and, according to the basis of our consideration to-day, the state university. In this way, care will be exercised by the individual in the choice of his vocation, appreciation of student opportunities will result, the risk of pauperizing citizens and educating them out of their sphere will be avoided and the educational deficit will be met. This certainly is a good business venture for a state.

Every community is accustomed to grant bonuses to infant industries for the encouragement of commercial interests and to enable them to equip themselves thoroughly and introduce new lines of activity. Most countries levy customs dues on certain manufactured products and even on raw materials so as to develop home production. It is therefore no new point of view to expect a state to provide adequate bonus for a manufacturing plant intended to train succeeding generations of its citizens in a way which will render them capable of taking their places in the world at large and at the same time to develop local resources so as to make their community as commercially independent as possible. This is being done in certain instances. In Minnesota, the experiments by the university upon wheat-raising, whereby it is now possible to make two or even more stalks of wheat grow where only one grew before, need no comment, and its work on animal husbandry is international in importance. The state of Wisconsin, first by university research and secondly by teaching the principles thus worked out, to its large farming class, has succeeded in producing even a greater revenue through its dairy products than is derived from wheat in its neighboring state, Minnesota. Germany affords perhaps the best example of support of educational institutions by the state, although there is a great difference in the method of working out the problem, as compared with American institutions. The work of von Hoffman on coal-tar products at first seemed to be of mere academic or educational interest, but there are now so many practical applications in dyeing, flavoring extracts, drugs and other synthetic compounds, that we scarcely realize what we owe to a university professor. The work of von Behring and of Koch, backed by governmental university support, has given us antitoxin, on the one hand, and thorough knowledge of tuberculosis, cholera, typhoid fever, anthrax and many other diseases, on the other. Is it not fair to assume that the scientific and technical education fostered by the state in the schools of Germany is responsible largely for her ability to manufacture raw materials into finished products so cheaply as to compete with all nations, even on their home grounds, and in the mere matter of mines to take material which has been thrown away as worthless in the more "rough-and-ready" American methods and from it make a second vast fortune? In comparing Europe with America we have to class ourselves as extremely wasteful, which was not of so much import, except as it affected habit, whilst the country was sparsely populated and the soil still virgin, but it becomes of growing importance with the advent and birth of new citizens and the exhaustion of the soil by repeated crop demands. We all return to mother earth for sustenance and from her bosom we derive life itself.

Each community does wisely if at the very outset it takes stock of its local assets, studies environmental and other conditions which affect operation, and takes immediate steps to utilize its local advantages to the utmost whilst exercising due care for future generations. It is strictly within the function of a university to aid in a practical way. Had the state been developed to its proper point, Edison should have been working in a university and not for his own and others' personal gain; Luther Burbank would have been stimulating colleagues and students by his observations; some national or state university would have sent Walter Reed and Carroll to Cuba instead of leaving it to the United States Army to solve the cause of and methods of protection in yellow fever; Marconi should have been developed in his practical applications as he had been in his theoretical knowledge by a university. In this way the state, that is all the citizens, and not individuals or corporations, would derive more directly the benefits which accrue from advancement in knowledge.

Manitoba can not content herself with teaching the languages, philosophy, mathematics and the sciences as known. She *must* be engaged in finding out new facts, not only those directly applicable to Manitoba, but those which are of world-wide importance. She must make provision in money, time and opportunity for the members of her university staff to engage in research. Fortunately, she has already secured in her university men who find some time for research and publication of results, but at a personal sacrifice of which the general public knows little or nothing.

This province has a fleeting present, practically no past, but a glorious future. If that future is to be well planned, provision must be made for a thorough study of local resources and the training of citizens properly to conserve and develop those resources. This can not alone be done by study of books or of methods used and results obtained elsewhere, but by practical and prolonged study at home of the local situation; in other words, research must be liberally provided for. This Manitoba will doubtless undertake, one line at a time, thoroughly equipping and fostering each, thus gradually covering the whole field of human activity. Her university should be used in its various departments as the source of expert advice and ultimate court of appeal in all matters pertaining to present knowledge and future progress, not as involving alone a question of Greek roots, history or philosophy, but in such concrete considerations as transportation, mines, public health, agriculture, industrial chemistry, formulation of methods of banking, drafting of new laws and other such practical lines of development, all of which are primarily of public interest, although frequently wrongfully used for purely individual ends.

The scope of the inquiries which the royal commission is expected to make is broad and perhaps it will not be thought impertinent or without the bounds of good taste if an alumnus of this institution, who has followed its development from the beginning until now, should say a few words concerning certain of the provisions given in the appointment of the commission.

THE SYSTEM OF UNIVERSITY GOVERNMENT

The instructions given to the commissioners would warrant the assumption that the present method of university government is cumbersome and not wholly efficient. The executive machinery is of small import if an adequate university staff of the right timber is available, the students are imbued with the proper spirit and the citizens and provincial authorities are in sympathy with the development of a *true* university. A method of governing university affairs is necessary only in order to stimulate and preserve a proper adjustment of all phases of university activity, to secure the institution against personal selfishness or undue aggressiveness of individuals and to obtain proper representation of all interests. It is surprising to find that Cambridge and Oxford conduct their affairs on republican principles whilst the American institutions are more or less comparable to monarchical governments. Cambridge University affairs are conducted practically entirely by the alumni of the institution. The American state university, with a president at the head, has a board of regents, appointed for a term of years by the governor of the state, or elected by direct vote of the people. The alumni have no voice in the government of the institution except as they may be appointed on the board of regents, or representations are made by the alumni associations to the board of regents and state legislature.

The alumni of the individual colleges which constitute the University of Manitoba are all thoroughly loyal to their colleges and filled with love and reverence for the instructors, past and present. Most of them recognize, however, the incompatibility of denominational college interests with those of general university development. If denominational colleges are to be an integral part of the state university, the activities of these individual colleges should be largely limited to theological teaching and, if so desired, to preparation for the university proper; instruction in lines of general culture including the natural sciences, philosophy, politics and other university subjects, should be provided by the university alone.

The University of Manitoba no longer confines its activities to the examination of students and the conferring of degrees, but has begun the more important part of its work, namely, the actual teaching of its students, and it is surely a more responsible undertaking to convert the raw material into finished product rather than merely to examine and put the label upon the finished product. The teaching work undertaken by the university can and will reach a far higher stage of efficiency by the elimination of duplication in instruction and by the development of broad, general, non-religious—please mark the term, not irreligious—teaching which excludes all tendency to give too early theological interpretation to new facts or view points as presented to students not yet trained to a point where they are able to draw their own conclusions from the premises presented.

It will be noted that the commissioners are instructed to report upon the relationships of the different educational institutions in the province to the provincial university. This may be difficult of adjustment. Consideration of the good of the whole university rather than that of individuals or of local or foreign precedent, together with a realization of the fact that all of the money which goes to support education is derived originally from the people and is, or should be, intended for the benefit of all, will do much to secure what is best for the province as a whole.

A university, college, or school should not be expected to provide exclusively or even largely for the teaching of manners, morals and religion. Something must be left to home influences, and with proper environment in the home and proper activity on the part of the churches, a non-religious instruction by the state will be found *not* to interfere with the satisfactory development of religion, but to yield an intelligent citizenship which is not possible in any other way for the same expenditure of effort and capital.

As to the form of university government, no hard and fast lines can be drawn, since each community has its own local problems to solve. In general terms, however, the alumni should have a very large voice in affairs, if they maintain an active university interest and connection. They know, as no others can, what is being done in the university. They know the strong points as well as the weak in their own training. If they have developed themselves as they should after graduation, they are in a position to compare results achieved at home with those secured abroad and, when working shoulder to shoulder with the staff of the university, are capable of giving advice, assistance and support that it is not possible to obtain from any other group of citizens. The faculties certainly should have representation in the general and special conduct of affairs, in the selection of new teachers and in the formulation and realization of a general university policy. The government of the state or province should also be represented, since it has charge of the state or provincial treasury, and has to meet the detailed needs of the province, including interests other than educational. University interests should be so safeguarded, however, that no individual or political party can in any way, or for any purpose, interfere with the proper performance of its function and its natural growth. Those who are interested in the government of universities will find a number of articles in recent issues of Science by leading educationalists of the United States and a great deal can there be gained which may be of value to Manitoba, because her problems are very similar indeed to those which confront the various states of the union.

Professor J. McKeen Cattell, of Columbia University, has written a number of articles recently which are instructive and far-sighted, although, at first glance, they appear much more radical than they really are. I may quote from his article on "University Control":[1]

In the colleges from which our universities have developed the problem of administration was comparatively simple. The faculty and the president met weekly and consulted daily; each was familiar with the work of the entire institution; a spirit of cooperation and loyalty naturally prevailed. The trustees also understood the economy of the college and were able to work intelligently for the general good. But when a university covers the whole field of human knowledge, when it is concerned with professional work in divergent directions, when it adds research and creative scholarship to instruction, when both men and women are admitted, when there are 500 instructors and 5,000 students, it is no longer possible for each trustee and for each professor to share intelligently in the conduct of the whole institution. We appear at present to be between the Scylla of presidential autocracy and the Charybdis of faculty and trustee incompetence. The more incompetent the faculties become, the greater is the need for executive autocracy, and the greater the autocracy of the president, the more incompetent do the faculties become. Under these conditions it appears that the university must be completely reorganized on a representative basis. It should not be a despotism and it can not be a simple democracy. Autonomy should be given to the schools, departments or divisions. The administrative, legislative and judicial work must be done by experts, but they should represent those whom they serve.

. . . .

The present writer ventures to propose tentatively the following form of organization for our larger universities, to be reached as the result of a gradual evolution:

1. There should be a corporation consisting of the professors and other officers of the university, the alumni who maintain their interest in the institution and members of the community who ally

[1] Science, N. S., Vol. XXIII., No. 586, pp. 475–477, March 23, 1906.

themselves with it. In the case of the state universities part of the corporation would be elected by the people. This corporation should elect trustees having the ordinary functions of trustees—the care of the property and the representation of the common sense of the corporation and of the community in university policy. The trustees should elect a chancellor and a treasurer who would represent the university in its relations with the community.

2. The professors or officers, or their representatives, should elect a president who has expert knowledge of education and of university administration. . . .

3. The unit of organization within the university should be the school, division or department, a group of men having common objects and interests, who can meet frequently and see each other daily. It should be large enough to meet for deliberation and to represent diverse points of view, but small enough for each to understand the whole and to feel responsible for it. The size of this group is prescribed by a psychological constant, its efficient maximum being about twenty men and its minimum about ten.

4. Each school, division or department should elect its dean or chairman and its executive committee, and have as complete autonomy as is consistent with the welfare of the university as a whole. It should elect its minor officers and nominate its professors. The nominations for professorships should be subject to the approval of a board of advisers constituted for each department, consisting, say, of two members of the department, two experts in the subject outside the university and two professors from related departments. The final election should be by a university senate, subject to the veto of the trustees. The same salaries should be paid for the same office and the same amount of work. The election should be for life, except in the case of impeachment after trial. The division should have financial as well as educational autonomy. Its income should be held as a trust fund and it should be encouraged to increase this fund.

5. The departments or divisions should elect representatives for such committees as are needed when they have common interests, and to a senate which should legislate for the university as a whole and be a body coordinate with the trustees. It should have an executive committee which would meet with a similar committee of the trustees. There should also on special occasions be plenums of divisions having interests in common and plenums of all the professors or officers of the university. There should be as much flexibility and as complete anarchy throughout the university as is consistent with unity and order.

Professor Cattell states in other articles[2] that in the development of universities during the initial stages the administrative autocracy of the typical college of the United States will serve its purpose as it has in the past and most effectively, provided the proper man be secured, but that he is to be replaced by some such system of control as has been advocated in the article just quoted. If the various constituent colleges of the University of Manitoba are to confine their teaching to preparation for the university and for theology, it will become necessary for the university to teach the humanities, and this can surely be done with greater success by large departments, well manned and equipped, than by the present methods. The medical college should become *in toto* what it is now *in parte*, namely, a true member of the university corporation. These points are of importance in planning for the future in regard to expenditures for buildings, equipment and site. The stimulation afforded by association of those engaged in research, study and teaching of all of the natural and physical sciences, and professions as well as of the humanities is best calculated to bring culture to the one and practicality to the other, whilst the focusing of all branches of university activity under a carefully selected and competent administration will preserve satisfactory relationships and tend to economize in time, effort and money.

UNIVERSITY FINANCES

The royal commission will probably find difficulty in inducing the citizens and pro-

[2] "The American University," *Popular Science Monthly*, June, 1902; "The University and Business Methods," *The Independent*, December 28, 1905.

vincial authorities to realize the magnitude of undertaking to provide a satisfactory university. Although Manitoba has had a university since 1877, it can not be said as yet to have made provision for it which is at all adequate.

Manitoba has now a population of about 380,000, and with all the demand on her for increased university facilities, which means expenditure for installation and maintenance, has only been able to expend approximately $80,000 for building and permanent improvement, and for maintenance $15,000 per annum (which until last year was only $6,000), with an addition of $25,000 from land grant and other sources, making a total current expenditure of $40,000 per annum.

A comparison with some of the state universities of the middle west which are comparable with Manitoba in the matter of resources, history of development and certain other conditions may be of interest. In order that those who wish to go more minutely into the various questions involved may have the opportunity of so doing, certain tables are appended. Certain of them were prepared and published in the *University of Minnesota Alumni Weekly* as the basis of an appeal to the state at large and the legislators in particular during the last session.

Minnesota had to begin in a small way and work out her educational problems from the ground, as is the case in Manitoba. Her university was founded nine years earlier than that of Manitoba, but development was going so slowly and the increased demands were so out of proportion to available facilities that the alumni and other interested individuals in the state became aroused and a campaign of general education began.

The development from 1887 to 1906 is shown. In 1887 there were only 412 students registered out of a state population of 1,180,000 and there was available $35,000 from state funds and a total of practically $70,000 from all sources, with a total student attendance per ten thousand population of 3.49. The cost to the state for educating a single student at that time was $84.94 and the total cost of the student's education was $169.24, with a total per capita cost to the people of the state of less than three cents. In 1906 the population of the state had nearly doubled, being then over two millions, the university attendance had increased to 3,956, the total funds derived from the state to $251,464.49 per annum, the total annual current expense of the university, exclusive of buildings and permanent improvements, was $542,167.49 per annum and the attendance at the university for each ten thousand of state population was twenty students. The cost to the state of educating each student had been diminished from $84.94 to $62.86 and the total cost of the education of the student decreased from $169.24 to less than $140.

The development of the State University of Illinois from 1859 to 1905 was rapid. The state appropriations for the university were increased from $60,000 per biennium (running in 1875 as low as $11,500 per biennium) to $1,153,000 in 1903 and $1,114,525 in 1905. It must be remembered, however, that the University of Chicago, Northwestern University and very many private, denominational and other colleges in Illinois were being developed synchronously and that the state appropriation for the university has been doubled since 1905.

Comparative statistics of the various state universities of the middle western states, with some of the endowed institutions, show approximately as many students at the state universities as in the endowed universities, whereas the funds up to 1905–6 were far less adequate.

For the year 1906 Minnesota had $542,-

167 for current expense, whereas the State University of Michigan, the State College of Agriculture and the State School of Mines, three institutions which correspond to Minnesota's State University, had $1,-314,928 available in 1905. Wisconsin and Illinois in 1905 and Iowa and Missouri in 1906 had available the following amounts: Iowa, $376,000 to be expended in educating 1,815 students; Missouri, $571,776 to educate 2,139 students; Wisconsin, $714,138 to educate 3,151 students, and Illinois, $737,527 to educate 4,100 students.

The cost of educating a student in the various state institutions varied from $139 to $267.

Columbia, Chicago and Pennsylvania spent during 1905 or 1906, as the case might be, between $1,150,000 and $1,766,-000 per annum, whilst Harvard for 1905 spent over $3,000,000 for all purposes.

During the legislative sessions of 1905–6 the various state universities became very active and their alumni and other interested individuals brought pressure to bear upon legislatures with very gratifying results. Not all of the exact figures can be obtained but by correspondence, and from other sources some approximate ideas of moneys available have been gained.

Illinois.—It will be seen that a total state appropriation of $2,207,790 was made to cover the biennial period beginning July 1, 1907. This does not include funds derived from the federal grant of $25,000 per annum, receipts from students' fees and sources other than state grants.

Iowa, which is a strictly agricultural community, and whose population is approximately 2,210,000, had available for the year 1906 a total of $550,000 derived from building tax, permanent fund, interest on endowment, fees and state appropriation. Its enrollment for the year was 2,100 students. Its permanent endowment fund, realized from the sale of land grants, amounts only to $2,240,500. The figures for 1907–8 were not yet available.

Wisconsin.—Certain particulars concerning state university expenditures in 1905 have already been quoted and later approximate statistics have been furnished by prominent members of the faculty. She has a two sevenths of a mill tax, which is expected for the years 1907–8 to bring in over $600,000 per annum, which, with other funds, will make available for university expenditures for the next biennial period over one million dollars per annum. This includes a building fund yielding $100,000 per year for the next five years.

Nebraska has a population of approximately one and one half millions, with available state university funds amounting to $590,000 for the coming year. Figures for 1906 you have already considered.

Michigan has no state university which is comparable with that in Minnesota or Wisconsin, since her school of mines and school of agriculture are separate state institutions. The exact figures for the coming biennial period are not available, but for the university proper in 1906 the total expenditure was given as $735,464.52, which included appropriations of one fourth mill tax for general university purposes. The students' fees for 1906 amounted to $233,-207.79. For the coming biennial period funds of over $969,000 per annum will be available, owing to the increase of the state tax for university purposes from one fourth to three eighths of a mill.

Minnesota, whose population is now in excess of two million, has recently received much more generous financial support, for which the alumni association deserves much credit. The university has just completed during the last biennial period (1905–6, 1906–7) $874,000 worth of new buildings and equipment which does not include other permanent improvements. She has available for the coming biennial period an amount of $2,697,000 which may be even greater, since conservatism has been exercised in the estimates of funds derived from students' fees, the state tax of 23/100 of a mill and miscellaneous receipts.

She is about to erect a $250,000 engineering building covered by state funds, a hospital costing $115,000 from a bequest of a Minnesota citizen, and is about to increase the size of her campus by a state fund of $450,000 which may be distributed over the next three years, but which doubtless will be all completely expended within the next two years, and has a further increase of campus extension fund by the donation to a hospital site fund of over $40,000 by citizens of Minneapolis. Her total expenditure for maintenance, exclusive of state grants for hospital maintenance, special investigations, library expenses, repairs, etc., will be over $663,000 per annum. Her pay-roll now amounts to over one half million dollars per annum.

The original land grant for university purposes in Minnesota was very much more generous than was realized until quite recently. The state university timber land was once supposed to have value purely for its timber, and the swamp land, when drained, as an agricultural resource. They have been found, however, to be rich in iron. The state auditor estimates that from fifteen to ninety millions of dollars will be derived from these lands, according to the method used in realizing on the ore. A conservative estimate made by him is forty-five million dollars, the annual income of which, when invested, would be available for university purposes, which in addition to her 23/100 of a mill tax, the federal grants which increase annually and students' fees, quite apart from special state appropriations, should enable her, by properly educating her students, to develop state resources, stimulate private and commercial enterprises and improve social and economic conditions. The enrollment of the State University of Minnesota this year will be upwards of 4,400 students and surely it is time now for a proper realization of responsibilities and opportunities. Development of university ideals, a comprehensive plan looking forward to the future, and in general wholesome optimism which sees the future as a definite present obligation, are necessary in order to find the university men and mechanism and the state citizenship and governmental authority ready to meet the gigantic responsibilities and opportunities involved. Minnesota University must awaken to the immediate necessity of an active preparation in order to preserve and utilize intelligently what is in the immediate future. No excuse need be made for presenting in some detail the experience of Minnesota, since her state problems have been—and bid fair to continue to be—very like those of Manitoba. Furthermore, Minnesota conditions are better understood by Manitobans than nearly any other community which is at all accessible.

UNIVERSITY SITE

Manitoba, like nearly all her sister universities, provincial, state and endowed, has been short-sighted in her original plans for location, but is valiantly endeavoring now to provide for the future. If she is to centralize teaching in sciences, arts and the professions and to establish and maintain an agricultural department, she will require several hundred acres. Every endeavor should be made to bring and keep all portions of the university in as close association as possible and this means, of necessity, the building, equipment and maintenance of lecture rooms, libraries, laboratories, museums, provision for hospital and dispensary service, workshops, horticultural, botanical, agricultural and general biological facilities for outdoor as well as indoor experimentation. All of these interests should be associated and fostered under one university and they should be as close to a metropolis as possible. The voice of the pessimist or of the short-sighted individual should not be heeded for a moment. McGill is really cramped for space. Toronto with all the land she had originally, has not sufficient room at the present time to accommodate her new hospital. Columbia has had to move and will have to move again. Johns Hopkins University has not been able to locate all of the various departments in one group. The older universities of Europe suffer from the same failure of imagination. Minnesota has already had to buy at a very great advance in price, additional land for the agricultural department and is now doubling the size of her campus, upon which are located the other departments, at an expense of one half million dollars, and the end is not yet.

UNIVERSITY BUILDINGS

In planning buildings everything will depend upon the recommendations of the commission as to the nature, scope and methods of teaching which are to be immediately employed. Manitoba will be different from other universities if she is able to anticipate and keep up with the demands for building and equipment. She will doubtless make adequate immediate provision for those departments which are considered most essential, namely, those for which the local need and local opportunity are greatest.

No one can forecast the development of the province, but it will doubtless seem strange to outsiders, and to Manitobans themselves, as they consider it seriously, that a people with the optimism for which Manitoba is celebrated, has not long ere this made definite satisfactory provision for the education of its students along those lines which will be of most value to the development of the province. Optimism to be effective must be consistent and if the good things predicted for Manitoba come true—and we all believe that they will come true—it is time that Manitobans demonstrated an actual practical belief in their predictions by the exercise of an optimistic university policy, casting aside all short-sighted, personal, denominational, political and commercial prejudice. The prairie province will probably profit more by the experience of the states to the south of her than she will by imitating too closely the methods of the older English or European universities, since these were founded at an early period of world development in which conditions were not comparable in any degree to those of to-day. Students of public economy and social development see in the older universities much to admire in the way of tradition and in the way of culture and past accomplishment, but the very traditions and associations which appeal so much to us of the western world are really, when seen at close hand, frequently not to be differentiated from narrow prejudice which prevents them from meeting their own national or local demands and renders utterly impossible a satisfactory reconstruction so as to cope with responsibilities which a state might reasonably place upon her university. The younger universities in England, which are perfecting their professional and technical schools so rapidly, will lack for many years the intangible and often mythical something known as culture, but will furnish brains, utensils and methods which will count for far more in the total of British development. Much must be done by the older English universities if they are to keep pace with the newer universities and technical schools, although they are loath to admit that anything so new and utilitarian can in any sense rival them.

Manitoba is to be envied that within the next few months the British Association, for the Advancement of Science representing the mother country, and the American Public Health Association representing to a more limited degree and along a more limited line the countries of America, will be convening in her capital city. These distinguished visitors will be anxious to see how Manitoba is meeting her responsibilities and it is to be hoped that the royal commission may be ready to make at least a preliminary report by that time.

We alumni of this university wish to do our part in securing for our younger brothers and sisters everything which they have a right to expect from the province where they are to receive their education and where, for the most part, their life work will be done. The province has only to realize fully what it owes to itself in the way of provision for the strongest arm of provincial development, that is, its university, in order to make a beginning towards the payment of that debt. It must be a matter in which each individual citizen interests himself so that intelligent cooperative action may be taken, and in the process, not only will the total citizenship participate, but individuals will not be found wanting who will realize their opportunities and privileges of doing something for their neighbors and for their own sons and daughters by giving liberally of private funds for public good. The university should not, however, be dependent mainly upon private gifts nor should these be accepted under conditions which will initially or even in far distant years cripple in any way the utility or development of the institution which should be now, and doubtless will soon become, Manitoba's stimulus and guide to progress in all directions. When the possibilities, not merely cultural, but utilitarian, of an ideal university are recognized by the different states and provinces, there will be no need of appeal to public or private interests.

STATISTICS OF THE UNIVERSITY OF MINNESOTA, FROM "UNIVERSITY OF MINNESOTA ALUMNI WEEKLY"

Year Ending	Attendance	Expenses		Attendance per 10 M. Pop.	Cost per Student		Per Capita Cost to People of the State
		State	Total		To State	Total	
1887[3]	412	$35,000.00	$69,770.33	3.49	$84.94	$169.24	2.966 cts.
1888	491	40,000.00	52,998.04		81.47	107.93	
1889	781	50,000.00	68.214.22		64.02	87.34	
1890[4]	1002	65,000.00	135,130.86	7.70	64.87	134.86	3.840 cts.
1891	1183	65,000.00	154,809.69		54.94	130.85	
1892	1374	73,932.31	170,815.21		53.80	124 32	
1893	1620	78,665.01	177,819.85		48.43	109 76	
1894	1828	71,441.16	220,352.29		39.08	120.54	
1895	2171	155,300.16	248,473.61		71.53	114.45	
1896	2467	129,307.32	219,064.80	15.32	52.41	88.80	8.031 cts.
1897	2647	82,332.59	283,716.26		31.10	107.18	
1898	2890	98,904.78	296,483.61		34.22	102.58	
1899	2925	144,835.48	323,491.00		49.51	110.59	
1900[5]	3236	152,128.25	387,697.83	18.48	47.01	119.80	8.68 cts.
1901	3413	158,502.55	412,164.99		46.44	120.75	
1902	3656	184,030.69	419,744.97		53.36	114.81	
1903	3788	187,518.00	447,961.19		49.50	118.25	
1904	3845	174,996.19	403,465.76		45.50	104.93	
1905	3944	243,942.71	455,596.33		61.85	115.51	12.19 cts.
1906[6]	3956	251,464.49[7]	542,167.49	20.00	62.86	137.05	

LEGISLATIVE APPROPRIATIONS FOR UNIVERSITY OF ILLINOIS FROM 1869 TO 1905 INCLUSIVE

1869	$ 60,000.00
1871	130,000.00
1873	51,500.00
1875	11,500.00
1877	69,500.00
1879	24,000.00
1881	40,000.00
1883	54,500.00
1885	68,000.00
1887	71,300.00
1889	80,150.00
1891	147,300.00
1893	295,000.00
1895	439,900.00
1897	499,964.81
1899	521,900.00
1901	832,330.01
1903	1,153,000.00
1905	1,114,525.00
Total	$5,665,679.82

[3] Population, estimated, 1,180,000.

[4] Population, 1,301,826.

[5] Population, 1,751,394.

[6] Population, 2,000,000.

[7] Balance left over, $65,430.23.

TABLE OF COMPARATIVE STATISTICS, FROM "UNIVERSITY OF MINNESOTA ALUMNI WEEKLY"

Iustitution	Enrollment	Income			Cost per Student	Annual Library
		State	Other Sources	Total		
Minnesota, 1906	3956	$251,464	$291,703	$542,167	$139	$6,500
Michigan, 1905[8]	5734	675,284	639,644	1,314,928	229	22,500
Wisconsin, 1905	3151	486,439	227,699	714,138	226	38,643
Illinois, 1905	4100	401,000	336,327	737,527	180	35,000
Iowa, 1906[9]	1815	271,500	104,500	376,000	207	
Missouri, 1906	2139	411,000	160,776	571,776	267	10,000
Washington, 1906	1194	149,000	2,500	151,500	125	
Nebraska, 1906	2914	313,000	130,235	443,235	152	10,000
Columbia, 1906	4833			1,150,000		
Chicago, 1905[10]	4580			1,766,332		40,000
Pennsylvania, 1905[10]	2692			1,210,728		
Yale, 1905[10]	2995			888,711		
Harvard, 1905[10]	5393			3,082,103		

ABSTRACT OF APPROPRIATIONS MADE FOR THE UNIVERSITY OF ILLINOIS BY THE STATE LEGISLATURE FOR THE BIENNIUM BEGINNING JULY 1, 1907

(Exclusive of other revenues)

1

	Per Annum	For the Biennium
College of Agriculture	$ 50,000	$100,000
Feeding experiments	25,000	50,000
Experiments in corn growing	15,000	30,000
Examination of soils	25,000	50,000
Orchard investigations	15,000	30,000
Dairy investigations	15,000	30,000
Floriculture investigations	7,500	15,000
		$305,000

2

Ordinary operating expenses	$450,000	$900,000
Materials for shop practise	5,000	10,000
Increasing cabinets and collections	2,000	4,000
Purchase of books, etc., for Library	25,000	50,000
Additions to apparatus and appliances	3,000	6,000
Fire protection	1,500	3,000
Engineering College and Experiment Station	75,000	150,000
Buildings and grounds	14,345	28,690
State Water Survey	6,000	12,000
Draining, etc., on experimental farms	5,000	10,000
Department of social and political science	25,000	50,000
School of Music	3,000	6,000
Agricultural extension	6,000	12,000
Law School	15,000	30,000
Chemical Laboratory	10,000	20,000
School of Pharmacy	5,000	10,000
Graduate School	50,000	100,000
Veterinary College		30,000
School of Household and Domestic Science	10,000	20,000
Additional equipment of the water station		3,000
Increasing telephone exchange		1,500
Enlarging general heating and light plant		35,000
For purchase of farm land		11,600
		$1,502,790

[8] These figures include the University, the College of Agriculture and the School of Mines, three institutions to take the place of Minnesota's single university.

[9] Figures for the University alone. Figures for the College of Agriculture not being available.

[10] Figures from the World's Almanac of 1905, and include annual income for all purposes.

3

Physics Laboratory	$250,000
Natural History Hall	150,000
	$400,000
	$1,502,790
	400,000
	305,000
Grand total	$2,207,790

ESTIMATED TOTAL INCOME OF UNIVERSITY OF MINNESOTA FOR THE BIENNIAL PERIOD 1907–8 AND 1908–9

State appropriation for Engineering Building		$250,000
State appropriation for enlargement of campus		450,000
State appropriation for land, School of Agriculture		76,000
State special appropriations for University School of Agriculture, Experiment Station and substations, including building, repairs, campus improvement, library and equipment		380,000
Hospital site fund contributed by citizens		40,000
Hospital building fund (Elliott estate bequest)		115,000
Hospital maintenance for 1908		25,000
Current expense, including federal grant, of	$ 60,000	
Special support fund from state	165,000	
Interest on invested funds	53,000	

Students' fees, estimated	140,000
State tax of 23/100 of a mill..	215,000
Miscellaneous receipts from University and Experiment Station about	30,000
Total per annum	$663,000
Total for the biennium	$1,326,000
Balances carried forward for expenditure in 1907–8.....................	35,000
Total for biennium	$2,697,000

F. F. Wesbrook
University of Minnesota

SCIENTIFIC BOOKS

THE SCIENTIFIC RESULTS OF THE ZIEGLER POLAR EXPEDITION [1]

The scientific work of the Ziegler Polar expedition to the Franz Josef Archipelago, 1903–5, commanded by Anthony Fiala, was placed in charge of Mr. W. J. Peters, the representative of the National Geographic Society and second in command of the expedition. Entering the employ of the Carnegie Institution of Washington shortly after his return, as commander of the Magnetic Survey yacht *Galilee,* he was unable to attend personally to the reduction and to the publication of the results. The completion of the work was therefore entrusted to Mr. John A. Fleming, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, who has put it in its present form.

The principal observations were upon the earth's magnetism, with notes and sketches of the aurora, meteorology, the tides and the topography of the archipelago, supplemented by astronomical observations for precise geographical positions. It is to be regretted that the party was not prepared to attempt more in the study of the geology and biology of the region. Mr. Fiala notes in his introduction to the volume that some interesting fossils were seen, and numerous veins of coal discovered, the latter find proving of practical as well as of scientific interest.

More than one half of the volume is devoted to the results of the observations on terrestrial magnetism. A small magnetic observatory was erected at Teplitz Bay, in which observations were made from September, 1903, to July, 1904, very near the site of the magnetic station of the Abruzzi expedition of 1900. The observatory was left standing, with the probable expectation that it will be available for future use. In view of the very extended series of results obtained by this expedition, a future series at the same point would have a greatly increased value.

In the discussion of the declination results, some interesting conclusions are drawn as to the character of the daily movement of the needle, during the several seasons of the year. By dividing the entire time over which the observations extend into periods of four weeks each, and plotting the means of the hourly values, each value based on about 240 separate readings, a series of graphs has been constructed, very clearly showing the change in the amplitude of diurnal variation with the time of the year, the times of principal maximum and minimum positions, the epochs of mean declination, and the existence and form of the secondary maximum and minimum. In a further discussion the relation of the mean yearly amplitude of the diurnal variation to the magnetic latitude is again pointed out, and the change in this relation with the epoch in the sunspot cycle is shown.

A large amount of meteorological information was collected on the expedition, which will prove useful in future discussions; its full value, however, was unfortunately affected by deficiencies in the instrumental outfit used. Two very satisfactory series of tidal observations were made at points approximately 150 miles apart. These have been arranged and discussed by Mr. L. P. Shidy, chief of the Tidal Division of the United States Coast and Geodetic Survey, who concludes that the tide wave reaches the archipelago by the two channels on either side of Spitzbergen, the one

[1] "The Ziegler Polar Expedition, 1903–1905, Anthony Fiala, Commander." Scientific results obtained under the direction of William J. Peters, representative of the National Geographic Society in charge of scientific work. Edited by John A. Fleming. Published under the auspices of the National Geographic Society by the estate of William Ziegler, Washington, D. C., 1907, 4to, pp. viii + 630, with 43 inserts and 3 maps.

flowing west of that island arriving about four hours earlier.

An attractive feature of the book is a series of lithographic reproductions of sketches by Mr. Fiala, showing the successive appearances of the aurora on three separate occasions. The series made on the night of January 23, 1904, is particularly striking.

Not the least important part of the work is the series of maps which accompanies it. Mr. Gilbert H. Grosvenor, of the National Geographic Society, has compiled from the available sources a map of the polar regions above latitude 65° north, embodying the results, and showing the routes of the various expeditions. The map survey work of the Ziegler Expedition is delineated on an excellent set of maps by Mr. Russell W. Porter, who, under the direction of Mr. Peters, had charge of that part of the work in the field.

On the whole, the amount and value of the scientific work accomplished, notwithstanding the limitations in equipment, the accidents and exigencies incident to polar exploration and the severe attendant physical conditions under which work in polar regions must be performed, are greatly to the credit of all concerned in the observational work and in the reduction and publication of the results. It must certainly be a source of satisfaction that the second Ziegler expedition under Messrs. Fiala and Peters resulted in a substantial addition to our knowledge of terrestrial physics in the polar regions.

H. W. FISK
CARNEGIE INSTITUTION OF WASHINGTON,
DEPARTMENT TERRESTRIAL MAGNETISM,
November 27, 1907

The Proteins of the Wheat Kernel. By THOS. B. OSBORNE. Published by the Carnegie Institution of Washington, D. C. 1907. Pp. 119.

This monograph gives in a clear and concise form the results of the author's extensive work as well as that of other investigators. The importance of the subject is set forth in the introductory sentence: "Of the protein substances used as food none is more important than those contained in the seeds of wheat." The proteids are discussed mainly from the analytical side, pure types are prepared, their properties studied and ultimate composition determined. The products of hydrolysis of the various proteids are also given. The "Experimental Part" is a unique feature of the work; the methods employed are described in detail, thus permitting future investigators to intelligently review the work and not remain in doubt as to the methods employed in the preparation of the various proteins. The individuality of the various proteins have not been sufficiently recognized by chemists. These compounds have all been considered of equal value from a nutritive point of view, an assumption which should be verified by exhaustive experiments.

> That a molecule of gliadin can have the same nutritive value as one of casein would seem impossible if one molecule of food protein is transformed into one of tissue protein, for in the former lysine is wholly lacking, and glutaminic acid, ammonia and proline are in great excess over the amount required to form any of the tissue proteins of which we know. It would seem probable that either the animal requires a variety of food, so that the relative proportion in which the amino-acids are available for its use shall correspond more nearly to its requirements, or that only a small part of these amino-acids are converted into its tissue proteins and the rest oxidized as such.

This report will prove of special value in suggesting new lines of work and in the interpretation of the results of previous investigations. The extensive analytical work accomplished by Osborne, together with the synthetic investigation by Fischer and others, on proteins, bids fair to give us a more complete knowledge of the composition and structure of these complex bodies which have not heretofore been expressed by chemical formulæ. Professor Osborne and the Carnegie Institution are both to be congratulated upon the publication of this valuable work, "The Proteins of the Wheat Kernel."

HARRY SNYDER

SCIENTIFIC JOURNALS AND ARTICLES

The closing (October) number of volume 8 of the *Transactions of the American Mathematical Society* contains the following papers:

Max Mason: "The expansion of a function in terms of normal functions."

Maurice Fréchet: "Sur les opérations linéaires (troisième note)."

A. G. Greenhill: "The elliptic integral in electromagnetic theory."

Also "Notes and errata, volume 8," and index of volume.

The December number (volume 14, number 3) of the *Bulletin of the American Mathematical Society* contains: Report of the September Meeting of the San Francisco Section, by W. A. Manning; "On Quadratic Forms in a General Field," by L. E. Dickson; "On the Canonical Substitution in the Hamilton-Jacobi Canonical System of Differential Equations," by D. C. Gillespie; "The Maximum Value of a Determinant," by F. R. Sharpe; "Third Report on Recent Progress in the Theory of Groups of Finite Order," by G. A. Miller; "The Dresden Meeting of the Deutsche Mathematiker-Vereinigung," by C. A. Noble; "Bryan's Thermodynamics," by E. B. Wilson; "Shorter Notices" (G. Vivanti's Funzioni Poliedriche e Modulari, by J. I. Hutchison; J. Sommer's Vorlesungen über Zahlentheorie, by G. H. Ling; L. Couturat's Les Principes des Mathématiques, by J. W. Young); "Notes"; "New Publications."

The January number of the *Bulletin* contains: Report of the October Meeting of the Society, by F. N. Cole; "On Triple Algebras and Ternary Cubic Forms," by L. E. Dickson; "Isothermal Systems in Dynamics," by E. Kasner; "On the Equations of Quartic Surfaces in Terms of Quadratic Forms," by C. H. Sisam; "Symbolic Logic" (Review of works by Couturat, MacColl and Shearman), by E. B. Wilson; "Shorter Notices" (H. Durège's Elemente der Theorie der Funktionen (fifth edition), by J. Pierpont; H. Burkhardt's Elliptische Funktionen, by J. Pierpont; Bromwich's Quadratic Forms, by Maxime Bôcher); "Notes"; "New Publications."

SOCIETIES AND ACADEMIES

THE CONVOCATION WEEK MEETINGS OF SCIENTIFIC SOCIETIES

The American Association for the Advancement of Science and the national scientific societies named below will meet at the University of Chicago during convocation week, beginning on December 30, 1906.

American Association for the Advancement of Science.—December 30–January 4. Retiring president, Professor W. H. Welch, The Johns Hopkins University, Baltimore, Md.; president-elect, Professor E. L. Nichols, Cornell University, Ithaca, N. Y.; permanent secretary, Dr. L. O. Howard, Cosmos Club, Washington, D. C.; general secretary, President F. W. McNair, Houghton, Mich.

Local Executive Committee.—Charles L. Hutchinson, chairman local committee; John M. Coulter, chairman executive committee; John R. Angell, Thomas C. Chamberlin, Joseph P. Iddings, Frank R. Lillie, Charles R. Mann, Robert A. Millikan, Charles F. Millspaugh, Alexander Smith, J. Paul Goode, local secretary.

Section A, Mathematics and Astronomy.—Vice-president, Professor E. O. Lovett, Princeton University; secretary, Professor G. A. Miller, University of Illinois, Urbana, Illinois.

Section B, Physics.—Vice-president, Professor Dayton C. Miller, Case School of Applied Science; secretary, Professor A. D. Cole, Vassar College, Poughkeepsie, N. Y.

Section C, Chemistry.—Vice-president, Professor H. P. Talbot, Massachusetts Institute of Technology; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

Section D, Mechanical Science and Engineering.—Vice-president, Professor Olin H. Landreth, Union College; secretary, Professor Wm. T. Magruder, Ohio State University, Columbus, Ohio.

Section E, Geology and Geography.—Vice-president, Professor J. P. Iddings, University of Chicago; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York City.

Section F, Zoology.—Vice-president, Professor E. B. Wilson, Columbia University; secretary, Professor C. Judson Herrick, University of Chicago.

Section G, Botany.—Vice-president, Professor C. E. Bessey, University of Nebraska; secretary, Professor F. E. Lloyd, Desert Botanical Laboratory, Tucson, Arizona.

Section H, Anthropology and Psychology.—Vice-president, Professor Franz Boas, Columbia University; secretary, George H. Pepper, American Museum of Natural History, New York City.

Section I, Social and Economic Science.—Vice-president, Dr. John Franklin Crowell, New York City; secretary, Professor J. P. Norton, Yale University, New Haven, Conn.

Section K, Physiology and Experimental Medicine.—Vice-president, Dr. Ludvig Hektoen, University of Chicago; secretary, Dr. Wm. J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

Section L, Education.—Vice-president, Hon. Elmer E. Brown, U. S. Commissioner of Education; acting secretary, Professor Edward L. Thorndike, Teachers College, Columbia University, New York City.

The American Society of Naturalists.—December 28. President, Professor J. Playfair McMurrich, University of Toronto; secretary, Professor E. L. Thorndike, Teachers College, Columbia University, New York City. Central Branch, president, Professor R. A. Harper, University of Wisconsin; secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The American Mathematical Society. Chicago Section, December 30, 31. Chairman, Professor Edward B. Van Vleck; secretary Herbert E. Slaught, 58th St. and Ellis Ave., Chicago, Ill.

The American Physical Society.—President, Professor E. L. Nichols, Cornell University; secretary, Professor Ernest Merritt, Cornell University, Ithaca, N. Y.

The American Chemical Society.—December 27–January 2. President, Professor Marston T. Bogert, Columbia University; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

The Association of American Geographers.—December 31–January 1. Acting-president, Professor R. S. Tarr, Cornell University, to whom correspondence should be addressed; secretary, Albert P. Brigham, 123 Pall Mall, London, Eng.

The Entomological Society of America.—Secretary, J. Chester Bradley, Cornell University.

The Association of Economic Entomologists.—December 27, 28. President, Professor H. A. Morgan, Knoxville, Tenn.; secretary, A. F. Burgess, Columbus, Ohio.

The American Society of Biological Chemists.—December 30–January 2. President, Professor Russell H. Chittenden, Yale University; secretary, Professor William J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

The Society of American Bacteriologists.—December 31–January 2. Vice-president, F. D. Chester, Delaware Agricultural College, Newark, Del.; secretary, Professor S. C. Prescott, Massachusetts Institute of Technology.

The American Physiological Society.—Beginning December 31. President, Professor W. H. Howell, Johns Hopkins University; secretary, Professor Lafayette B. Mendel, 18 Trumbull St., New Haven, Conn.

The Association of American Anatomists.—January 1–3. President, Professor Franklin P. Mall; secretary, Professor G. Carl Huber, 1330 Hill St., Ann Arbor, Mich.

The American Society of Zoologists.—Central Branch. Secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The Botanical Society of America.—December 31 and January 1, 2 and 3. President, Professor George F. Atkinson, Cornell University; secretary, Dr. D. S. Johnson, Johns Hopkins University.

The Botanists of the Central States.—Business Meeting. President, Professor T. H. Macbride, University of Iowa; secretary, Professor H. C. Cowles, University of Chicago, Chicago, Ill.

The American Psychological Association.—December 27, 28. President, Dr. Henry Rutgers Marshall, New York City; acting secretary, Professor R. S. Woodworth, Columbia University, New York City.

The Western Philosophical Association.—Secretary, Dr. John E. Bowdoin, University of Kansas, Lawrence, Kans.

The American Anthropological Association.—December 30, January 4. President, Professor Franz Boas, Columbia University; secretary, Dr. Geo. Grant MacCurdy, Yale University, New Haven, Conn.

The American Folk-lore Society.—December 30–January 4. President, Professor Roland B. Dixon, Harvard University; secretary, Dr. Alfred M. Tozzer, Harvard University, Cambridge, Mass.

Other national societies will meet as follows:

NEW HAVEN

The American Society of Zoologists.—Eastern Branch. December 26, 28. President, Dr. C. B. Davenport, Cold Spring Harbor, N. Y.; secretary, Professor W. L. Coe, Yale University, New Haven, Conn.

The American Society of Vertebrate Paleontologists.—December 26–28. President, Professor Bashford Dean, Columbia University; secretary, Professor Frederick B. Loomis, Amherst College, Amherst, Mass.

NEW YORK

The American Mathematical Society.—December 27, 28. President, Professor H. S. White, Vassar College; secretary, Professor F. N. Cole, Columbia University.

ALBUQUERQUE, N. M.

The Geological Society of America.—December 30–January 4. President, President Charles R. Van Hise, University of Wisconsin; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York City.

ITHACA

The American Philosophical Association.—December 26, 28. President, Professor H. N. Gardiner, Smith College; secretary, Professor Frank Thilly, Cornell University, Ithaca, N. Y.

NEXT SUMMER, AT SOME PLACE TO BE DETERMINED

The Astronomical and Astrophysical Society of America.—President, Professor Edward C. Pickering, Harvard College Observatory; secretary, Professor Geo. C. Comstock, Washburn Observatory, Madison, Wisconsin.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 638th meeting of the society was held November 9, 1907, President Hayford in the chair. Mr. C. E. Waters, of the Bureau of Standards, presented by invitation a paper entitled "The Standard Cell." The speaker reviewed briefly the earlier efforts to fix adequate standards of electrical measurements, the unit of resistance having first received attention, mention being made of the work of the British Association in this connection. It was noted that present requirements demand higher accuracy in the standards of measurement. The development of the standard cell, down to the present time, was briefly reviewed and the defects of those formerly used were pointed out, especial reference being made of their lack of stability.

The principal feature in the preparation of a standard cell is that of securing materials of requisite purity. The methods employed to secure satisfactory materials and the results obtained by Messrs. Wolff and Waters at the National Bureau of Standards, in preparing the H type of standard cell were spoken of at considerable length.

Several chemical compounds were tested in the experiments. The difficulties of obtaining mercurous and cadmium sulphates were especially pointed out, and the methods devised for obtaining them in a sufficiently pure state were described. Before setting up the cells the materials were carefully cleaned. More accordant results were obtained by amalgamating the platinum terminals. The cells were measured in au electric bath in order to maintain a steady temperature. The thermo-electric effects were eliminated by the methods of observation. The experiments showed that mercurous sulphate can be obtained in several ways that will give good electromotive force properties. Standard cells are now found constant enough to be depended upon for a considerable length of time. The final conclusion was that satisfactory cells can now be set up by different observers of different materials.

The second paper of the evening was presented by Mr. C. W. Burrows on "The Reduction of Iron to a Magnetically Neutral State for Permeability Measurements." In the experiments described several different kinds of iron were used. The test pieces were 50 cm. in length and varied in square cross-section from 0.3 mm. to 1 cm. The ballistic method was used in the demagnetization tests. Numerous diagrams were exhibited showing permeability, induction effect, effect of temperature and of vibration, and also curves of tests of non-homogeneous iron.

As a matter of definition iron is in a magnetically neutral state when it is free from all residual induction and yields as readily to positive as to negative magnetizing forces. A small magnetic needle or a movable test coil will give evidence of any residual induction, but they tell nothing as to any difference in susceptibility to positive and negative forces. A long series of experiments leads to the conclusion that iron is in the neutral state when the change in induction observed on reversal of a given magnetic force is a maximum. Imperfect demagnetization always results in a lower induction. The following points are noted:

1. The higher the rate of reversal or fre-

quency of the demagnetizing current, the less complete is the demagnetization. This effect of frequency is more marked in large bars and in soft iron.

2. A sufficient range for the demagnetizing current carries the iron from just above the "knee" of the induction curve down to the lowest value to be studied. Hard iron and steel require a relatively higher initial current than soft iron.

3. The demagnetizing current is best reduced in such a way that the induction decreases approximately uniformly.

4. One initial demagnetization produces the same results as a separate demagnetization before each step in the induction curve.

5. Even many thousands of reversals of the magnetizing force to be studied do not accomplish the effect of demagnetization.

After iron has been demagnetized the apparent induction observed increases for a few reversals, passes through a maximum, and then decreases, approaching a lower limit asymptotically. This final limiting value is *defined* as the true induction.

The influence on permeability determinations of temperature, small mechanical vibrations, magnetic viscosity, and the terrestrial field are investigated, and it is shown experimentally that these elements must be considered if an accuracy of one per cent. is to be obtained. Their influence is greatest in the steep part of the induction curve.

R. L. FARIS,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 433d meeting was held October 19, 1907, with President Stejneger in the chair.

The single paper of the evening was offered by Dr. E. D. Merrill, on "The Geographic Distribution of Philippine Plants." The subject-matter presented was the outcome of five years' experience of the author and others, during which large collections had been made and many of the islands visited. He first discussed the relations of the Philippine flora with that of Hawaii and northern Australia, noting the interesting fact that of many Australian types found, all were confined to the high mountains of the island of Luzon. He then considered the relations with Celebes, Borneo, Formosa and the Asiatic continent. The great number of plants common to Luzon and Formosa he thought might indicate a former land connection. Similarly it was thought that the Philippines might have been connected with Queensland. Although the flora of the high mountains was Asiatic, it was evident that the great migrations had come from the south.

A brief discussion followed on the distribution of Philippine animals. Dr. Stejneger gave various reasons for considering reptiles, batrachians and mammals the best guides in determining former land connections. Judging by the reptiles, there is no indication of a connection between Formosa and Luzon since the Jurassic.

Dr. Lyon, speaking of the mammals, said this group gave no indication of a connection with Formosa. The mammals of the mountains of Luzon are so peculiar that it is difficult to say what their relationships are, but their strongest leanings seem toward Australian types.

Mr. Oberholser spoke of the birds, of which there are about 700 known species representing 175–200 genera. They may be divided into Cosmopolitan, Palearctic and Philippine groups. The latter comprises the following subdivisions: (1) East Asian, with few species, (2) Australasian, with rather few, (3) Celebesian, with somewhat more, (4) Bornean, with a still greater number, (5) Indo-Malayan, with the largest of all, (6) Endemic, not considered.

Dr. Gill said the freshwater fishes of the Philippines were of little interest in the present connection, most of them being Asiatic and many of them widely distributed. They show no relationship with Australian forms.

The 434th meeting was held November 16, 1907, President Stejneger in the chair. The evening was taken up with an account by Dr. B. W. Evermann, of "Freshwater Mussels and the Pearl Button Industry" along the Mississippi River, illustrated with specimens of shells, buttons, pearls, etc.

WILFRED H. OSGOOD,
Recording Secretary pro tem

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The meeting of November 19, 1907, was addressed by Professor Marshall H. Saville, Columbia University, on "Archeological Researches on the Coast of Ecuador." Professor Saville, who has charge of the G. G. Heye expedition, plans to examine the antiquities of the entire region between Mexico and Peru, taking up in order the coast and interior valleys, and thus far, two seasons have been spent in western Ecuador, between the 4° south latitude and 1½° north latitude. Two cultures anciently occupied the coast; the Manabé, in the dry region of the south; and the Esmaraldas in the humid region on and north of the equator. The ruins of the former are situated on the slopes of forested foothills which are watered with night fogs that descend about midway on their flanks. The houses, which were light wooden structures capable of resisting earthquakes, were placed on terraces excavated from the hillsides resembling the trincheras of Mexico. The remains are a few slabs sculptured in bas relief and numerous great stone seats of U-shape resting on the back of a puma. Mounds occur in which skeletons and pottery are found. The remains of Esmaraldas are exposed on the sea bluffs and along the river banks. Enormous deposits of artifacts are found along the coasts for two hundred and fifty miles, and on the Atacamanes River are great deposits in the alluvium, showing on sections two lines of human remains, pottery, etc. In these deposits were upright tubes of pottery which were coffins. Numerous gold objects and some emeralds were found by the expedition. A remnant of the Caiapas Indians living in northern Ecuador, about sixty miles north of the town of Esmaraldas, were visited and photographed.

The thanks of the society were extended to Professor Saville for his interesting paper.

Walter Hough,
General Secretary

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF BIOLOGY

On May 13, 1907, the section met at the American Museum of Natural History for an interesting session. The papers were as follows:

Brief Account of the Expedition to the Fayoum, Egypt: Professor Henry F. Osborn.

A summary of the valuable results of this expedition in search of *Palæomastodon* and *Arsinoitherium* was given and illustrated by a fine series of stereopticon views. A detailed account of the expedition has already been published in Science.[1]

The Supernumerary Chromosomes of Hemiptera: Professor Edmund B. Wilson.

In striking contrast to nearly all forms heretofore described, the genus *Metapedius* presents a considerable range of variation in the individual number of chromosomes, though the number is constant in each individual. The following numbers have thus far been observed in a total of 30 individuals (spermatogonia in the males, ovarian cells in the females). *M. terminalis*, males 22, 23, females 22, 25; *M. femoratus*, males 22, 23, 26, females 24, 26; *M. granulosus*, males 23, 26, 27 (?), females 26. The variation is thus seen to be independent of sex; and it is not a casual fluctuation within the individual, since the individual number is constant and in the male is definitely correlated with the number present in the maturation-divisions. Thus with 22, 23 or 26 spermatogonial chromosomes the first spermatogonial division shows, respectively, 12, 13 or 16 chromosomes—a relation shown constantly and in a large number of cells. Study of the conditions shown in the males leads to the conclusion that all individuals possess a fundamental or type group of 22 chromosomes that are always present and show the same general arrangement in the first division. To these may be added in certain individuals one or more "supernumerary chromosomes" which, like the idiochromosomes, differ in behavior from the others in failing to couple at the time of general synapsis, dividing as univalents in the first division where they appear smaller than the bivalents (as will be shown hereafter in photographs). Thus are explained the peculiar numerical relations above stated—

[1] N. S., Vol. XXV., No. 639, March 29, 1907.

e. g., 16 chromosomes in the first division include ten bivalents and six univalents (two idiochromosomes and four supernumeraries). In the second division the supernumeraries almost always unite with the idiochromosome-bivalent to form a compound element; and the facts indicate that the individual members of this complex may undergo an asymmetrical distribution to the spermatozoa, which probably gives the explanation of the variations observed in the somatic numbers of different individuals. The new proof given by the facts of the genetic identity of the chromosomes, and their possible bearing on certain phenomena of heredity, were indicated.

Variations in the Leaf Type of Liriodendron Tulipifera during a Season's Growth: Dr. L. Hussakof.

The leaves were collected from a single tree during three successive summers beginning with 1904, and their variations in form statistically studied. During 1905 and 1906 "average samples" (about 500 leaves, representing all parts of the tree) were collected at intervals of about a month and systematically tabulated. It was found that at the end of May the six-pointed type of leaf constitutes over half the total foliage (.58 in 1905; .65 in 1906), and that the four-pointed type is totally absent. During the next month there is a remarkable growth of four-pointed leaves so that at the end of June they constitute over 50 per cent. of the total foliage. The six-pointed leaves become reduced to about 35 per cent. of the total. During the remainder of the summer these figures vacillate only within about 5 per cent. The leaves with 8, 10, 12 and 14 points were also studied; each makes up only a small per cent. of the total foliage, the last being very rare.

The talk was illustrated by charts and specimens.

Orthogenesis in Gastropods: Professor A. W. Grabau. (Illustrated with lantern slides.)

No abstract of this paper has been received.

On October 14, 1907, the section met at 8:15 p.m., in the American Museum of Natural History. The evening was devoted to brief reports on summer work by members of the section. Among others the following members addressed the section: Professor W. M. Wheeler: "A Study of Ants in Switzerland"; Professor N. L. Britton: "Recent Explorations in Jamaica"; Professor H. E. Crampton: "A Second Journey to the Society Islands."

Professor E. B. Wilson also gave a brief account of the summer work at Woods Holl, and described some interesting experiments made by him on the structure of living cells.

Brief reports were also made by several other members of the section, after which the meeting adjourned.

On November 11, 1907, after a short business meeting, at which sectional officers for 1908 were elected, the following papers were read:

A Paleontological Trip to Northwestern Nebraska: Professor Henry F. Osborn.

Professor Osborn reported upon two excursions, during the seasons of 1906 and 1907, into the Lower Miocene beds of northwestern Nebraska, variously known as Arikaree, Harrison and Rosebud.

The recognition of these beds as containing fauna transitional between the Oligocene and Lower Miocene is due to the successive explorations of Hatcher, Barbour, Peterson, Matthew and Thomson. The lower division (Lower Harrison, Lower Rosebud) is somewhat more recent than the true Upper Oligocene of France. The upper division (Upper Harrison, Upper Rosebud) may also represent the beginning of the Miocene, and is sharply defined from the lower division by the absence of certain mammals and the presence of others. The formation as a whole is a very grand one, extending continuously over 200 miles east and west; varying in thickness from 1,200 feet in the west to 800 feet farther east. It is, in fact, one of the most extensive, most readily distinguished, and most definable of the Tertiary series, but it still awaits accurate definition and distinction, especially from overlying beds, partly owing to the fact that it has been embraced under the "Arikaree," which practically includes a considerable part of the Miocene series.

In the region of Agate, Sioux County, Nebr., the first discoveries of fossils were made by Mr. James H. Cook and his son, Mr. Harold Cook. This region has been especially explored by Carnegie Institute parties under Mr. O. A. Peterson and Mr. W. H. Utterback. The Monroe Creek, Lower Harrison, and Upper Harrison divisions are very distinctly separated from each other geologically and faunistically. The remarkable deposit known as the "Agate Spring Quarry" is about forty feet below the summit of the Lower Harrison and its fauna, and has been especially described by Mr. Peterson. This is on the same level as the Dæmonelix Beds of Barbour, and is characterized by the presence of *Moropus, Syndyoceras, Oxydactylus, Diceratherium* (smaller and larger species), *Parahippus, Blastomeryx, Dinohyus, Thinohyus* and *Promerycochœrus. Steneofiber,* a castoroid, is quite abundant and is frequently found in the Dæmonelix spirals. The origin of these spirals still remains a very difficult problem. The Upper Harrison is sharply defined by the appearance of the large *Merycochœrus* in the upper levels, by the presence of cameloids of three or four types. *Dinohyus* persists in the lower levels but disappears above.

A more exact determination of the geological and faunal characters of these beds will mark a great advance in our knowledge of the Tertiary series.

A fine series of lantern slides illustrated the paper.

The Ptarmigan—Living and Dead: Frank M. Chapman.

Both the distribution and color of ptarmigans are of special interest. In distribution, we have a circumpolar group extending its range southward on the Arctic Alpine summit of mountain ranges with isolated groups (for example, *Lagopus mutus,* in the Alps and Pyrenees, and *Lagopus leucurus,* in the Rocky Mountains of Colorado and New Mexico) occupying restricted areas at the south, which it is probable they reached at some time during the Glacial Period. The fact that the birds of these south Alpine islands are specifically like their representatives at the north indicates absence of differentiation since their isolation, and consequent great stability of color characters.

The ptarmigan's seasonal changes of plumage were described at length and were said to furnish one of the most conclusive proofs of the necessity for protective coloration known among birds.

Particular attention was called to the transitional autumn plumage which, in defiance of the laws of molt, is interpolated between the known summer plumage and the white winter plumage, to carry the bird from the end of the nesting season to the season of snowfall in October. If the winter plumage were to be acquired at the end of the nesting season, when molt is apparently a physiological necessity, the bird would be white before the coming of snow.

All the changes in plumage, it was asserted, were accomplished by actual feather loss and growth, no basis being observed for the theory of change of color in the individual feather.

The paper was illustrated with specimens and a series of slides showing the White-tailed Ptarmigan and its haunts on the summits of the Canadian Rockies in Alberta.

The Distribution of the Juncos, or Snow Birds, on the North American Continent: Dr. Jonathan Dwight, Jr.

The birds of the genus *Junco* are widely distributed, occupying in the breeding season the whole of Canada, the higher parts of the Appalachian, Rocky and Coast ranges of mountains, and the pine forests of Mexico and Central America. They fall quite naturally into several large groups that differ widely in plumage and are also farther divisible into lesser groups that possess characters more or less intermediate. Intergradation between the various forms seems to be complete and one view is to consider them all geographical races of one species, but a view more in harmony with the apparent facts, is to recognize several of the groups as species and to consider the intermediates either as hybrids or as races, or perhaps as both. A blackheaded junco, for instance, would seem to be specifically distinct from a red-headed bird, because each possesses a character not found in the other, while mere color variations, attributable to climatic conditions, point to geographical races.

Whether Mendelian principles will or will not explain the complicated plumage characters of the juncos, here at least there seems to be a promising field for experimental research to supplement the facts derived from field study.

The paper was illustrated by a large series of specimens brought together by Dr. Dwight for his investigations, and representing collections in all parts of the country.

The meeting then adjourned.

ROY WALDO MINER,
Secretary of Section

THE TORREY BOTANICAL CLUB

THE club met at the American Museum of Natural History on November 12, 1907. The meeting was called to order by Dr. J. H. Barnhart. Dr. E. B. Southwick was elected chairman. In the absence of the secretary, Miss W. J. Robinson was elected secretary *pro tem.* Eleven persons were present.

The following scientific program was presented:

Demonstration of Regeneration in Drosera: WINIFRED J. ROBINSON.

Miss Robinson observed regeneration in the leaves of plants of *Drosera rotundifolia* which she had under observation for experimental purposes, at the propagating house of the New York Botanical Garden, in August, 1907. Young plants appeared upon old and apparently dead leaves which were attached to the plant and were at first thought to be seedlings which had penetrated the leaf tissue in their growth. Sections showed that this was not the case but that the young plant grew from the cells of the old tissue which had remained in an embryonic condition. No formation of callus was observed. Regeneration occurred with equal facility from blade or petiole of the leaf or from the flower stalk. The first leaves of the young plant bear no tentacles, but later leaves are exactly like those of the parent plant. The roots appear after the stem has attained some size and are at first diageotropic, but later bend toward the substratum.

Drosera is not mentioned in recent literature upon regeneration but Spencer in his "Principles of Biology," 1867, referred to the subject as a matter of common knowledge. Naudin recorded the appearance of a bud upon the upper surface of the leaf of *D. intermedia* in *Ann. Sci. Nat.*, II., 14: 14, *pl. 1, fig. 6,* 1840. Planchon gave his observations upon certain "monstrous flowers" of *D. intermedia* in *Ann. Sci. Nat.*, III., 9: 86, *pl. 5 and 6,* 1853. His observations were verified by various later writers. The most extended study of regeneration in *D. rotundifolia* was made by Nitschke, professor at Westphalia, whose investigations were printed in the *Bot. Zeit.* 8: 239, 237, 245, 1860. He studied plants in the bogs and observed that the age of a plant could be determined by the successive rings of young plants about it.

Photographs of regenerating plants and of sections showing relation of the regenerating tissue to the parent plant were shown, also specimens in alcohol, demonstrating the origin of young plants from petiole and blade of leaf and from the flower stalk.

Notes on Tumboa (Welwitschia): NORMAN TAYLOR.

After a short account of the history and synonymy of *Tumboa Bainesii* (*Welwitschia mirabilis*), a general description of the mature plant was given. Attention was called to the peculiar characters of *Tumboa,* which is exogenous in the two cotyledons and the 2–4-merous perianth, endogenous in the parallel-veined leaves and six stamens, angiospermous in the general structure of the flower, and gymnospermous in the naked ovule and typical "cone" flowers.

Particular mention was made of the seedling, of which there are two now growing at the New York Botanical Garden. In germination the two ligulate cotyledons appear first above the soil, followed by the two nepionic leaves, at first erroneously supposed to develop into the only two leaves that the plant ever has during the conjectural one hundred years of its life, but this interpretation of the foliage was subsequently corrected in the "Genera Plantarum." Photographs were shown illustrating the two cotyledons and also the position and character of the two nepionic leaves. The latter, which will subsequently develep into the long, tentacle-like leaves of the mature plant, are at first small and linear, springing up directly between the cotyledons, which they closely resemble, and at right angles to them. It was noted that sometimes these leaves were pressed close together, and at other times spread as far apart as possible; that is, they were prostrated on each side of the axis of the plant. From being thus flattened out on the soil they would gradually become erect and finally touch their inner surfaces together. In seeking an explanation of this peculiarity several ideas suggested themselves, the true one seeming to be that the movement of the leaves was a direct response to the presence or absence of water. When they were prostrate they were simply wilted, and it was the water that made them stand erect. On accouut of the typically xerophytic aspect of even these seedling leaves one would not suspect that they were wilted, there being no external evidence of any loss of turgidity, except the change of position above described.

Some Recent Species of Plantago: E. L. Morris.

Plantago is the genus of plants containing our common plantain. Probably these plants are by most people considered nothing more than weeds, but in contrast to these as weeds there is a large group of species typically at home and indigenous in the semi-arid regions of our west and southwest. The species for a long time were included under one name, a name which was applied originally to the South American species found only in Patagonia.

The speaker called attention to a series of sheets of some fifteen species which, he stated, were until 1900, or a few years preceding, classified under the name of *Plantago patagonica* Jacquin, or, to speak more definitely, since 1845 there had been but three specific segregations from this composite and decidedly variant group. One of these was described by Dr. J. K. Small, another by Miss A. M. Cunningham and another by Dr. E. L. Greene. The misapplication of the name of Miss Cunningham's species to a specimen received in exchange, led to the study of the group and the segregation of the species into two distinct types, those with relatively long and definitely acute bracts, in distinction from those with typically short and definitely obtuse or rounded bracts. Among the group of perennial species of the genus, reference was made to a species from Mt. Shasta, formerly included in a species typical only of the extreme southwest. Reference was then made to a recent species from Alaska, characterized by the marked septation or partitioning of the leaf hairs. A most notable fact regarding this species is that the next important collection of it was made in Montana. It appears that no collections of this species have been made along the Rocky Mountain regions between the Yukon and Montana stations. The last group of species noticed was that belonging to the typical South American subgenus *Plantaginella,* represented there by several species. A species recently reported from Mexico belongs unquestionably to this group, though quite out of its formerly known range. The chief characteristic of this species is the unifloriate spike, which, preceding anthesis, is enclosed within a prominent sheathing bract. Then followed a brief discussion of variation in our common eastern species, the facts being noted that certain forms may soon require a segregation with the rank of species.

A brief discussion followed the presentation of each of the topics of the evening.

Winifred J. Robinson,
Secretary pro tem.

THE SCIENCE CLUB OF WELLESLEY COLLEGE

The club held its 90th regular meeting on October 8. Dr. Lincoln W. Riddle presented a paper on "Some Fungi Parasitic on Insects." The paper took up two groups of fungi: *Entomophthora* and *Empusa* parasitic on flies, grasshoppers and various hairy caterpillars; and *Cordyceps,* parasitic especially on various subterranean insect-larvæ. Attention was called to the economic importance of these fungi, and to the possibility of the use of *Empusa Anlicæ,* parasitic on the caterpillars of the brown-tail moth, in fighting the moth-pest. The paper was illustrated by specimens of the various fungi described.

At the 91st meeting, held on November 5, Dr. Caroline B. Thompson reviewed the recent work of McClung, Montgomery, Wilson, Stevens and others, on the chromosomes of insects, and especially Wilson's theory of the heterochromosomes as sex determinants.

Mary T. Hollister,
Secretary

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA

The 173d meeting was held in the main lecture hall of the Chemical Laboratory, Tuesday evening, November 12, 1907, at 7:30 o'clock. Dr. W. C. Coker described "A Trip to Porto Rico." The talk was fully illustrated with lantern slides and a large collection of botanical specimens.

A. S. Wheeler,
Recording Secretary

DISCUSSION AND CORRESPONDENCE

LODGE'S ETHER AND HUYGHENS'S GRAVITATION

The alarming density of the ether which Sir Oliver Lodge believes must be taken into consideration is liable to leave one more open-mouthed with astonishment than did Lord Kelvin's famous molasses-candy ether, even if open mouths are suggested in connection with the latter. But 10^{12} grams per cubic centimeter is not an every-day experience, consciously at least. I have thought of it in relation to Huyghens's ingenious mechanism for gravitation. If a body rotates in a fluid *lighter* than itself, it must in virtue of centrifugal force and Archimedes's principle, *sink* toward the center of rotation. Electronists insist that the ether is absolutely stationary: but suppose that it rotated just a little with the earth. We may then write for the buoyancy per cubic centimeter $\rho_e\omega_e^2R$ and for the centrifugal force per cubic centimeter of submerged matter $\rho_m\omega_m^2R$, where ρ, ω, R denote density, angular velocity and radius of curvature, respectively. In other words

$$\omega_e^2/\omega_m^2 = \rho_m/\rho_e = 10^{-12};$$

that is, if the angular velocity of the ether were but one millionth that of the earth about the sun, there would be no centrifugal force to compensate gravitation. The brilliant experiments of our recent medallists show that observationally, $\omega_e = \omega_m$. The electronist gets around this by the principle of relativity. But if, granting Lodge's ether as little as $\omega_m/10^6$ would imply conditions comparable with gravitation, one can not escape a little uneasiness unless, from the interpenetration of matter and ether, ρ_m is ultimately, *i. e.,* per corpuscle, much larger than ρ_e. As a whole, however, a fixed ether would be the only satisfactory inference.

Carl Barus

Brown University,
Providence, R. I.

METAGENESIS IN INSECTS

In a recently issued paper by Professor Montgomery[1] attention is called again to the condition approaching an alternation of generations in the case of insects with complete metamorphosis:

> Among insects with a more or less complete metamorphosis the crawling larva becomes a quiescent pupa; then from a series of points of the hypodermis of the pupa the organs of the imago are formed, while all the remaining tissues of the pupa degenerate by histolysis and then become ingested by phagocytes. Therefore an adult fly or moth or wasp is an individual quite different from the pupa, an individual produced asexually by the conjunction of a series of buds. This is in every sense as truly metagenetic as the development of a medusa from a polyp (Montgomery).

This is, in a way, true (the word larva, however, should be substituted for pupa in most of the above, as the histoblasts from which the adult parts are derived are already distinguishable and have begun development in the larva), and is suggestive. And the fact

[1] *Trans. Texas Acad. Sci.,* Vol. IX., pp. 75–94.

should have more attention than it seems to get. The whole matter of metamorphosis in insects has been looked at too much from the angle of the systematists, who have found "incomplete" and "complete" metamorphosis a convenient taxonomic character, and of the nature study teachers, who have found it a subject of fascinating interest to children. The true biologic significance of the process has been pretty consistently overlooked. Montgomery does well to recall attention to it and to suggest an interpretation of it of great interest.

However, before accepting this interpretation, or any other, or following it too far, we should be sure we know the actual state of affairs represented to us by the phrase "complete metamorphosis." This commonly suggests, first, the externally obvious, apparently violent and radical changes from larva to pupa to adult, and, second, the interesting internal phenomena of the histolysis of the larval parts and histogenesis of the imaginal parts. But we are very likely to let a type or example of this total performance represent to us the whole range of the phenomenon, which is misleading. For as a matter of fact every gradation can be found among insects from the simple going over, with little or considerable transformation, of larval parts into adult parts, as taken to be characteristic of "incomplete" metamorphosis, to the radical disintegration and disappearance of the larval parts with the fundamental new building of the imaginal parts from isolated histoblasts, taken to be characteristic of and common to all insects of "complete" metamorphosis.

During the last few years, various students in my laboratory (particularly Mr. Powell) and I myself have given some special attention to the phenomena of insect metamorphosis, and have been able to break down any inherited belief of ours (or belief acquired from tradition and text-books) of the discontinuity of "incomplete" and "complete" metamorphosis. We have found insects of incomplete metamorphosis (Hemiptera) showing some of the characteristic phenomena of complete metamorphosis and insects of complete metamorphosis (Coleoptera) showing characteristics of incomplete metamorphosis. And these not as individual variant or aberrant cases, but as conditions characteristic of the development of species.

That is, if the insects with more specialized complete metamorphosis, as flies, ants, etc., are to be looked on as metagenetic in character (*i. e.*, "with a life cycle consisting of two or more individuals with alternation of sexual and asexual reproduction"), and the insects with most generalized incomplete metamorphosis as having a continuous (non-metagenetic) life cycle, the question arises as to where, in the insect class, the difference first appears. And if the whole process of metamorphosis differs in its most specialized and its most generalized states only in degree; if a complete series of intergrading or connecting states exists (as really does); where is the opportunity to interpret this process in the case of certain insects as true metagenesis, and in the case of others as a true continuous non-metagenetic life cycle?

Vernon L. Kellogg
Stanford University, Cal.

BOTANICAL TEXT-BOOKS

It is a pretty dull week when some one does not put out a new botanical text-book intended for high-schools, colleges and universities, and not infrequently these consist of 300 to 600 pages each, covering a wide range of topics. The great diversity of training given in the colleges of our country and of Europe, makes it next to impossible for any capable man to produce a book all sections of which will fit a large number of teachers. I think we may well learn a lesson regarding this multiplicity of books from the teaching of English literature.

Instead of compelling each member of a class to purchase complete sets of Burke, Patrick Henry, Webster or Clay, select speeches of these men are printed separately, which are inspiring and can be used by the students according to their different tastes. So here in botany, why should not some one, by this plan, prepare a considerable number of pamphlets, each suited to the needs of some teacher, which his own judgment will lead him to select. It usually discourages a student somewhat to buy a large text-book, one half or one third of which is used in his classes, and the rest omitted.

W. J. Beal

SPECIAL ARTICLES

THE PROBABLE ORIGIN AND PHYSICAL STRUCTURE OF OUR SIDEREAL AND SOLAR SYSTEMS[1]

Mainly because of the very high, and for certain reasons inadmissible, temperature heretofore obtained when Newton's law of radiation is employed, astronomers and physicists hold that this law can not be used for determining the effective surface temperature of the sun.

That Newton's law of radiation is just as true for the sun as is the law of gravitation, and that the sun's surface temperature can only be determined by means of this law will now be demonstrated.

Let us conceive that the sun's total radiant energy S (per unit of time) is concentrated in an ether vibration at the sun's center. Let the temperatures t_0 and t be taken as the measures of the intensity of vibration at the distances r_0 and r; we can then at once write

$$\left(\frac{S}{t_0 r_0^2}\right)=\left(\frac{S}{tr^2}\right), \tag{1}$$

hence

$$t_0=t\left(\frac{r}{r_0}\right)^2. \tag{2}$$

Now let us conceive that a thin spherical shell of lampblack having the radius r_0, and coinciding with the sun's surface, receives and transmits in each unit of time the total energy S, the temperature t_0 of this shell will then be the same as the temperature of the sun's surface, and the temperature t in any exterior similar shell of radius r must necessarily be such as to satisfy equation (2), for to assume any gain or loss through the substitution of the total energy S given out by the surface shell in place of the energy S given out by the central vibration would be contrary to the law of the conservation of energy.

Now to find t_0 the temperature t, at the earth's distance from the sun, must first be found, and *just here is where inadmissible errors have been committed in past determinations.*

I offer the following extremely simple method for determining the absolute temperature of space:

Let D denote the diameter of a mirror (or objective) having the focal length F, the linear diameter d of the sun's focal image will then be $d=2F \tan \theta$, in which θ is the angular semi-diameter of the sun. (For our present purpose d depends only on F and θ and is independent of D.) Let T denote the measured absolute temperature in the sun's focal image, then, if we neglect for the present the effects due to atmospheric absorption, we can at once write for a theoretically perfect telescope

$$\frac{T}{t}=\left(\frac{D}{d}\right)^2. \tag{3}$$

The expression for the absolute temperature of space is therefore

$$t=T\left(\frac{d}{D}\right)^2. \tag{4}$$

Now let a denote the factor by which T must be multiplied in order that the product shall equal the surface temperature t_0 of the sun; we then have

$$a\frac{T}{t}=a\left(\frac{D}{d}\right)^2=\frac{t_0}{t}=\left(\frac{r}{r_0}\right)^2, \tag{5}$$

from which we find

$$a=\left(\frac{d}{D}\right)^2\left(\frac{r}{r_0}\right)^2, \tag{6}$$

in which all the quantities are known. The expression for the effective surface temperature t_0 of the sun is therefore

$$t_0=t\left(\frac{r}{r_0}\right)^2=aT. \tag{7}$$

My observational work has been carried on with the aid of three mirrors which I constructed to continue investigations under way at the time of my departure from the Lick Observatory. The first two of these telescopes are briefly described in No. 539 of the *Astronomical Journal;* the third mirror has an aperture of two feet and a focal length of three feet. The definition of this last-men-

[1] Extract from a still unfinished paper.

tioned telescope is such that images of the faintest-known isolated stars can (with the aid of a powerful magnifying glass) be plainly seen on a photographic plate exposed for less than five minutes in the focus. When this instrument is turned to the sun all known metals are melted and vaporized. A circular hole equal in size to the sun's focal image is almost instantly formed in a thin plate of sheet-iron held in the focus; by taking a much thicker piece the vaporization of the boiling-iron image of the sun (held in place by capillary action with the bordering plate of cold iron) can be observed at leisure until a hole is again formed.

To obtain a known value of T for a measured value of D the aperture of this mirror was gradually reduced (by means of circular openings, of different diameters, cut in cardboards placed centrally over the mirror) until a strip of platinum plate could just be melted when held in the focal plane. With the sun at 54° zenith distance, in a clear atmosphere, the corresponding diameter was found to be eighteen inches.

Neglecting for the present the corrections due to aberrations and absorptions in the telescope and in the atmosphere, we have the following approximate values for substitution in formulas (4), (6) and (7):

$$D = 18.0 \text{ in.}$$
$$d = 0.337 \text{ in.}$$
$$\left(\frac{r}{r_0}\right)^2 = 44000$$
$$T = 2000° \text{ C.}$$

The uncorrected results are, therefore,

Absolute temperature of space $= t = 0°.7$ C.
Effective surface temperature of the sun $=$
$t_0 = 30800°$ C.

The instrumental corrections (due mostly to absorption at the silver surface of the mirror) increase the value of t from 0°.70 to 0°.75. The effect of atmospheric absorption on the intensity of ether vibrations must next be considered. My information on this subject is based upon a long series of photographic observations (on certain fixed stars) which I made, reduced and discussed more than sixteen years ago; the work (8vo, pp. 89) was published in 1893 under the title "Terrestrial Atmospheric Absorption of the Photographic Rays of Light" and forms No. 3 of "Contributions from the Lick Observatory." The tabular data on page 86 of this work give, for 54° zenith distance, the intensity (or brightness) 0.61, the brightness at the zenith being unity. If the temperature of the sun's focal image varies according to the same law, the value of t is increased from 0°.75 to 1°.23 in the zenith; this value must, finally, be further increased by a still undetermined correction for absorption in the zenith; if we *assume* a one-fourth increase in the temperature due to this cause we have finally

Absolute temperature of space $= 1°.5$ C.
Effective surface temperature of the sun
$= 66000°$ C.

It should be explicitly stated that the formulas are derived for the theoretical case of the earth *without* an atmosphere, or of observations made in free space. In actual observations T denotes *the rise in temperature* above the temperature of the surrounding medium and, therefore, is equal to the absolute temperature of the sun's focal image minus the absolute temperature of the air at the place of observation. J. M. Schaeberle

Ann Arbor,
November 24, 1907

A NOISELESS ROOM FOR SOUND EXPERIMENTS

For many experiments in laboratories of physics, physiology and psychology a place is needed from which all, or nearly all, external sound can be excluded. An absolutely noiseless room opens up numerous new possibilities of research, especially in the fields of sound physiology and psychology. For this reason rooms have been constructed in many laboratories, but all the attempts to produce a noiseless room that are known to the writer are more or less unsuccessful, with the exception of the room to be described here.

The room to which reference is made is in the Physiological Institute of the University of Utrecht, Holland. It has been constructed under the direction and has been used by Professor H. Zwaardemaker, to whom I am indebted for permission to publish the present description.[1]

The room is located on the top story of the laboratory building devoted to physiology. This floor of the building is little used, except for the sound room, and there are, consequently, few footsteps and other noises in the immediate neighborhood of the room. The location of the room at a distance from the street prevents to some extent the transmission of vibrations and jars of the street traffic. Moreover, the room is an inside one, separated from the building walls by other rooms or a corridor, although in its construction, as will be noted below, provision is made for thorough ventilation and the entrance of sunlight. The other rooms of the laboratory on the same floor are comparatively little used, and by surrounding the sound room they help to isolate it.

A vertical section of the room from north to south is given in the accompanying figure. It will be seen that in the construction a small room has been formed to the south of the sound room. The ceiling of the small room is the roof of the building. The roof has been cut to form a window which admits light and air. The small room has been constructed with walls nearly as sound-proof as the larger room, and for some work may be used as an additional place for sound experiments. When closed, it also serves to act as a dead air space between the larger room and the building wall and roof.

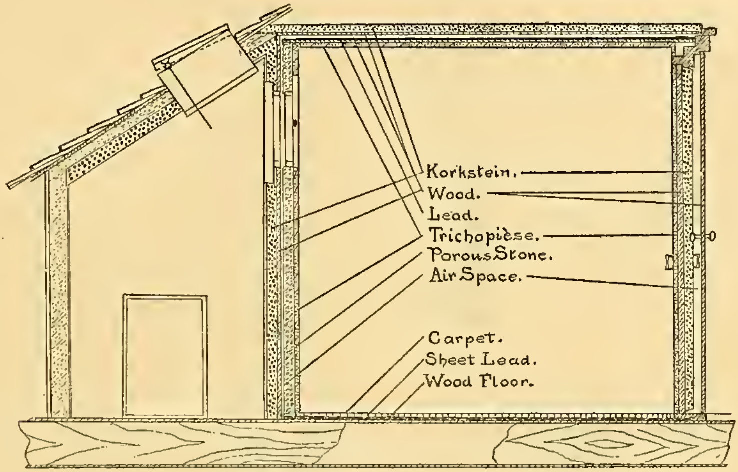

Fig. 1

The inside measurements of the sound room are as follows: Length, 228 cm.; width, 220 cm.; height, 228 cm.

The sides of the room are built of six layers. From the inside outwards the layers are as follow: (1) *Trichopièse,* about 5 cm. thick. This is a felt-like material made of horse hair, and from experiments it has been found to have very low coefficients of conduction and reflection of sound. This layer is covered with a net on the inner side (to keep the hair from falling) and then fastened with nails to the second layer, which is more stable. (2) Porous stone, 7.5 cm. thick. This part of the wall does not rest directly on the floor, but is isolated from the floor by a layer of sheet lead,

[1] At the International Physiological Congress, Heidelberg, August, 1907, Professor Zwaardemaker read a description of the room and showed lantern slides of the plans of construction. Later, the writer had an opportunity of examining the room in the laboratory at Utrecht. A full description of the construction is to be published in the *Zeitschrift f. Ohrenheilkunde.* The proof of this article was in the writer's hands at the time of writing the present account.

3 mm. thick. Next there is (3) a dead air space from 2 to 3 cm. thick. Layer 4 is a wood partition, 2.5 c.m. thick. The outermost layer (6) is a special composition of grouud cork, *Korkstein,* 6 cm. thick. The outer surface of the last layer is plastered, probably mainly for appearance. The space between layers 4 and 6 is filled with a mixture of ground cork and sand. The thickness of this mixture is 4 cm. The total thickness of the walls is, therefore, about 11 inches.

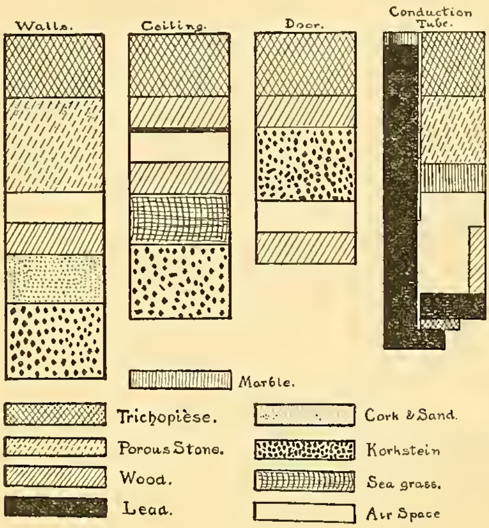

FIG. 2

The ceiling is more simply made, but it has an analogous "double-wall" construction. From withiu outwards there is (1) *Trichopièse,* (2) wood ceiling, to which the *Trichopièse* is fastened and which in turn rests on the porous stone of the inside layer of the walls, (3) sheet lead, 3 mm. thick, (4) an air space, (5) a second wood ceiling, which is covered with (6) asphalt paper, (7) sea grass and (8) *Korkstein.*

The floor is the least satisfactory part of the construction. The floor of the old room had to be used. To prevent vibrations passing from board to board the joints were sawed through and the crevices thus made were filled with lead. The whole floor was then covered with a layer of lead, 3 mm. thick, and over this a very thick (1 cm.) carpet has been placed. At times a second carpet is also used. Had the original floor been of marble or cement it is probable that the two layers (lead and carpet) would have been as satisfactory as the six layers of the walls.

The door is double. The outer part opens on the corridor. It is an ordinary door, made of wood, but accurately fitted with felt. The inner door is composed of three layers. The middle layer is wood, the inner or room layer is *Trichopièse,* and the outer layer is *Korkstein.* This inner door opens into the room. There is the usual air space between the two doors. The door is part of one of the long sides of the room.

Nearly opposite the door is a small rectangular window, 38 by 45 cm. This opens into the small adjoining room to the south and is directly opposite the window in the roof. The roof window opens to admit light and air, but the opening is covered with a fine gauze screen to exclude insects and especially moths. When both windows are open the sun can get into all corners of the room and the room may be partially ventilated. With doors and windows open the room is thoroughly ventilated.

The sound stimuli may have their origin in or outside the sound room. If the source of the sound is in an adjoining room the apparatus is placed in a cabinet, isolated from the floor by a lead plate and felt, and covered with the same materials. This isolation still further decreases the chance of these noises or tones entering the room through floor, ceiling or walls except in the manner that is desired.

For experiments in which it is necessary to have the origin of the sound stimuli at a distance from the subject means are needed for conducting the sound into the room. For this reason a hole was bored through one of the walls and a copper tube inserted. This tube is fastened to a marble plate, which in turn is fastened to the second layer, porous stone, of the inner wall. The wood partition is here omitted and a plate of lead, 2.5 cm. thick, is used for the outer part of the wall. To close the copper tube lead plugs were made, one of which is solid, a second has a single opening, 1.5 cm. diameter, and the third has two openings, each 0.8 cm. diameter. The solid lead plug serves to keep the room sound-proof if it is not necessary to conduct the sound from without; the second and third give opportunity of introducing one or two sound stimuli, respectively.

The room is fitted with electric light and wires for telephone and other electrical purposes.

The location of the window, on the southern side of the room, makes it possible to have the room lighted by the sun and a thorough ventilation may be secured in the intervals of a series of experiments. One thing has not been solved in the construction, viz., the ventilation of the room during a series of tests. The room is large enough to hold one person for, say, a half hour without discomfort from lack of oxygen, and the use of porous material in the construction may make it possible to remain a longer time without ill effect.[2] For a series of tests on tones a half hour is sufficient time if we do not have to deal with a condition of the ear analogous to the adaptation of the eye. If time is needed for the "adaptation" of the ear perhaps some further scheme of ventilation may be required. On this point, the adaptation of the ear, we have no information and one of the possibilities of the room is the discovery of such adaptation.

When in the room, some, not all, persons experience peculiar sensations from the ear (drum?), corresponding to the sensations in slightly compressed air. There is a distinct feeling of pressure which is subjective and which disappears so soon as a sound is made, or sound stimuli are given.

The noiselessness of the room is shown by the fact that one hears a subjective buzzing, similar to but of less intensity than the buzzing produced by large doses of quinine. Many normal people can also hear their own heart sounds. It is true that their own heart sounds can be heard by some in rooms not noiseless, but this is not the case with many normal individuals except after very violent exercise. In the room a few swings of the leg or arm is often sufficient to make the heart sounds quite distinct. Other body noises may also be heard. If a movement of a few inches in extent is made, such as lightly brushing the foot over the carpet or a free movement of the arm, the sound is distinctly audible. So audible are these noises that one must be careful not to move when experiments are in progress. A further proof of the noiselessness of the room is to be found in the fact that a shell held to the ear does not appear to give forth any sound. The tones for which the shell is resonant are absent. It should be mentioned again here that the felt-like lining of the room effectually stops all sound reflection. Whatever sounds are produced or brought into the room are in this respect simple; they cease when the vibration reaches the wall.

[2] On this point I failed to make inquiries.

To keep the room fresh and clean, in addition to the entrance of sunlight and fresh air, dust and other dirt are removed by a mechanical cleaner—the so-called compressed air cleaner—and it is disinfected by formalin vapor.

In experiments during the past three or four years the room has been used in its various conditions of evolution and in its final form has proved to be most satisfactory. For many years it will doubtless be a standard for the construction of similar rooms in other institutions.

Shepherd Ivory Franz
George Washington University
Government Hospital for the Insane

SEVENTH INTERNATIONAL ZOOLOGICAL CONGRESS—SECTION OF PALEOZOOLOGY

For the first time in the history of the International Zoological Congress, a section of paleozoology was organized and met during the Boston convention of the congress, August 19–24. Early in the year a circular announcing the formation of this section was sent to paleontologists of this and other countries from the office of the organization chairman, Professor H. F. Osborn.[1] This circular called attention to the unusual opportunity afforded

[1] Owing to Professor Osborn's absence in Egypt, many omissions in the sending of this circular occurred.

by the congress for seeing the great paleontological collections of the Eastern United States and to the further opportunity which the meeting of American with European paleontologists would afford for the discussion of some of the broader problems of the science. The response to the invitation was a gratifying one; such a goodly number of paleontologists attended the congress, and so much was the need of such a periodic gathering of the workers in this science felt, that the permanency of the section is assured. These meetings will be looked forward to as the opportunity for establishing closer personal relations with fellow paleontologists of distant lands and for a discussion of those questions of our science which are of more than local interest.

The meetings of the section were scheduled for Tuesday and Wednesday mornings, August 20 and 21, from 10 A.M. to 1 P.M., but it was found necessary to hold additional sessions on Thursday and Friday mornings. The first meeting was called to order by the organization chairman, Professor H. F. Osborn. Professor Charles Depéret, of the University of Lyons, France, was elected first chairman of the section, and Professor A. W. Grabau, of Columbia University, New York, secretary. Professor Gustav Steinmann, of the University of Bonn, was elected chairman for the sessions of Thursday and Friday.

The principal address of the meeting was delivered by Professor C. Depéret, on Wednesday morning. It was given in French, the title being "Les migrations des faunes tertiaires entre l'Europe et l'Amerique." Two other addresses on the broader aspects of the science were made, one by Professor Gustav Steinmann in German, on "Die Bedeutung der Paläontologie für die Abstammungslehre," on Wednesday, and the other on Friday, by Professor H. F. Osborn, on "Evolution as it appears to the Paleontologist."

The complete list of papers presented before the section and the order of their presentation was as follows:

Tuesday, August 20.

Professor A. GAUDRY: "Patagonie et Antarctique." (Read by Professor H. F. Osborn and since published in SCIENCE.)

Professor W. B. SCOTT, Princeton University: "The Zoogeographical Relations of the Miocene Mammals of Patagonia."

Dr. W. J. SINCLAIR, Princeton University: "The Santa Cruz Typotheria."

Professor H. F. OSBORN, American Museum of Natural History: "Zoogeographical Relations of Northern Africa in the Upper Eocene."

Wednesday, August 21.

Address by Professor CHARLES DEPÉRET, University of Lyons, France: "Les migrations des faunes tertiaires entre l'Europe et l'Amérique."

Professor GUSTAV STEINMANN, University of Bonn, Germany: "Die Bedeutung der Paläontologie für die Abstammungslehre."

Dr. W. J. HOLLAND, Carnegie Museum, Pittsburg: "A Preliminary Account of the Pleistocene Fauna discovered in a Cave opened at Frankstown, Pennsylvania, in April and May, 1907."

Professor T. D. A. COCKERELL, University of Colorado: "The Miocene Fauna of Florissant, Colorado."

Mr. O. A. PETERSON, Carnegie Museum: "Preliminary Notes on some American Chalicotheres."

Professor A. W. GRABAU and Miss MARGARET REED, Columbia University: "Mutations of *Spirifer mucronatus*."

Thursday, August 22.

Dr. P. E. RAYMOND, Carnegie Museum: "The Clymenia Fauna in the American Devonian."

Professor C. DEPÉRET, University of Lyons, France: "Sur un nouveau genre 'Lophiaspis.'"

Mr. C. H. STERNBERG: "*Hesperornis regalis*, the Royal Bird of the West."

Dr. F. W. TRUE, U. S. National Museum: "On the Correlation of North American and European Genera of Fossil Cetaceans."

Friday, August 23.

Professor H. F. OSBORN, American Museum of Natural History: "Evolution as it appears to the Paleontologist." (Since printed in full in SCIENCE.)

Professor A. W. GRABAU, Columbia University: "Value of the Protoconch and Early Conch Stages in the Classification of Gastropoda."

Professor R. S. LULL, Yale University: "The Evolution of the Ceratopsia."

Dr. E. DOUGLASS, Carnegie Museum: "The Oligocene Fauna of Montana, with Sections of the White River Beds at White Bed, Montana, and the Little Badlands in North Dakota." (By title.)

Professor R. T. JACKSON, Harvard University: "Studies of Fossil Limulus." (By title.)

Dr. C. R. Eastman, Museum of Comparative Zoology: "Cranial Structure of Dipterus and Related Genera." (By title.)

Dr. O. P. Hay, American Museum of Natural History: "Fossil Turtles of North America." (By title.)

Professor H. F. Osborn, American Museum of Natural History: "A Means of Estimating the Age of the Mastodon and other Proboscidia." (By title.)

At the Friday session a resolution was adopted, that it was the sense of the section of paleozoology, that the time was ripe for the organization of a Society of American Paleontologists, to include vertebrate and invertebrate paleozoology and paleobotany. A committee was appointed, with Professor H. F. Osborn as chairman, to confer with the officers of the Society of Vertebrate Paleontologists with a view to disbanding that society, or merging it with the larger body, and to correspond with all teachers of, and workers in, paleontology in North America, with the view to the formation of the new society.

Before the final adjournment of the section on Friday, Professor Osborn, in behalf of the local committee, and of the American members of the section, expressed great pleasure in being able to welcome the distinguished foreign paleontologists present, and assured them that American paleontologists greatly appreciated their efforts towards making this meeting such a success. Professor Steinmann, in reply, expressed the appreciation on the part of the foreign delegates, of the welcome given them, and further expressed the hope that this meeting might be the first of many others for the benefit of all concerned.

A. W. Grabau, *Secretary of the Section*

THE AMERICAN SOCIETY OF BIOLOGICAL CHEMISTS. SECTION K—PHYSIOLOGY AND EXPERIMENTAL MEDICINE—AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. BIOLOGICAL SECTION OF THE AMERICAN CHEMICAL SOCIETY

Preliminary announcement pertaining to the Chicago meetings, December 30 to January 2

Four sessions of the Biochemical Society, three sessions of Section K, of the American Association for the Advancement of Science, and one session of the Biological Section of the American Chemical Society will be held during convocation week. The provisional schedule of the meetings of these three organizations is appended.

Monday, December 30

1:30 p.m.—Meeting of the Council of the American Society of Biological Chemists.

2:30 p.m.—Business session of the American Society of Biological Chemists, followed by reading of papers.

Tuesday, December 31

9:30 a.m.—Joint session of the American Physiological Society and the American Society of Biological Chemists.

2:30 p.m.—Vice-presidential address by Simon Flexner, retiring chairman of Section K of the American Association for the Advancement of Science. Subject: "Recent advances and present tendencies in pathology," followed by a joint session of the American Physiological Society and Section K of the American Association for the Advancement of Science.

(No meeting of the Biochemical Society on Tuesday afternoon.)

Wednesday, January 1

9:30 a.m.—General session of the American Chemical Society in affiliation with Section C (Chemistry) of the American Association for the Advancement of Science, including (at about 9:45) the address of the president of the American Society of Biological Chemists and chairman of the Biological Section of the American Chemical Society, Russell H. Chittenden, on the subject: "Some of the Present-day Problems of Biological Chemistry," followed by a joint meeting of the Biological Section of the American Chemical Society and the American Society of Biological Chemists.

1:00 p.m.—Meeting of the Sectional Committee of Section K.

2:00 p.m.—Symposium on Immunity, under the auspices of Section K of the American Association for the Advancement of Science, with the following program:

Introductory remarks by the chairman, Ludvig Hektoen.

M. J. Rosenau and John F. Anderson: "Anaphylaxis and its Relation to Immunity."

V. C. Vaughan: "Hypersusceptibility and Immunity."

Preston Kyes: "The Hemolysins of Animal Toxins."

William W. Ford: "Artificial Immunity to Glucosides."

S. P. Beebe: "The Differentiation of Homologous Proteids by Serum Reactions."

Frederick G. Novy: "Immunity in Spirochetal Infections."

H. T. Ricketts and L. Gomez: "Immunity in Rocky Mountain Spotted Fever."

E. C. Rosenow: "Virulence of Pneumococci in Relation to Phagocytosis."

G. F. Ruediger: "The Mechanism of Streptococcus Immunity."

Mazyck P. Ravenal: "Immunity in Tuberculosis."

H. Gideon Wells: "Chemical Aspects of Immunity."

(No meeting of the Biochemical Society on Wednesday afternoon.)

8:30 P.M.—Smoker, Biological Chemists with the Anatomists and Physiologists.

Thursday, January 2

9:30 A.M.—Meeting of the American Society of Biological Chemists, with an executive session before adjournment.

2:30 P.M.—Joint session of the Society of American Bacteriologists and Section K of the American Association for the Advancement of Science.

Details of local arrangements during convocation week, including reference to railroad rates, hotels, special announcements by the Chicago committee for the guidance of visitors, etc., have been published in a pamphlet issued from the office of the Permanent Secretary of the American Association for the Advancement of Science, copies of which may be obtained, at request, from Dr. L. O. Howard, Smithsonian Institution, Washington, D. C.

Copies of the biochemical programs will be forwarded to the members of the Biochemical Society about December 23, and may be obtained after that date from

William J. Gies,
Secretary

437 West 59th Street,
New York City,
December 9, 1907

ORGANIZATION OF AN AMERICAN SOCIETY OF AGRONOMY

It is requested by the undersigned that all persons interested in agronomy join with them in a meeting during the coming holiday season at Chicago for the purpose of organizing an American Society of Agronomy. The meeting for organization will be held Tuesday morning, December 31, in the buildings of the Chicago University, the particular place of meeting to be announced later.

Although this meeting is called for the same period during which the sessions of the American Association for the Advancement of Science will be held in order to secure better attendance, it will be determined at such time whether the organization shall be a section of this association, an affiliated society, or take some other form. A suggestive constitution and by-laws will be submitted in order that business may be hastened and as much time as possible be given to the reading of papers even at this first meeting. Eight to ten papers have already been offered. Titles and abstracts or the papers themselves should be sent at the earliest date possible either to Alvin Keyser, University of Nebraska, Lincoln, Nebr., or to M. A. Carleton, U. S. Department of Agriculture, Washington, D. C.

C. A. Alvord	R. A. Moore
Alfred Atkinson	L. A. Moorhouse
E. D. Ball	H. A. Morgan
Wm. P. Brooks	C. L. Newman
C. P. Bull	W. H. Olin
M. A. Carleton	C. V. Piper
E. C. Chilcott	W. J. Quick
L. A. Clinton	P. H. Rolfs
W. R. Dodson	A. D. Shamel
J. F. Duggar	J. H. Shepperd
G. H. Failyer	C. D. Smith
F. D. Gardner	L. H. Smith
J. N. Harper	A. M. Soule
C. G. Hopkins	W. J. Spillman
T. F. Hunt	R. W. Thatcher
Wm. D. Hurd	J. D. Tinsley
Alvin Keyser	G. H. True
B. W. Kilgore	Edw. B. Voorhees
E. R. Lloyd	H. J. Wheeler
T. L. Lyon	J. A. Widtsoe
M. F. Miller	C. G. Williams
E. G. Montgomery	

SUBSCRIPTIONS FOR THE LAMARCK MEMORIAL

AMERICAN naturalists are responding to the invitation of French naturalists to join in the work of erecting a monument in Paris to Lamarck. The American members of the international committee, consisting of Messrs. Agassiz, Osborn and Dean, have not as yet, however, received a sum substantial enough to indicate adequately the interest which Americans have always displayed in the works of Lamarck, or the part which America should play in the building of this monument to the founder of the evolution theory. Up to the present time there are forty-two subscribers, and the total amount raised is $497.

At least $1,000 should be sent to France to represent worthily the zoological interests of this country.

Among the subscribers are Messrs. Agassiz, Mayer, Montgomery, Sigerfoos, H. L. Bruner, Osborn, Osburn, Gage, Allis, Dean, Brewer, Mary Rathbun, Thaxter, Dachrowski, Nachtrieb, Grover, Beal, Parker, Birge, Bigelow, Clarence H. Mackay, Woodward, Kellogg, Schuchert, Lee, Armstrong, N. Y. Academy of Sciences, Martha Bunting, Holland, Rathbun, Walcott, C. F. Cox, Gill, Wagner, Whitman, New York Zoological Society, Philadelphia Academy of Natural Sciences, Metcalf, Biological Society of Washington, Townsend, Hargitt.

Subscriptions and letters of inquiry should be addressed to Professor Bashford Dean, Columbia University, New York.

SCIENTIFIC NOTES AND NEWS

WE record with deep regret the death of Lord Kelvin on December 17.

THE Royal Society of Edinburgh has elected as British honorary fellows, Sir A. B. W. Kennedy, F.R.S., Sir E. Ray Lankester, K.C.B., F.R.S., Dr. J. A. H. Murray and Professor C. S. Sherrington, F.R.S.; foreign honorary fellows have been elected as follows: Professor Emil Fischer, Berlin; Dr. G. W. Hill, New York; Professor F. W. G. Kohlrausch, Charlottenburg; Professor H. F. Osborn, New York; Professor I. P. Pavlov, St. Petersburg; Professor G. Retzius, Stockholm; Professor A. Righi, Bologna and Professor L. J. Troost, Paris.

THE Geological Society of France has elected Dr. C. R. Eastman, paleontologist at Harvard University, in charge of fossil vertebrates, to foreign membership in the society.

M. WALLERANT has been elected a member of the Paris Academy of Sciences in the section of mineralogy.

A BRONZE cut of President Eliot has been placed in the Harvard union. It is the work of the French medalist, Leon Deschamps, and is the original from which were taken the bronze medals made in connection with the John Harvard celebration.

Nature states that the executive committee of the National Physical Laboratory has appointed Mr. G. W. Walker, official assistant to the professor of natural philosophy in the University of Glasgow, as superintendent of the Eskdalemuir Observatory. Mr. Guy Barr, of Christ's College, Cambridge, has been appointed to an assistantship in the metallurgical and chemical department of the National Physical Laboratory.

DR. ROBERT BELL, chief geologist of the Canadian Geological Survey, was the guest of honor at the banquet of the Canadian Camp, held recently at Hotel Astor, New York City.

DR. WILLIAM R. BROOKS, director of the Smith Observatory and professor of astronomy at Hobart College, Geneva, N. Y., recently delivered his illustrated lecture on "Comets and Meteors," at Trinity College, Hartford; and at Wellesley College, Mass.

AN expedition from the Desert Laboratory, including among its members Dr. D. T. MacDougal, Mr. Godfrey Sykes, Dr. W. T. Hornaday, of the New York Zoological Garden, and the Honorable J. M. Phillips, game commissioner of Pennsylvania, has recently traversed the region between Tucson and the Gulf of California. The geographical investigations centered at the Desert Laboratory were extended to include the Pinacate volcanoes, which lie near the Gulf of California in Sonora, and a general survey of plant distribution was made. A number of sunken craters, some of which were a mile in diameter and several hundred feet in depth, were discovered and measured, and material for the compilation of a map of the region was obtained. In addition to somewhat unexpectedly valuable data on the occurrence and distribution of desert plants and animals, splendid specimens of the big horn and antelope were secured, together with important information as to their habits and general behavior in this secluded region.

Nature says "Professor Bedson last June completed his twenty-fifth year as professor of chemistry at the Armstrong College, Newcastle-upon-Tyne. The event was the occasion of many congratulations and suitable presentations. In addition to the celebration arranged last summer, we notice from the report of the principal of the college that the council has 'deemed it only fitting to mark the occasion, and its profound appreciation of Professor Bedson's exceptional services to the college, by unanimously voting him a "jubilee" vacation of six months, to take effect in the course of the coming year, together with a sum of £200.' We congratulate Professor Bedson, and commend the course of action adopted by the Newcastle authorities to the notice of other college councils."

We regret to record the death of Sir James Hector, F.R.S., the British geologist, at the age of seventy-three years; of Admiral McClintock, the British Arctic explorer, at the age of eighty-eight years, and of Professor T. Barker, who formerly held the chair of mathematics at Owen's College, at the age of sixty-nine years.

The Michigan Academy of Science will hold its fourteenth annual meeting at Ann Arbor, Michigan, on April 2, 3 and 4, 1908. The titles of all papers to be presented at this meeting should be sent to the vice-presidents of the different sections before March 1, 1908. The officers of the academy are: President, Mark S. W. Jefferson, Ypsilanti; Acting Secretary-Treasurer, Walter G. Sackett, Agricultural College; Librarian, G. P. Burns, Ann Arbor. Vice-Presidents: Agriculture, A. C. Anderson, Agricultural College; Botany, W. E. Praeger, Kalamazoo; Geography and Geology, E. H. Kraus, Ann Arbor; Sanitary Science, J. G. Cumming, Ann Arbor; Science Teaching, S. D. Magers, Ypsilanti; Zoology, A. G. Ruthven, Ann Arbor.

The Physical Society, London, held its third annual exhibition of electrical, optical, and other physical apparatus at the Royal College of Science, South Kensington, on Friday evening, December 13, from seven to ten o'clock.

The Smithsonian Institution has published a fourth edition of meteorological tables. The publication of meteorological, physical and geographical tables is in furtherance of a policy adopted as early as 1852 by Secretary Henry, two years after the establishment of the Smithsonian weather service. In the preparation of the volume the institution was aided by Professors Alexander McAdie and Cleveland Abbe of the U. S. Weather Bureau.

Bulletin No. 33, from the Bureau of American Ethnology, by Ales Hrdlicka, entitled "Skeletal Remains suggesting or attributed to Early Man in North America," reviews the Calaveras, Lansing, Nebraska and other crania which have been supposed by various writers to indicate the existence of crania of low type in North America. The author reaches the following conclusion: "The various finds of human remains in North America for which geological antiquity has been claimed have been thus briefly passed under review. It is seen that, irrespective of other considerations, in every instance where enough of the bones is preserved for comparison the somatological evidence bears witness against the geological antiquity of the remains and for their close affinity to or identity with those of the modern Indian. Under these circumstances but one conclusion is justified, which is that thus far on this continent no human bones of undisputed geological antiquity are known. This must not be regarded as equivalent to a declaration that there was no early man in this country; it means only that if early man did exist in North America, convincing proof of the fact from the standpoint of physical anthropology still remains to be produced."

THE London *Times* states that the president of the Liverpool School of Tropical Medicine, Sir Alfred Jones, has received a short report from the Blackwater Fever Expedition of the Liverpool School, dated October 10, from Blantyre. The expedition, consisting of Dr. Wakelin Bannaii and Dr. Yorke, sailed from Marseilles in August last. They report that suitable laboratories have been placed at their disposal by the government of British Central Africa at Blantyre and at Zomba. Six days after the arrival of the expedition at Blantyre two cases of Blackwater fever occurred on the Shire Highlands Railway. The expedition visited the cases at once, and kept them under close observation until recovery occurred. The British government are defraying a portion of the cost of the Blackwater Fever Expedition.

A COURSE of popular lectures on natural history and travel, under the auspices of the Illinois State Museum of Natural History, will be given in the Arsenal Auditorium, Springfield, Ill., on Saturday evenings at eight o'clock as follows:

November 30—"Diamond Mining" (illustrated), by A. R. Crook, Ph.D., curator, Illinois State Museum of Natural History.

December 7—"Greater Steps in Human Progress," by W J McGee, LL.D., director of the St. Louis Public Museum.

December 14—"Zoological Collecting in British East Africa" (illustrated), by C. E. Akeley, Field Museum, Chicago.

January 4—"Mt. Pelé and the Destruction of St. Pierre" (illustrated), by E. O. Hovey, Ph.D., American Museum of Natural History, New York City.

January 11—"The Canadian Rockies" (illustrated), by C. S. Thompson, commercial agent, Illinois Central R. R., Milwaukee.

ACCORDING to the Paris correspondent of the *British Medical Journal* an interesting ceremony took place on November 19 in the Clinic Charcot. In the presence of M. Briand, the minister of public instruction, Dr. Jean Charcot handed over the library of his father to the administration of the Assistance Publique. The library, which was slowly collected by Professor Charcot, and contains works in all languages on diseases of the nervous system, is now permanently housed in the Salpêtrière Hospital, in the actual bookshelves and surrounded by all the consulting-room furniture and ornaments amidst which Charcot lived and worked. In addition to the minister and Dr. Jean Charcot there were present on the platform M. Mesureur, the director of the Assistance Publique; Professor Raymond, Charcot's successor in the clinical chair of diseases of the nervous system; Professors Bouchard, Marie, Brissaud, Déjerine, Segond, Madame Jean Charcot, Madame Jeanne Charcot, Madame Raymond, and many old pupils and friends of Charcot. Dr. Jean Charcot, in making the gift, said that it was not without a pang that he separated himself from these souvenirs, among which he had grown up, and which he had seen his father collecting and adding to, searching among the bookstalls on the quays, where he was well known, but he thought his father would have approved his action, seeing that he himself had sought other outlets for his energies. Professor Raymond thanked Dr. Jean Charcot for his gift, which, when it was originally offered to the faculty of medicine to be placed in the Salpêtrière, had been refused owing to lack of funds. The money, however, was offered by the Assistance Publique, and the library would always be open to workers from France and abroad. On Charcot's death his son refused a large German offer for the valuable library, and proposed that it should form part of the clinic which his father founded and made famous. M. Mesureur also thanked Dr. Jean Charcot for his act of filial piety. The Assistance Publique was glad to be associated with the state in the matter of teaching, for with its numerous hospitals and organizations for the relief of the poor, it really formed a large school of medicine. M. Mesureur expressed hope that the state would give further help to different clinics which were in want of funds, and thus increase the renown of medical teaching in France. The minister added a few words of thanks to Dr. Jean Charcot for his abnegation in the higher interests of science and of the university, and hoped that his example would be followed in others. After the distribution of medals to some of the nurses and the gardener of the Salpêtrière, the library was visited by all present.

A committee appointed to advise the senate of London University on the course to be pursued in regard to the proposed Institute of Medical Sciences has reported as follows: (*a*) That, owing to the lack of adequate financial support, the scheme for the establishment of an Institute of Medical Sciences, as set forth in the original appeal, and (in a modified form) in the appeal of June, 1905, has proved abortive; (*b*) that, apart from the money difficulty, which, in the opinion of the committee, is of itself fatal, the scheme has also become impracticable for other reasons. The medical faculty, which formerly reported in favor of the scheme, has now reported against it. Several of the medical schools have changed their opinions in the same sense, and some of them have made arrangements involving considerable outlay for providing more efficient instruction in preliminary and intermediate medical studies; (*c*) that, in the above circumstances, the university has no claim to the money which has been already paid by subscribers, or to the fulfilment of promises by subscribers who have not yet paid their subscriptions; and (*d*) that, in the absence of any special directions in any particular case all subscriptions already paid ought at once to be returned to the donors (including in that term the executors or legal representatives of deceased donors) without any suggestion as to any possible application of the money to any other purpose.

UNIVERSITY AND EDUCATIONAL NEWS

The main building of Monmouth College, including the science laboratories, was destroyed by fire on Thursday morning, November 14. All the science work has suffered much. The loss to the biology department was the greatest, as the laboratory was on the third floor under the roof, where the fire started. The collections and apparatus of that department, which were of much value—and the laboratory—were almost completely destroyed. Plans are being made for rebuilding and carrying on the work meanwhile.

Rice Hall, housing the biological and chemical departments of Washburn college, Topeka, Kansas, was partially destroyed by fire on December 6. The loss, estimated at $30,000, is covered by insurance; the building will be restored in the spring.

Pennsylvania Day at the State College was celebrated on November 22, when the new agricultural building was dedicated. Addresses were made by Governor Edwin S. Stuart, Senator Bois Penrose, Mr. James A. Beaver, president of the Board of Trustees, Dr. Nathan C. Schaeffer, superintendent of public instruction, Director Thomas F. Hunt, of the School of Agriculture, and Director Whitman Jordan, director of the New York State Agricultural Experiment Station, Geneva, N. Y.

According to the New York *Evening Post* foreign countries are represented at Harvard University as follows: Canada, 42; China, 24; Japan, 8; England, 5; Mexico, 4; Republic of Argentina, 4; Germany, 3; Italy, 3; Australia, 2; Costa Rica, 2; France, 2; Ireland, 2; New Zealand, 2; Russia, 2; Bulgaria, 2; India, 2; Asia Minor, 1; British West Indies, 1; Korea, 1; Peru, 1; Siam, 1; Colombia, 1; Sweden, 1; Turkey, 1; Syria, 1; Rumania, 1; South Africa, 1.

President Norman Plass, of Washburn College, Topeka, Kans., has resigned to go into business, his resignation to take effect at the close of the academic year.

Dr. Louis Cohen has been appointed assistant professor of mathematics and Dr. Perley G. Nutting, assistant professor of physics at the George Washington University.

Mr. E. T. Campagnac has been elected professor of education at Liverpool University to fill the vacancy caused by the retirement of Professor Woodward.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, DECEMBER 27, 1907

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE CHICAGO MEETING

THE meeting of the American Association for the Advancement of Science and its affiliated national scientific societies, to be held in Chicago during the convocation week that begins on Monday next, will be an event of consequence for the history of science in America. It will be by far larger and more important than any previous gathering of scientific men west of the Atlantic seaboard. Since the establishment of convocation week and the affiliation of the scientific societies, there have been three large meetings, those of Washington five years ago, of Philadelphia three years ago and of New York a year ago. At each of these meetings the attendance exceeded 1,500, and the proceedings represented a considerable part of the scientific work accomplished during the year. In the Christmas holidays of 1901—the year before the first of the convocation-week meetings—the American Society of Naturalists met at Chicago, and this meeting was the largest in its history. It was surprising as well as gratifying to note the large number of active scientific workers from Illinois and the neighboring states, as well as the number willing to make the trip from the Atlantic states and even from the Pacific seaboard.

It is now nearly forty years since the American Association last met in Chicago.

At the meeting which opened on August 5, 1868, there were 259 members in attendance. The immediately preceding meetings at Burlington and Buffalo had, respectively, an attendance of only 73 and 79 members. At the time of the Chicago meeting the membership of the association increased from 415 to 686. The retiring president was Professor J. S. Newberry, the eminent geologist of Columbia University, and the president of the meeting was Professor B. A. Gould, the eminent astronomer of Harvard University.

The forty years that have elapsed since the Chicago meeting of the association have witnessed a growth of scientific and educational institutions and an increase in the number of scientific workers unparalleled elsewhere or hitherto. Cornell University was established in the year of the Chicago meeting; one year later the new administration of Harvard University under Dr. Eliot was inaugurated; the Johns Hopkins University opened its doors in 1876. Since then our universities have become great centers for research as well as for instruction. Parallel with them have been established museums and institutions devoted wholly to investigation; while the national government and the states have undertaken work in economic and pure science to an extent that none could have anticipated a few years ago.

The state of Illinois and the city of Chicago, beginning later, have witnessed a rapid development of their scientific institutions, scarcely rivaled by any other state or city. Nowhere else will there be found a state university and an incorporated university which have enjoyed a growth so great as that of the University of Illinois and the University of Chicago. Twelve years ago there were 500 students in the University of Illinois; there are now 4,000 students and 500 teachers. The University of Chicago, which has received gifts amounting to $27,000,000, was opened only sixteen years ago. Northwestern University and other institutions of the state have developed in nearly equal measure.

Our societies have aimed to adjust themselves to this scientific activity, ever increasing in range and complexity, and have on the whole succeeded. In 1875 the American Association was divided into two sections, one for the exact sciences and one for the physical sciences. In 1882 nine sections were established corresponding in general to the present organization, except that a section of physiology and experimental medicine was added five years ago, and a section of education will hold its first meeting next week at Chicago. The American Chemical Society was organized in 1876; the American Society of Naturalists in 1883, the Geological Society of America and the present American Mathematical Society in 1888, and there are now national societies for nearly every science. The interrelations of these societies offered many perplexing problems, and it can not be claimed that they are all solved. But it is undoubtedly true that progress has been made, and that the general spirit of cooperation among scientific men is better than ever before.

The natural group is those living in the same locality and having common interests. Such a group may unite with others in the same neighborhood to form an academy and with others following the same science to form a national society. The members of the local academies and national societies, in so far as they have common interests, would unite in a national association for the advancement of science. Among the questions open are the size of the local group—whether it should be limited to a city or include a state or have some other basis—whether it should be limited to the natural and exact sciences or should include other groups, as the historical and linguistic sciences or medicine and engineering. In the case of the special societies there is a tacit agreement to make them national or rather continental, but there is a tendency to hold sectional meetings. Thus this year the zoologists are meeting both in Chicago and in New Haven, and the mathematicians are meeting both in Chicago and in New York. It seems certain that the national societies will be maintained for purposes of publication, and it seems probable that they will continue to hold general meetings.

The American Medical Association has an organization devised with great care. There are county societies, which unite in state societies and these form a national association. The national association conducts an admirable weekly journal and holds annual migrating meetings. There is a house of delegates for legislative purposes having strong standing committees. The teachers of the country, who, like the physicians, are subject to county regulations and state laws, are organized along similar lines, but less effectively. The chemists, who include those engaged in professional work as well as those devoted to pure science, have an excellent monthly journal and regional sections with two annual migrating meetings, one of which is held in affiliation with the American Association. Each of the natural and exact sciences has now its organization, and in some cases the society has regional sections. Thus the American Mathematical Society holds meetings in the eastern, central and western states and the American Society of Zoologists in the eastern and central states. There are also local societies for special sciences, which are not as yet affiliated with the national organizations.

We surely need a general association to represent the united scientific interests of the country, but the relations that should subsist between it and the special national societies and the local and state academies are not entirely clear. The American Association may become an affiliation of scientific societies rather than of individuals, its work being done by a council or senate representing the separate societies. It may hold meetings that are national or sectional or both. It may include only the natural and exact sciences, being coordinate with the associations for philology, history, medicine, engineering, education, etc., or it may aim to represent all the scientific interests of the country.

Under existing conditions of our civilization cooperation and organization are required, and there are at least four reasons, which make them essential in science. The first of these is that science is by its nature cooperative; men of science must work together for a common end. The second is the vast importance of science for the stability and progress of society. The third is that scientific work is not economically self-supporting. Scientific men are not paid directly for the research work they do, and means must be found by which scientific work shall be supported. The fourth is closely connected with this—the need to keep science in touch with the general public, whence it must obtain its recruits and its support.

We can not therefore doubt that a national association for the advancement of science will be maintained, and that it will grow in importance and influence. It is the part of each scientific man to support the existing organization, to exercise patience when the complexity of the immediate situation does not admit of easy solution, and to do his share toward improving the conditions. Not only all scientific men, but also all those who wish well to science, should appreciate the privilege of membership in the American Association and the desirability of attending the approaching meeting at Chicago.

HISTORY OF THE FORMER STATE NATURAL HISTORY SOCIETIES OF ILLINOIS[1]

The history of scientific organization is a part, merely, of the history of scientific progress, and that is a part of the history of the progress of civilization, and especially of education; and the subject which I am to present is no exception to this rule. It is difficult to omit from even a brief abstract of the history of the Illinois natural history societies all reference to the character and status of the general movements of which they were scarcely more than by-products, and still to leave in the account enough significance to make it worthy of presentation here. Under these circumstances I shall be governed by the reflection that we are to-day looking forward and not back—that we are preparing for the future and not studying the past—and that we are hence practically interested in what has come and gone only as it may help us to bring a new thing into being in a way to secure its permanent continuance and its normal growth. There have been two state natural history societies in Illinois, one founded in 1858 and the other in 1874. The first was the result of a proposal by an entomologist, Dr. Cyrus Thomas, afterwards state entomologist of Illinois, made at a meeting of the State Teachers' Association at Bloomington in 1857. The second sprang up as a sequel to the sessions of a summer school of natural science held at the State Normal School, at Normal, and had for its first president the state geologist, A. H. Worthen, and for its first secretary the present writer, then in charge of the museum of the old society in the State Normal building.

The first society was chartered by the state legislature in 1861; held its tenth and last annual meeting in 1868; published, in 1861, Volume I., series 1, of its *Transactions* (in Volume IV. of the *Transactions* of the State Agricultural Society, and again, in a second edition, in 1862, as a separate pamphlet, a rare copy of which I hold in my hand); formed a museum of natural history which was housed in the building of the State Normal School at Normal; and held two final business meetings in Bloomington, May 26 and June 22, 1871, for the transfer of its museum to the state in accordance with a provision of law passed by the general assembly of that year. This museum, held by the State Board of Education "for the use and benefit of the state," was gradually transformed, in due time, into the present State

[1] An address given on the occasion of a meeting called to establish the Illinois Academy of Sciences.

Laboratory of Natural History. A part of its original material is now in the possession of that institution at Urbana, a part of it belongs to the State Normal School at Normal, and the remainder is in the State Museum of Natural History, founded here in 1879, and now in charge of Professor Crook as its curator.

The officers of the society mainly responsible for its establishment and growth were its corresponding secretary, later called its general commissioner, and the curator of its museum. The former was its field agent and general manager, and the latter was the custodian of its collections. Its first corresponding secretary was C. D. Wilber, who served in that capacity until 1864. He subsequently became a mining engineer, much consulted by western railroads in the location and development of coal lands on their grants and in their neighborhoods. Its curator was for several years Dr. J. A. Sewall, instructor in chemistry in the State Normal School, at Normal, and afterwards president of the Colorado State University. Its second general commissioner, and afterwards the second curator of its museum, was Major J. W. Powell, who was in its service in the latter capacity when he made those remarkable western explorations, and especially that most remarkable expedition down the Colorado River of the West, which gave him world-wide fame and did much to make him later the United States Geologist. The third actual curator, serving, however, nominally as Major Powell's deputy, was Dr. George W. Vasey, afterwards for many years botanist to the United States Department of Agriculture at Washington; and the last to serve in this capacity was the present writer, appointed by the State Board of Education in 1872, after the state had acquired the museum, and continued as director of the State Laboratory of Natural History after the change of name and function finally made in 1879.

This society came into existence at a time so different from our own that we can derive little from its experience by way of either warning or instruction. Its period was that of the first active exploration and discovery of the scientific contents and economic resources of our territory, and of the first general impulse to the scientific education of the people; and the society was formed as an agency for a natural history survey of the state, in the old sense of an accumulation of museum specimens and a descriptive record of its zoology, botany and paleontology—meteorology and physical geography being nominally included, also, within the scope of the society. In 1858 the State Geological Survey was just getting on its feet, with Mr. Worthen appointed that year as its director. The normal school at Normal was the only state educational institution in Illinois, and that had been organized only one year. The state university was not founded until nine years thereafter, at which time, also, the state entomologist's office was first established.

Almost none of the men engaged in the work of this old society had anything approximating what we would now call a scientific education, and very few of them were what we would now call professional scientists or teachers of science, and yet they were evidently the pick of the state in scientific ability, enthusiasm and activity. Among its more efficient members, besides Powell, Vasey, Worthen and Thomas, already mentioned, were Benjamin D. Walsh, the first state entomologist; M. S. Bebb, well known for his work on the willows of the United States; Dr. Oliver Everett, of Dixon; James Shaw, of Mt. Carroll, and Dr. Henry M. Bannister, the last two assistants on the Geological Survey; Dr. J. W. Velie, a life-long ornithologist, still living in Michigan; and Dr. Frederick Brendel, of Peoria, author of many botanical papers, and also still with us, one of the very few survivors of the early membership. I must not omit, even in this briefest mention, the name of Professor J. B. Turner, of Jacksonville, first president of the society, famous in the history of the state universities because of his leadership in the pioneer movement for an industrial education of college grade; nor Dr. Edmund Andrews, of Chicago, who became one of the leading surgeons of that city; nor Newton Bateman, state superintendent of public instruction, who lent to the society the prestige of his great name—a most potent educational influence in that day.

You will wish, I am sure, to know something of the subjects in which the more prominent members were interested, and on which they wrote their papers for the society programs, and I will mention a few of them, taken at random. By Dr. Brendel: "Forests and Forest Trees of Illinois," "The Trees and Shrubs of Illinois," "The Oaks of Illinois," "Meteorology in connection with Botanical Investigations," "Additions to Robert Kennicott's Flora of Illinois." By Dr. Everett: "The Geology of a Section of Rock River Valley." By A. M. Gow, of Dixon: "Natural History in Schools." By R. H. Holder, of Bloomington: "A Catalogue of the Birds of Illinois." By James Shaw: "The Great Tornado of 1860." By Dr. Thomas: "Insects of Illinois, with Catalogue of Coleoptera," "Mammals of Illinois." These latter papers, it scarcely need be said, were extremely slight sketches of their subjects. By Dr. Vasey: "Additions to the Flora of Illinois," "The Pernicious Weeds of Illinois," "The Range of Arborescent Vegetation." By Dr. Walsh: "Insects Injurious to Vegetation in Illinois," "The Army-worm and its Insect Foes," "Insect Life in its Relation to Agriculture." By Mr. Wilbur: "The Mastodon giganteus, its Remains in Illinois." Most of these papers were published in the *Transactions* of the State Agricultural Society, some of them also in the *Prairie Farmer*, of Chicago, those being virtually the only avenues of publication open to students of science in Illinois in that day.

The society operated through an elaborate organization of special committees of its members, one for each division of the natural history of the state, each committee composed, of course, of unpaid volunteers who were made responsible for the accumulation and preparation of material for their several departments of the museum, and for contributions on their respective divisions of its natural history. This survey work was extremely irregular in amount and unequal in value, and its results were never organized by the society into a working collection. The curator was an instructor in the normal school, and seems to have received no pay from the society; but the general commissioner was supposed to give his entire time to its service. His salary was evidently uncertain in amount, and dependent largely on his success in securing entrance fees from new members. Financial complications arose—disputes as to ownership of property, difficulties in the payment of debts incurred, refusals to turn over to the treasurer the funds claimed by the society—and these, with other confusing and discouraging conditions, led to the withdrawal by members of gifts and deposits of specimens and a falling off in the active membership. The society finally collapsed chiefly because of its financial disabilities. Since it could neither pay adequately its general commissioner or its curator, nor organize its collections or publish its papers from its own resources, it turned to the state for aid, and found itself ultimately obliged to accept the condition that its property should be transferred to the state, and that its curator should be appointed by a state board, as the price of continued appropriations; which, by the way, were largely drawn upon to outfit and maintain the Powell expeditions to the far west. (Fifteen hundred dollars directly appropriated by the State Board of Education.)

There is no doubt that this short-lived society brought a body of influential public opinion to the aid of state scientific and educational enterprises appearing during its existence, and that it did much to stimulate a general interest in scientific knowledge and research, and thus to hasten the introduction of the sciences into the public schools—influences which did not cease when its own organic life was ended. It also afforded to Powell the standing-ground from which he leaped into fame as an explorer, and won his way to a scientific career of the first importance, and it left in its museum nuclear collections which were later made useful in a revival and firm establishment of the original enterprise of the society, modified to suit more modern ideals, by the State Laboratory of Natural History. This first state society thus gave indirect origin to the state laboratory, with which the state entomologist's office became practically identified in 1883, much as the first geological survey of the state gave origin to our present state museum. If our new academy do no more, proportionately to its period and its environment, within the next ten years, it will amply justify our proceedings to-day.

By 1879, after an interval of eleven years from the actual dissolution of the old society, a virtually new situation had arisen in science, and especially in scientific education. Under the influence of Darwin and Agassiz and Huxley, a transforming wave of progress was sweeping through college and school, a wave whose strong upward swing was a joy to those fortunate enough to ride on its crest, but which smothered miserably many an unfortunate whose feet were mired in marsh mud. This wave reached central Illinois in the early seventies with the effect to bring about, in 1875, a summer school of natural history at the State Normal School—only two years, it will be noticed, after the first session of the Agassiz School at Penikese. Wilder, of Cornell, and W. S. Barnard, just back from Europe with a doctor's degree, were members of its teaching staff, together with Burrill, of the State University; Thomas, the state entomologist, and the present writer, who was also director of the school. Besides an abundance of living plants and animals of our own environment, we had great boxes and barrels of marine material in large variety, some of it received alive, secured by a most active collector engaged for the purpose, who scoured the New England coast for us from Portland to Buzzard's Bay. This school was a notable success, except that the Illinois instructors all worked for nothing and paid their own expenses; but the Centennial Exposition of 1876 deranged plans for its immediate continuance. In 1878, however, a second equally successful session was held, at the close of which its students spontaneously organized themselves into a natural history society, and appointed a committee of correspondence to extend its membership and enlarge its scope. As a consequence of the numerous and unanimously favorable responses to the letters following, a conference was held at the office of the state geologist in Springfield, December 12, 1878, and the secretary of this conference was instructed to call a convention at Chicago for the organization of a state natural history society.

Some forty persons responded to the call, and organized at the Palmer House, January 16, 1879, and letters were read from fourteen others who wished to join the proposed society. The first officers were A. H. Worthen, of Springfield, president; T. J. Burrill, of Urbana, and H. M. Bannister, of Chicago, vice-presidents; Homer N. Hibbard, of Chicago, treasurer; S. A. Forbes, secretary, and Selim H. Peabody, of Champaign, and Cyrus Thomas, of Carbondale, additional members of the executive committee. By the close of the year sixty-six members had paid their initiation fees of three dollars each.

This was the period of the return to nature in the study of science, and annual field meetings were provided for. The first of these was held at Ottawa, July 10, 1879. Dividing into three sections—geological, botanical and zoological—under the leadership of Worthen, Burrill and Forbes, respectively, the society took to the woods in the beautiful, prolific and historically interesting valley extending along the Illinois River eighteen miles from Ottawa to Peru, and with Starved Rock, Deer Park, Buffalo Rock and the site of the famous Indian village at Utica within or near its boundaries.

Annual program meetings followed at Bloomington, Springfield, Urbana, Springfield, Peoria and Jacksonville; and field meetings at Lake George, Indiana, near Chicago, where a Chicago sportsmen's club placed their club-house, premises and equipment at our disposal; at Fountain Bluff and Grand Tower, on the Mississippi in southern Illinois; at Warsaw, in Hancock County, the home of Mr. Worthen; and at Peoria, where the Peoria Scientific Association joined us in a steamer trip up the Illinois River for aquatic work. These field meetings were well attended, as a rule, and were much enjoyed, although it must be confessed that they were perhaps more agreeable than permanently profitable to us. The annual meetings also were interesting to the participants, and did something, no doubt, to stimulate the workers among us, and something also to interest and instruct the communities in which they were held. Their average character may be well enough illustrated by the program of the Urbana meeting in 1882.

The first session was devoted to an address on "Primitive Religion in America," by Mr. McAdams, of Jerseyville, which was substantially an account of the religion of the Mound Builders as inferred from idols and other implements of a religious character which had been collected by the speaker. During the next session, Dr. Edwin Evans, of Streator, read a paper on "The Rock System of the Northwest," based mainly on the records of borings for artesian wells, and illustrated by maps and colored diagrams. This was followed by a paper on "Recent Microscopy," by Professor Burrill, of the university, giving a historical account of the development of the microscope and a description of its most recent improvements and performances; and this by a paper on "Prehistoric Remains in Southeastern Missouri," by F. S. Earle, of Cobden—essentially a classification and general description of mounds studied on a trip made for the Smithsonian Institution. A lecture on "The Fossil Tracks of the Connecticut Valley," by Don Carlos Taft, professor of geology in the university; a paper on "The Army-worm in 1881," by F. M. Webster, of Waterman; and one on "The Organs of the Sixth Sense of Blind Fishes," by S. A. Forbes, completed the program of the first day, which was followed by an evening reception to the society by the faculty and students of the university, and a microscope display given jointly by the university and the society.

The program of the following day contained a paper on "Sciences in the Public Schools," by C. W. Rolfe, of the university; one by Mr. McAdams on "The Great

Cahokia Mound of Madison County,'' of which the writer had just completed a survey; one by Professor Burrill on ''Some Vegetable Poisons,'' and one by Mr. Forbes on ''The First Food of the White-fish.'' Professor N. C. Ricker, of the university, read a paper on ''The 'Blue Process' of Copying by Photography,'' just coming into use for the duplication of papers and drawings; James Forsythe, of Champaign, gave an account of the life history of a jellyfish studied by him at Beaufort, S. C.; Dr. Evans gave a paper on ''The Subterranean Waters of the Northwest''—a discussion of the origin of the artesian waters of northern Illinois and southern Wisconsin; Mr. A. B. Seymour, botanist to the State Laboratory of Natural History, read a paper on ''Field Work on Parasitic Fungi''; Mr. Cyrus W. Butler, also a state laboratory assistant, gave some zoological notes from the field-book of a naturalist; J. A. Armstrong presented an abstract of the papers read at a recent meeting of the University Natural History Society; and Professor Rolfe read brief papers on ''Experiments with Germinating Seeds,'' and on ''The Rings of Wood as indicating the Growth of Trees.''

In 1880 the question of an enlargement of the field of the society to include the physical and mathematical sciences came up for discussion, and was decided negatively, on the ground that the interests represented by physicists, chemists and mathematicians were so separate from those of the naturalists that a common society was not desirable—a conclusion perhaps warranted in view of the kind of naturalists that most of us were.

In 1882, when the treasurer reported a balance of $150 in his hands and $122 more due from members in annual fees, the question of a publication of papers and proceedings was brought forward in the secretary's report and referred to a committee; but no steps were taken to that end on the ground that it was not desirable to multiply centers of publication unnecessarily, and that there was no lack of opportunity to publish really valuable papers in established periodicals.

Following upon these conclusions, and possibly in part because of them, the paid-up membership of the society began to decline. Indeed, of the sixty-six persons who completed their membership during the first year, thirty-nine did not continue their payments thereafter, and at the end of the second year the actual paid-up membership was fifty-two. The following year it was fifty-four, then fifty-two, then forty-three and finally, in 1884, it fell to twenty-seven. The executive committee took these facts to indicate that there was at the time no sufficiently general and urgent desire for the permanent maintenance of a society of this description to warrant its continuance, and after the Jacksonville meeting of 1885, which passed without a formal election of officers, it was not called together again.

And now I hardly need say that, after the lapse of twenty-two years of amazing progress in science and in scientific education, an entirely new situation again exists in Illinois—one so radically different from that of the early eighties that the conclusions then reached have no very important bearing on our problem of to-day. There are more college specialists here to-day from one department of one institution than there were in our whole membership in 1879. Indeed, that list is not so long that I can not give it to you now, to emphasize the contrast. It consisted of J. D. Conley, of Carlinville; T. J. Burrill, of Urbana; S. H. Peabody, of Champaign; Rev. Francis X. Shulak, of St. Ignatius College, and E. S. Bastin, of the old University of Chicago—five men, one of whom, Dr. Bastin, did not meet with us again.

Lindahl, of Rock Island, and Marcy, of the Northwestern, joined us in 1880, and Robertson, of Carlinville, in 1882, and a few additional members of the faculty of the State University paid us the compliment of an initiation fee when we held our meeting at Urbana, but went no farther with us. If there was any professional or active worker in biology or geology at any other Illinois college at the time, we never made his acquaintance nor he ours. Of the state scientific officials there were only Worthen, Thomas and Forbes. Thomas left the state in 1883, but the two others stayed with the society to the end.

It should be remembered, in this connection, that this was a time when college men, as a rule, worked like dray-horses and were paid like oxen, and the sacrifice of time and means necessary to prepare adequately for the annual and semi-annual meetings of the society, and then to attend them, was more than they could, or ought to, make, except for some really important end.

It will be seen that, under these conditions, our membership would now be almost wholly classed as amateurs. The active members of the last two years were chiefly collectors of specimens, and species-students of the old school—a few still-glowing brands from the enthusiasms of the exploration period, with scarcely a spark to testify to the coming illumination, in the midst of which it is our present privilege to live. And so the society passed, leaving no permanent material product of its work, except private collections and such papers of its members as were published here and there, as each individual thought best.

Does this account seem discouraging to our present undertaking? I do not think that it ought to; but quite the contrary. If, under such conditions, with so little material, and—as a reasonable modesty perhaps requires that I should add—under such general management, it was possible then for us to organize a state natural history society and to keep it actively at work for seven years, we ought now, I think, with all our present comparatively immense advantages, to found a state academy of sciences which shall live and thrive at least for seventy years, and, for all that I can see, for seventy times seven—by which time we shall all have been long relieved from all our responsibilities, and the labors and the honors of scientific enterprise will have been handed on to our remote successors.

S. A. Forbes
University of Illinois

MEDALS OF THE ROYAL SOCIETY[1]

The Copley medal is awarded to Professor Albert Abraham Michelson, foreign member of the Royal Society, on the ground of his experimental investigations in optics.

In 1879 Michelson brought out a determination of the velocity of light by an improved method, based on Foucault's which gave 299,980 kilometers per second. Three years later, by means of a modification of the method, capable of even greater precision, he found for this constant, of fundamental importance for electric as well as optical science, the value of 299,853 kilometers.

Michelson has been a pioneer in the construction of interferometers, which are now indispensable in optics and metrology. With his new instrument, at Paris, he determined the absolute wave-lengths of the red, green and blue lines of cadmium by counting the number of fringes (twice the number of wave-lengths) corresponding to the length of the standard meter of the Bureau International des Poids et Mesures. He found the meter to be 1,553,164 times the wave-length of the red line of cad-

[1] Concluding part of the presidential address of Lord Rayleigh—read at the anniversary meeting of the Royal Society on November 30.

mium, a result which is almost in exact agreement with the redetermination last year by Perot and Fabry. Michelson thus proved the feasibility of an absolute standard of length, in wave-lengths, of such accuracy, that if the standard meter were lost or destroyed it could be replaced by duplicates which could not be distinguished from the original.

He had the greatest share in the elaboration of precise experiments on the relative motion of ether and matter. He repeated in an improved form Fresnel's experiment of the speed of light in moving media, using water and sulphide of carbon. He found that the fraction of the velocity of the water by which the velocity of light is increased is 0.434, with a possible error of $\pm$ 0.02. The fact that the speed is less in water than in air shows experimentally that the corpuscular theory is erroneous; but his results, moreover, established the correctness of Fresnel's formula for the effect, the theory of which has since become well understood.

In conjunction with E. W. Morley, he devised and carried out a very remarkable method by which, on the assumption of ether at rest, an effect depending on quantities of the order $(v/V)^2$ would appear to be appreciable. No displacement of the fringes was found. Of this result the simplest explanation would be that the ether near the earth partakes fully in its orbital motion; but modern electric and optical science appears to demand a quiescent ether, and the existence of this and similar null results is fundamental for its theory.

He has shown the possible application of the interferometer method to astronomy, by himself measuring the diameters of the four satellites of Jupiter, which are only about one second of arc. He suggests the further application of the instrument to such of the fixed stars as may not subtend less than one hundredth of a second of arc.

In 1898 Michelson constructed a spectroscope which enables us to make use of the great resolving powers of the very high orders of spectra which are absent in the use of the ordinary grating, and with the added advantage of having most of the light in one spectrum. The echelon consists of a pile of glass plates of precisely equal thickness, which overlap by an equal amount; with it spectral lines which appear single with the most powerful gratings can be resolved into components. This instrument has been especially useful for the direct observation of the important, because definite, influence of magnetism on light, discovered by Zeeman. With thirty plates, and using the 25,000th spectrum, the echelon has a resolving power of 750,000, while the most powerful gratings do not exceed 100,000.

In connection with the analysis of radiations, he has constructed and used various machines for the analysis of periodic motions. For example, in conjunction with Stratton, he perfected a remarkable machine which is based on the equilibrium of a rigid body under the action of springs.

Professor Michelson has also investigated by his interferometer the important subject, both theoretically and practically, of the breadth and the structure of spectral lines, including the effect of a magnetic field, and in various other ways his genius has opened up new ground in experimental optics.

One of the Royal medals has been awarded, with the approval of His Majesty, to Dr. Ernest William Hobson, F.R.S.

During the last twenty years Dr. E. W. Hobson has been distinguished for the fundamental character of his contributions to mathematics and mathematical physics. His earlier published work, from 1888 onwards, deals largely with the so-called harmonic analysis, which embraces many topics having for their common aim the solution of the potential equation in forms suitable for application to the problems of physics. The exhaustive examination of the general types of harmonic functions contained in his paper in the *Philosophical Transactions,* 1896, has been found to be of high utility for this application. He was led by these researches, and particularly by the difficulty of describing in general terms the characteristics of a function capable of being represented by Fourier's series, to take part in the revision of the logical basis of differential and integral calculus which is now in progress; his presidential address to the London Mathematical Society in 1902 on the questions here arising aroused general interest among mathematicians, and he has recently (1907) published an extensive volume dealing with the whole matter and its applications to the theory of Fourier's series, which is of great importance for the history and development of mathematics.

His Majesty has also approved the award of a Royal medal to Dr. Ramsay H. Traquair, F.R.S. Dr. Traquair is honored on the ground of his long-continued researches on the fossil fishes of Paleozoic strata, which have culminated, within the past ten years, in his discovery of new groups of Silurian and Devonian fishes, and in his complete exposition of the structure of *Drepanaspis, Phlyctenaspis* and other remarkable forms.

For nearly forty years Dr. Traquair has been busy with the description of fossil fishes, mostly from the Paleozoic rocks of Scotland, and he is deservedly held to be one of the most eminent paleontologists of the day. He has been highly successful in the interpretation of the often very obscure and fragmentary remains which he has had to elucidate, and his restorations of fishes have won such credit as to appear in all modern text-books of paleontology. It may be said that his work, notwithstanding the great difficulties of the subject, has well stood the test of time.

Dr. Traquair has done much to advance our knowledge of the osteology of fishes generally. His earliest memoirs on the asymmetrical skull of flat-fishes and on the skull of *Polypterus* remain models of exactness. His acquaintance with osteology enabled him to show how former superficial examination of the Paleozoic fishes had led to wrong interpretations. He demonstrated that *Chirolepis* was not an Acanthodian, as previously supposed, but a true Paleoniscid. In 1877 he satisfactorily defined the Paleoniscidæ and their genera for the first time, and conclusively proved them to be more nearly related to the sturgeons than to any of the other modern ganoids with which they had been associated. He thus made an entirely new departure in the interpretation of extinct fishes, replacing an artificial classification by one based on phylogenetic relationship. His later memoir on the Platysomidæ was equally fundamental and of the same nature.

All subsequent discoveries, many made by Traquair himself, have confirmed these conclusions, which are now universally accepted.

In 1878 Dr. Traquair demonstrated the dipneustan nature of the Devonian *Dipterus,* and somewhat later he began the detailed study of the Devonian fishes. His latest researches on the Upper Silurian fishes of Scotland are equally important, and provide a mass of new knowledge for which we are indebted to his exceptional skill and judgment in unraveling the mysteries of early vertebrate life.

The Davy medal is awarded to Professor Edward Williams Morley. Professor Edward W. Morley is well known both to chemists and to physicists for his work in the application of optical interferences and other physical phenomena to increase the accuracy of measurement. Numerous valuable papers have appeared, either in collaboration with Professor Michelson and others, or in his own name, on such subjects. Special reference may be made to his experiments, in conjunction with Professor Michelson, on the fundamental question of the absence of effect of translatory motion of material bodies on luminous phenomena.

His claim to the Davy medal rests on grounds closely related to these researches, for he has combined thorough mastery of accurate measurement with an intimate knowledge of modern chemistry, and has utilized them in his attempt to solve one of the most difficult and fundamental problems of chemical science. The special problem to which he has consecrated many years of his life is the determination of the relative atomic weights of hydrogen and oxygen; it has been attacked by him with rare insight and skill, and with indomitable perseverance, and he seems to have settled it for many years to come, if not permanently. All the recent work devoted to this problem, and there has been much, has tended to establish more firmly the ratio arrived at by Professor Morley.

His determinations of the absolute weights of a liter of hydrogen and of oxygen, and his investigations of the amounts of moisture retained by gases dried by various desiccating agents, are of the very greatest importance for scientific progress.

Professor Wilhelm Wirtinger, of Vienna, is the recipient of the Sylvester medal. He is distinguished for the importance and wide scope of his contributions to the general theory of functions. Our knowledge of the general properties and characteristics of functions of any number of independent variables, and our ideas for the further investigation of such functions, are, for the most part, at present bound up with the theory of multiply-periodic functions, and this theory is of as great importance for general solid geometry as the ideas of Abel have proved to be for the theory of plane curves. Professor Wirtinger has applied himself for many years to the study of the general problems here involved. A general summary of his researches is given by him in the Abel centenary volume (XXVI., 1902) of the *Acta Mathematica*. Two of his papers may be particularly referred to, both of 1895. One of these deals with the reduction of the theory and general multiply-periodic functions to the theory of algebraic functions, with a view to their expression by theta functions; this was one of the life problems of Weierstrass, who did not, however, during his lifetime, publish anything more than several brief indications of a method of solution. Professor Wirtinger's memoir obtains a solution, and is, moreover, characterized throughout by most stimulating depth and grasp of general principles. This paper was followed by two others, one continuing the matter in detail, the other making an application of its principles to the general theory of automorphic functions. Another extensive paper, which obtained the Beneke prize of the Royal Society of Göttingen, deals with the general theory of theta functions. In it he obtained results of far-reaching importance, for geometry as well as for the theory of functions, the full development of which will require many years of work.

The Hughes medal is awarded to Principal Ernest Howard Griffiths. Principal Griffiths has conferred great benefit on physical science by his series of measurements of fundamental constants, mainly in the domain of thermal and electric energy. At a time when the equivalent of the thermal unit in mechanical energy stood urgently in need of revision, he devoted himself to the problem with all the refinements and patient manipulation that could be devised, the result being a value for Joule's equivalent which at once acquired authority in the light of the evidence produced, and largely confirmed the corrections already advanced by Rowland and others. A main cause of discrepancy had been found to be the variation of the thermal capacity of water with the temperature; and by an investigation in which this variation was determined, Griffiths elucidated and correlated fundamentally the work of previous observers, from Joule onward. Of special importance also, in the domain of chemical physics, was an investigation of the depression of the freezing point of water by very dilute admixture of dissolved substances, wherein he verified, with all the refinement of absolute physical determinations, that the change of freezing point ran exactly parallel to the electric conductivity when the dilution of the electrolyzable salt was comparable to that of gases, being twice as much per molecule as the standard value of the depression for non-electrolytes.

The Buchanan medal is awarded to Mr. William Henry Power, C.B., F.R.S. Mr. Power's services to hygienic science and practise have extended over a period of more than thirty years, and have been of the most distinguished kind. He has himself personally conducted successful inquiries into the causes of the spread of various diseases, and has obtained results which have proved of the greatest benefit to mankind. Moreover, in his long connection with the medical department of the Local Government Board he has planned and directed numerous general and local investigations whereby our knowledge of disease, and of the methods of coping with it, have been greatly increased. The medical reports issued by the Local Government Board, which are universally regarded as among the most important contributions of our time to this subject, have for many years past been either written by him or owe much to his editorial criticism and supervision. It is not too much to say that no living man in this country has advanced the cause of scientific hygiene more than Mr. Power, or is more worthy of the distinction of the Buchanan medal.

SCIENTIFIC BOOKS

Research in China. Volume I., Part 2. *Petrography.* By Eliot Blackwelder. Carnegie Institution of Washington, Washington. 1907.

Rocks from northern and central China are described microscopically in this portion of the report; their field relations and stratigraphy have been given in Part 1 of this volume. The method of treatment is as individual specimens arranged according to geographical distribution, that is, by districts of which eleven are recognized. Their further arrangement is by geological age, mode of formation, and finally by petrographic character. The report is, therefore, a detailed statement of observations and data, with little attempt at general or comprehensive summary of results. The material collected is not considered sufficient for such a treatment.

The Khin-Gan district of the mountain range by that name in northwestern Manchuria, so far as seen from the Chinese-Eastern Railroad, appears to be made up largely of igneous rocks. In addition to a gray biotite-granite there are black quartz-porphyry, hornblende-porphyry, feldspar-porphyry and gray hornblende-granite.

In the western portion of the Liau-Tung peninsula in southern Manchuria the rocks observed belong to several distinct systems: The T'ai-shan gneissic complex; the Ta-ku-shan schists, quartzites and marbles; the Sinian sedimentary series including quartzite conglomerate and psammites of Cambro-ordovician age, besides igneous rocks in dikes. These are rhyolite porphyries, andesitic and basaltic porphyries, more or less altered.

In the neighborhood of Peking a small ridge of greenish aporhyolite occurs. It appears to have been at one time a glassy rock.

The western Shan-Tung district contains rock formations ranging from the oldest Pre-Cambrian to early Mesozoic (?), consisting of rocks of metamorphic, igneous and sedimentary origin. The oldest rocks are gneisses and schists. Embracing biotite-gneiss, biotitic-hornblende-gneiss, hornblende-gneiss, and schists of similar composition. With these are associated biotite granites. The limestones and shales forming the Sinian system present features of interest in the oolitic concretions that have been extensively developed, and have subsequently undergone recrystallization into aggregates of coarser crystals, and in the conglomeratic character of some of the limestone interformational conglomerates. These sedimentary rocks are described in detail. Associated with the Sinian series are basaltic and dacitic porphyries, besides syenitic and quartz-syenite porphyries in dikes and intruded sheets. The carboniferous strata overlying the Sinian series are traversed by dikes and sheets of various kinds of rocks, and by some extrusive flows of basalt. The commonest rocks are basalts and syenite-porphyries, with some dacites and andesites. There is also less commonly gabbro and peridotite.

In western Chï-Li there is a complex of gneisses, schists, granites and porphyries covering extensive areas. So far as evidence was found, the metamorphic rocks appeared to be mostly of igneous origin; in one instance there was proof of a sedimentary source. This complex is followed by the Ta-yang series of limestones, with shale and quartzite, of Algonkian age; and by the sedimentary rocks of the Sinian system.

The Wu-T'ai district consists mostly of metamorphosed Algonkian sediments, some of which are highly altered, while others are but slightly changed, resembling in places Paleozoic rocks. The more metamorphosed series called the Wu-T'ai system consists of mica-schists, gneisses, garnet-schists, chlorite-schists, quartzites, marble, schistose conglomerates, arkoses, etc. With these are some eruptive rocks, more or less metamorphosed: granite, augen-gneiss, hornblende-schists, quartz-porphyries, etc. The less metamorphosed series, the Hu-T'o system, consists of slates, graywackes, limestones and quartzites, with fewer igneous rocks, in dikes, both basic and acid. The district also contains rocks of the Sinian system.

The rocks of the Ts'in-ling district are mostly sedimentary; either highly metamorphosed or only slightly altered. There are also large intrusions of granite and occasional dikes of other igneous rocks. The same may be said of the Han River district, the rocks of which are described in considerable detail.

The Yang-Tzï Gorge district is chiefly sedimentary rocks of Paleozoic age, with local exposures of Mesozoic and Pre-Cambrian terranes. They are strongly but not intensely folded, and are not notably metamorphosed, except the oldest formations.

The report closes with a résumé of literature containing descriptions of the rocks of China, which shows that very little has been done in this direction. Mr. Blackwelder's report is a valuable contribution to the petrography of the region, and it is to be regretted that he was not in a position to pursue his studies more thoroughly and systematically, and that no chemical analysis of the best of his material was undertaken.

J. P. Iddings

Annual Reports of the Progress of Chemistry for 1906. Issued by the Chemical Society. Vol. III. London, Gurney and Jackson. 1907. Pp. 387. Price $2 net.

The development of chemistry in many different directions is so very rapid that it is impossible for any one to keep informed even with regard to the important work which is published in the various fields. The reports of progress which are published annually, by the London Chemical Society, serve, therefore, a very useful purpose in bringing together a summary of the really important advances of the science during a given year. The divisions of the present volume are: General and Physical Chemistry, by Alexander Findlay; Inorganic Chemistry, by P. P. Bedson; Organic Chemistry—Aliphatic Division, by H. J. H. Fenton; Homocyclic Division, by J. B. Cohen; Heterocyclic Division, by J. T. Hewitt; Stereochemistry, by W. J. Pope; Analytical Chemistry, by A. C. Chapman; Physiological Chemistry, by W. D. Halliburton; Agricultural Chemistry and Vegetable Physiology, by J. A. Voelcker; Mineralogical Chemistry, by Arthur Hutchinson, and Radioactivity, by Frederick Soddy. It will be seen at once that many of these authors are well known authorities in their various fields. The topics chosen for presentation are well selected and the treatment is clear and concise. The copious references to the literature render the book a valuable index for one who wishes to follow any subject further, while the discussions are sufficiently full, in most cases, to be extremely useful to those who read for the purpose of broadening their general knowledge of the science.

W. A. Noyes

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for November opens with an article on the "Response of Toads to Sound Stimuli" by S. A. Courtis showing that there is very little response to anything save the mating call. But—why should there be? The sound of a bell, a whistle or any similar noise carries with it no association. Why not feed the toad each time the bell is rung and note what the result would be after a month or two? Max Morse contributes "Further Notes on the Behavior of *Gonionemus*," mainly in respect to the influence of light, and Edward W. Berry has a paper on "Pleistocene Plants from Alabama," noting that they indicate a climate about the same as at the present time. Frederic T. Lewis has "A Further Study of Leaf Development," concluding that there is a determinate evolution of leaf forms. E. A. Andrews discusses "Earthworms as Planters of Trees," showing that they do this by gathering seeds, such as those of the maple, with which to plug the openings of their burrows. T. H. Morgan considers "The Cause of Gynandromorphism in Insects." There are various points of interest in the notes and reviews. We think few will agree with Professor Montgomery that physiological evidence is better calculated to show relationships or differences that are anatomical or, what is the same thing, paleontological.

Laboratory Bulletin No. 13, of Oberlin College, is on "The Development of Nestling Feathers," by Lynds Jones. It contains a series of detailed observations, and notes among other things that the first down has no shaft and no quill, the barb vanes passing without interruption into the first definitive feather vanes, the seeming quill being due to the coalescence of the vanes of the down.

The first number of the *Bulletin of the Brooklyn Conchological Club* has just been issued. It contains among other papers articles on "Abnormal Shells" and a "List of Long Island Shells," by S. C. Wheat, and "Suggestions for the Organization of a National Conchological Society," by W. H. Dall.

SOCIETIES AND ACADEMIES

THE CONVOCATION WEEK MEETING OF SCIENTIFIC SOCIETIES

The American Association for the Advancement of Science and the national scientific societies named below will meet at the University of Chicago during convocation week, beginning on December 30, 1907.

American Association for the Advancement of Science.—December 30–January 4. Retiring president, Professor W. H. Welch, The Johns Hopkins University, Baltimore, Md.; president-elect, Professor E. L. Nichols, Cornell University, Ithaca, N. Y.; permanent secretary, Dr. L. O. Howard, Cosmos Club, Washington, D. C.; general secretary, President F. W. McNair, Houghton, Mich.

Local Executive Committee.—Charles L. Hutchinson, chairman local committee; John M. Coulter, chairman executive committee; John R. Angell, Thomas C. Chamberlin, Joseph P. Iddings, Frank R. Lillie, Charles R. Mann, Robert A. Millikan, Charles F. Millspaugh, Alexander Smith, J. Paul Goode, local secretary.

Section A, Mathematics and Astronomy.—Vice-president, Professor E. O. Lovett, Princeton University; secretary, Professor G. A. Miller, University of Illinois, Urbana, Illinois.

Section B, Physics.—Vice-president, Professor Dayton C. Miller, Case School of Applied Science;

secretary, Professor A. D. Cole, Vassar College, Poughkeepsie, N. Y.

Section C, Chemistry.—Vice-president, Professor H. P. Talbot, Massachusetts Institute of Technology; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

Section D, Mechanical Science and Engineering.—Vice-president, Professor Olin H. Landreth, Union College; secretary, Professor Wm. T. Magruder, Ohio State University, Columbus, Ohio.

Section E, Geology and Geography.—Vice-president, Professor J. P. Iddings, University of Chicago; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York City.

Section F, Zoology.—Vice-president, Professor E. B. Wilson, Columbia University; secretary, Professor C. Judson Herrick, University of Chicago.

Section G, Botany.—Vice-president, Professor C. E. Bessey, University of Nebraska; secretary, Professor F. E. Lloyd, Desert Botanical Laboratory, Tucson, Arizona.

Section H, Anthropology and Psychology.—Vice-president, Professor Franz Boas, Columbia University; secretary, George H. Pepper, American Museum of Natural History, New York City.

Section I, Social and Economic Science.—Vice-president, Dr. John Franklin Crowell, New York City; secretary, Professor J. P. Norton, Yale University, New Haven, Conn.

Section K, Physiology and Experimental Medicine.—Vice-president, Dr. Ludvig Hektoen, University of Chicago; secretary, Dr. Wm. J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

Section L, Education.—Vice-president, Hon. Elmer E. Brown, U. S. Commissioner of Education; acting secretary, Professor Edward L. Thorndike, Teachers College, Columbia University, New York City.

The American Society of Naturalists.—December 28. President, Professor J. Playfair McMurrich, University of Toronto; secretary, Professor E. L. Thorndike, Teachers College, Columbia University, New York City. Central Branch, president, Professor R. A. Harper, University of Wisconsin; secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The American Mathematical Society. Chicago Section, December 30, 31. Chairman, Professor Edward B. Van Vleck; secretary Herbert E. Slaught, 58th St. and Ellis Ave., Chicago, Ill.

The American Physical Society.—President, Professor E. L. Nichols, Cornell University; secretary, Professor Ernest Merritt, Cornell University, Ithaca, N. Y.

The American Chemical Society.—December 27–January 2. President, Professor Marston T. Bogert, Columbia University; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

The Association of American Geographers.—December 31–January 1. Acting-president, Professor R. S. Tarr, Cornell University, to whom correspondence should be addressed; secretary, Albert P. Brigham, 123 Pall Mall, London, Eng.

The Entomological Society of America.—Secretary, J. Chester Bradley, Cornell University.

The Association of Economic Entomologists.—December 27, 28. President, Professor H. A. Morgan, Knoxville, Tenn.; secretary, A. F. Burgess, Columbus, Ohio.

The American Society of Biological Chemists.—December 30–January 2. President, Professor Russell H. Chittenden, Yale University; secretary, Professor William J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

The Society of American Bacteriologists.—December 31–January 2. Vice-president, F. D. Chester, Delaware Agricultural College, Newark, Del.; secretary, Professor S. C. Prescott, Massachusetts Institute of Technology.

The American Physiological Society.—Beginning December 31. President, Professor W. H. Howell, Johns Hopkins University; secretary, Professor Lafayette B. Mendel, 18 Trumbull St., New Haven, Conn.

The Association of American Anatomists.—January 1–3. President, Professor Franklin P. Mall; secretary, Professor G. Carl Huber, 1330 Hill St., Ann Arbor, Mich.

The American Society of Zoologists.—Central Branch. Secretary, Professor Thomas G. Lee, University of Minnesota, Minneapolis, Minn.

The Botanical Society of America.—December 31 and January 1, 2 and 3. President, Professor George F. Atkinson, Cornell University; secretary, Dr. D. S. Johnson, Johns Hopkins University.

The Botanists of the Central States.—Business Meeting. President, Professor T. H. Macbride, University of Iowa; secretary, Professor H. C. Cowles, University of Chicago, Chicago, Ill.

The American Psychological Association.—December 31, January 1 and 2. President, Dr. Henry Rutgers Marshall, New York City; acting secretary, Professor R. S. Woodworth, Columbia University, New York City.

The Western Philosophical Association.—Secretary, Dr. John E. Bowdoin, University of Kansas, Lawrence, Kans.

The American Anthropological Association.—December 30, January 4. President, Professor Franz Boas, Columbia University; secretary, Dr. Geo. Grant MacCurdy, Yale University, New Haven, Conn.

The American Folk-lore Society.—December 30–January 4. President, Professor Roland B. Dixon, Harvard University; secretary, Dr. Alfred M. Tozzer, Harvard University, Cambridge, Mass.

Other national societies will meet as follows:

NEW HAVEN

The American Society of Zoologists.—Eastern Branch. December 26, 28. President, Dr. C. B. Davenport, Cold Spring Harbor, N. Y.; secretary, Professor W. L. Coe, Yale University, New Haven, Conn.

The American Society of Vertebrate Paleontologists.—December 26–28. President, Professor Bashford Dean, Columbia University; secretary, Professor Frederick B. Loomis, Amherst College, Amherst, Mass.

NEW YORK

The American Mathematical Society.—December 27, 28. President, Professor H. S. White, Vassar College; secretary, Professor F. N. Cole, Columbia University.

ALBUQUERQUE, N. M.

The Geological Society of America.—December 30–January 4. President, President Charles R. Van Hise, University of Wisconsin; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York City.

ITHACA

The American Philosophical Association.—December 26, 28. President, Professor H. N. Gardiner, Smith College; secretary, Professor Frank Thilly, Cornell University, Ithaca, N. Y.

NEXT SUMMER, AT SOME PLACE TO BE DETERMINED

The Astronomical and Astrophysical Society of America.—President, Professor Edward C. Pickering, Harvard College Observatory; secretary, Professor Geo. C. Comstock, Washburn Observatory, Madison, Wisconsin.

DISCUSSION AND CORRESPONDENCE

BADGES AND EXPENSES OF THE AMERICAN ASSOCIATION

To the Editor of Science: I am interested in Professor C. L. Speyer's letter on pages 834–835 of the last number of Science. His idea of posting an alphabetical list with numbers corresponding to those on the badges, in a conspicuous, accessible place on the wall of the registration room is an excellent one. I was not poking fun at him when I expressed myself as pleased with the idea, at the New York meeting, and, in fact, I made a memorandum of the suggestion for possible use at Chicago. The alphabetical list is an excellent thing, but the expense of publication is very considerable and the Association is far from rich. Of the three dollars a year dues paid by each member, two dollars go to the publishers of Science, leaving one dollar from each member to pay the entire expenses of the association. It is quite possible that the council will direct the publication of a numbered list of members in attendance at Chicago, and then of course it will be done. The buttons for this year have already been ordered and delivered, so that it is too late to change the style. The delay by which Professor Speyers and others were inconvenienced last year occurred through the failure of the contractors to deliver the buttons at the specified time.

L. O. Howard,
Permanent Secretary

[It should perhaps be added that since Science has been sent to members of the American Association, beginning in 1901, about 4,000 new members have joined and their entrance fees, amounting to about $20,000, have been available for current expenses. But it is, of course true that a dollar from each member, even if the sum of $3,000 a year from entrance fees is added, does not adequately defray the expenses of the office of the permanent secretary, of the arrangements for the meetings and of publication of the proceedings. It is also true that $2 from each member does not pay the cost of printing Science. In Great Britain it costs $12.50 a year to be a member of the British Association and to receive *Nature;* in France it costs $10 a year to be a member of the French Association and receive the *Revue Scientifique.* Here where the purchasing power of money is less it costs $3 a year to be a member of the American Association and to receive Science. In order that the work of the association may be carried forward effectively, its membership should be increased to at least ten thousand, and it does not seem to be impossible to accomplish this when we know that the National Geographic Society has by concerted efforts increased its membership to over twenty-five thousand. It would in fact be about accomplished if each member would send one nomination to the permanent secretary. Ed.]

QUARTZ AFTER PROCHLORITE AT CRANSTON AND WORCESTER AND COAL PLANTS AT WORCESTER

To the Editor of Science: During the recent field day of the New England geologists at Providence we were guided by Professor Brown to the graphite mine in the Carboniferous at Cranston. This mine interested me very greatly because of its close resemblance to the coal mine at Worcester, Mass., a resemblance which extended by chance even to the size and shape of the excavation and the dip of the rocks. There was the same greatly mashed and slickensided graphitic slate, the same white and yellow efflorescence of alumina and iron sulphates and a more abundant development of ottrelite in the adjacent schists. Our attention was especially attracted by a white to pale green mineral which filled fissures in the slate with its fine satiny fibers.

This was described as asbestus by Dr. J. W. Webster in the first volume of Silliman's Journal in 1819, and in a note the editor speaks of it as long known. It has been often mentioned since as asbestus, amianthus, or fibrolite. Its action under the microscope was so peculiar that I had it analyzed at Washington by Mr. L. G. Eakins. It proved to be a prochlorite changed in varying degrees to silica. The mean of the analyses roughly recalculated, to omit impurities, was: SiO_2, 23.13; Al^2O^3, 22.38; FeO, 28.76; MgO, 11.70; Alk, 1.57; H_2O, 12.45. The fibrous structure seems to be a parting developed in the chlorite by pressure as often happens in the case of muscovite.

The fact that this very peculiar metamorphosis of the carboniferous shales of the Rhode Island basin is exactly repeated at Worcester would be strong evidence that the rocks were of the same age without the coal plants which were found at the Worcester locality some years ago by Mr. J. H. Perry and determined to be Lepidodendron acuminatum by Lesquereux.

This note is written because doubt was expressed at the meeting as to the carboniferous age of the Worcester beds, and an old suggestion was brought up that the fossils were not authentic, that they were perhaps brought there to "salt" the mine. The slabs with fossils were dug up near the mine, one was a foot and a half long and several inches thick; and they were found by two persons at different times and were of exactly the same peculiar graphitic character as the rest of the rock at the mine and equally useless as a fuel, and there is no known locality showing exactly the same characteristics, since even at the Cranston locality the metamorphosis has been a little more severe and no fossils are found there.

The Worcester "coal mine" is the only fossiliferous locality between Providence and Bernardston on the Connecticut, and while there is no doubt that the fossils are coal plants and were found *in situ*, the common characteristics of the Worcester and Rhode Island beds are so many and so peculiar, and the succession is so similar that no doubt should arise as to their common age.

B. K. Emerson

Amherst, Mass.,
November 21, 1907

A SALAMANDER-SNAKE FIGHT

While studying the geology of Buck Peak, twelve miles west of Riddle, Douglas Co., Oregon, last September, I saw a mortal combat that interested me very much because so anomalous. James Storrs, a mountaineer and trapper of California, well acquainted with the habits of wild animals, was with me at the time and remarked that it was "the first ring engagement he had ever seen in which the salamander showed any sand." In these strenuous days of nature faking it is after all not surprising that even the salamanders are beginning to take an active part in affairs.

We watched the progress of the fight for a few moments each time at intervals of about forty-five minutes for three hours.

Thinking that the occurrence might be familiar to herpetologists, I sent a brief account of it to my friend Dr. C. Hart Merriam for information. In his reply he regarded the observation as important and expressed a request that the account be published in SCIENCE as a matter of permanent record.

The combatants were a salamander and a garter snake. The salamander was about eight inches in length, of a rather dark brown color above and lighter below. On the back and sides including the tail were irregularly elongated roundish darker spots. His smooth skin was naturally moist and being plump and chunky he seemed to be a bull-dog of his kind. Judging from the specimens kindly shown me by Dr. Stejneger in the National Museum the salamander was probably an *Amblystoma*.

The garter snake was of good size, about two feet in length, and with other stripes had reddish-brown markings on the sides. Both animals seemed to be in perfect condition for a hard fight.

When first seen in a narrow dry water course I supposed that the snake was swallowing the salamander, but the squirming of the snake attracted closer attention and the salamander was found to have a firm grip on the snake at the base of the right jaw and neck. The snake could not bite the salamander but writhed so as to turn him over and over and drag him along on his side or back without affecting the grip of the salamander. His whole attention seemed to be given to holding on without caring whether he was right side up or not.

This moderately active writhing in which the snake furnished all the energy continued for over two hours with gradually waning strength on the part of the snake. In the course of the struggle they passed beneath a bank and out of sight, but when last seen, half an hour later they were out again at the old place. This time all was quiet. The salamander was now in control. He had changed his grip. He was directly in front of the snake and had a deep hold on its upper jaw covering its nostrils. The lower jaw of the snake was hanging limp. The salamander seemed fresh in the enjoyment of his victory, while the snake was nearly dead.

J. S. DILLER

U. S. GEOLOGICAL SURVEY,
WASHINGTON, D. C.,
December 7, 1907

TROTTING AND PACING: DOMINANT AND RECESSIVE?

IN his book, *The American Trotter,* Mr. S. W. Parlin makes several allusions to the production of pacers by trotters which suggested to me the likelihood that the pacing gait may be a Mendelian recessive in the horse. In reply to my questions, Mr. Parlin, who has kindly interested himself in the matter, assures me that he has never known a natural trotter produced by two natural pacers, though, of course, pacers are often produced by trotters. Mr. John Thayer, of Lancaster, Mass., tells me that his experience agrees with that of Mr. Parlin. Certain alleged cases to the contrary have proved to be given erroneously. It seems, therefore that there is *prima facie* reason to suppose that the trotting gait depends on some physiological factor which is absent from the pacer. My object in writing this letter is to suggest to American readers the desirability of investigating the subject more fully. The materials for doing so are not to be had in England. It is scarcely necessary to point out the extraordinary interest of this illustration of Mendelian inheritance, if it should prove to be genuine. No doubt either gait may to some extent be acquired artificially by training, but I understand that the distinction between the natural trotter and the natural pacer is so definite that doubtful cases are exceptional.

W. BATESON

CAMBRIDGE, ENGLAND,
December 13, 1907.

QUOTATIONS

POPULAR SCIENCE[1]

IN the December number of *The Popular Science Monthly* Dr. William Morton Wheeler, of the American Museum of Natural History, has an article on "The Origin of Slavery among Ants." Such a jumble of sesquipedalian words and false analogies it would be difficult to find even inside the covers of a work on physiological psychology. We shall quote some sentences taken almost haphazard as specimens of the turgid nonsense so pompously pieced together by this pretentious sciolist. He writes on the most nebulous questions with an air of dogmatic infallibility which he himself would resent in a decree of Pius X. He is a type of a class of men rapidly growing in the United States, shallow-brained and half-educated, and intoxicated with the exuberance of their own barbarous phraseology.

Lest we should leave ourselves open to the suspicion of unfair criticism we shall give illustrations of this fellow's ridiculous jargon. As will be easily seen no Irish hedge schoolmaster discussing Virgil's birth in a portmanteau in the pages of Carleton's romances ever did perpetrate more puerile attempts to parade an aggregation of inane verbosity. "Slavery or dulosis," he tells us in the opening sentence of his second paragraph, "is a rare phenomenon among ants." What was the motive for introducing the word dulosis? It is derived from doulos, the Greek word for slave, and means precisely the same thing as slavery. Was it introduced to show that the author had some knowledge of Greek, or was it interposed to clarify his meaning and make science popular? *Omne ignotum pro magnifico.* Many persons are so constituted that they worship the unknown and "It's all Greek to me" has come to be synonymous with ignorance. In this way Wheeler throws dust in his reader's eyes and conceals the scantiness of his knowledge.

Here is another example of a vacuum filled up by a compound Greek word: "An eminently predatory species thus comes to live in intimate *symbiosis* with workers of an alien species which are said to function as slaves or auxiliaries." Symbiosis is derived from the Greek preposition *syn*, meaning together, and the word *bios*, meaning life. The writer's idea is that these predatory species live in communities, or in common. But in order to inject a Greek word, parade his erudition, and confound the reader he has recourse to a barbarous circumlocution, an absurd tautology which when literally translated into ordinary language reads: "An eminently predatory species thus comes to live in intimate common living," etc. The two passages examined are taken from the same paragraph. Immediately afterwards we stumble on the literary gem: "The colony grows apace, the workers increasing in number, size and *polymorphism* with successive broods." Similar vaporings meet the vision at every stage of the article.

Wheeler is a blatant bigot, a hater of Christianity, a man who out-Herods Herod and out-Haeckels Haeckel. He dwells with pride on his monkey ancestry and he is not without many of the apish instincts of the ourang-outang. Animalism as opposed to intellectualism is his philosophy. He has long dwelt among stuffed mastodons and ichthyosauri, and his mind, dwarfed by his environment, has no higher ideal than an ant-heap or a skeleton. If he undertakes to explain the highest spiritual attainments of man or to interpret the most complex forms of social organization he goes for light to the hænatococcus or to the mosquito. Logic is utterly discarded by him. He knows as much about the laws of dialectics as, to use Luther's

[1] This comment on the work of one of the most distinguished American naturalists exploits a point of view which readers of SCIENCE probably regard as obsolete. The editorial article is immediately preceded by an autograph letter, which, as translated, reads: "To our beloved children, the writers and readers of *The New World*, published in Chicago, under the auspices of the Most Reverend Archbishop of that city:—We impart with cordial affection our apostolic benediction and invoke for them every good and salutary gift in the Lord. From the Palace of the Vatican, 6th day of April, 1907.—PIUS X., Pontifex Maximus."

expression, a cow does about a new gate. But like all sciolists he is absolutely cocksure in his views, especially when settling for all time a great religious or moral problem. Young students, we are told, as they see him strutting across the museum campus are wont to recite Goethe's famous lines:

> Who's that stiff and pompous man?
> He walks with haughty paces,
> He snuffles all he snuffle can,
> He scents the Jesuit's traces.

Referring to a certain form of parasitism he writes: "It is not confined to ants and other social insects, but has analogies also in human societies (trusts, grafters, criminal and ecclesiastical organizations)," etc. Ecclesiastical organizations are classified with trusts, grafters and criminal hordes! Whither are we drifting in America, when a pigmy scientist can dare to write thus in a magazine that is widely read even by Catholics? Did not Voltaire and the Encyclopedists by writing cheap science in the nastiest form, like Wheeler, undermine Christianity in France? And if the Catholic body in this country supinely submits to be traduced and caricatured by every addle-pated scientist who, by pull and lobbying, lands himself in a position for which he has no visible qualifications, the enemies of religion, encouraged by such impunity, will redouble their efforts to supplant the kingdom of God by the Worship of Mammon and materialism.

Is the Catholic Church a parasite in the United States? Then Marquette was a parasite in Illinois. Who was a greater benefactor of our sovereign state than he? From the Atlantic to the Pacific and from Alaska to the Gulf, almost every county has its shrine that commemorates the heroic sacrifices and the imperishable services of priests to civilization and the commonwealth. Was Archbishop Carroll of Baltimore, the great patriot and the intimate friend of Washington, a parasite, or Archbishop Hughes, Lincoln's friend and ambassador to Europe, a parasite? Were the sisters of our religious communities, who ministered during the civil war to the boys in gray and to the boys in blue with the undiscriminating catholicity of their devoted hearts, parasites? Is the Catholic Church in Chicago at the present hour, educating as it does 100,000 children, thus saving the city more than $3,000,000 annually, parasitical? But what does Wheeler care about all these striking facts, these sublime spiritual achievements compared with the gyrations of a queen bee or the evacuations of a *Formica rufescens*?

The Popular Science Monthly has long been a peril to Catholic faith and morals. We know Catholic homes in which the faith has been blunted in boys and girls under twenty years of age through contact with that shallow organ of materialistic evolution. Catholic fathers and mothers would never place it within reach of their offspring did they know the deadly moral poison that pervades many of its pages.—*The New World.*

ASTRONOMICAL NOTES

THE PLANET MARS

Discussion as to the conditions for intelligent life on Mars continues to hold the attention of the public. Many of the magazines and daily papers have contained articles on the subject. Professor Percival Lowell is the central figure in this discussion. He holds the center of the stage not less for the brilliant manner in which he has presented his views to the public, than for the enthusiasm and skill with which he has carried on his observations.

The recent Lowell expedition to South America, under the direction of Professor Todd, well known for his extended travels in search of the eclipsed Sun, has added to the general interest. A site was selected on the desert pampa, at a moderate elevation, near Iquique, Chile, where the conditions were found to be exceptionally favorable. Mars, when on the meridian, was within a few degrees of the zenith. Special effort appears to have been made to keep the public informed of the details of the expedition, and the announcement was early made that photographs had been obtained showing the canals double.

What may be regarded as the human side of the problem undoubtedly appeals strongly to the average reader. This calls for neither surprise nor criticism. If it could be demonstrated, beyond reasonable doubt, that intelligent life, similar to our own, existed on some neighboring world, all men would wish for a time to turn astronomers.

There are two somewhat distinct problems; first, the determination of the facts so far as that is possible, especially the correct delineation of the surface markings, not merely the subjective impression but the objective reality. Second, the interpretation of the observed phenomena. The first is largely a matter of observation, the second, of speculation. Owing to inherent difficulties, it is probable that the observed facts will never be so definite as to exclude a wide range of interpretation.

Some of the difficulties which stand in the way of our knowledge concerning Mars were discussed by Professor Simon Newcomb in the July number of *The Astrophysical Journal.* According to Professor Newcomb, it is theoretically impossible, owing to instrumental aberration, to see fine, sharp lines, such as are shown in drawings of Mars, even if they exist on the planet. Various psychological problems also enter into the discussion, in addition to physiological ones. Professor Lowell, in a reply in the October number of the same journal, assails Professor Newcomb's position both from the theoretical and practical side.

Meanwhile, those observers who do not see the finer details which are shown on the elaborate drawings of the planet have awaited with interest the publication of the photographs, which it is claimed verify them. A display was recently made, at the Massachusetts Institute of Technology, Boston, of a large number of transparencies, reproduced from the negatives of Mars which were made both in Arizona and in South America. The original negatives, in both places, were obtained by the use of a color screen used in connection with special plates. These photographs undoubtedly mark a distinct advance in planetary photography, and much credit is due to Messrs. Lampland and Slipher, Professor Lowell's assistants. The photographs made in Chile excel slightly those obtained earlier in Arizona. All show the broader markings on Mars much better than any obtained elsewhere. In a general way they corroborate the synchronous drawings by Professor Lowell. So far as the writer could determine, however, from a careful examination of the transparencies, they do not show any of the long, straight, and sharply defined canals shown on many drawings, nor was any trace of doubling visible. It is possible, of course, that groups of fine details, which appear distinct in the brief intervals of good seeing, may be blended on the photograph into the broad shadings shown on the transparencies. Though not out of harmony with the drawings, it is difficult, nevertheless, to see how the photographs can be regarded as confirming the details. Assuming the drawiugs to be correct, the photograph even now, compared with the eye, is a very poor second in the delineation of planetary detail. On the other hand, the photographs show nearly as much as has been seen by many conservative observers of Mars.

Too much importance need not be attached to the doubling of the canals. Whether this is a reality or an illusion does not appear to affect seriously the problem of intelligent life. Even if photographs should be obtained showing the canals distinctly double, the objective reality of the phenomenon would not thereby be absolutely assured, that is, photographs like figures sometimes lie. A striking case in point was the announcement, in 1890, by an English astronomer, of α Lyræ as a spectroscopic binary, from the duplicity of the lines of its spectrum as shown on photographs. This was an error due to causes never explained. This case is unusual only on account of its publicity. An artificial duplicity is one of the ordinary dangers which must be guarded against in astronomical photography. Sometimes the causes are apparent, at other times they are extremely obscure.

The subject is one which appeals strongly to the imagination. That intelligent life is confined to our earth alone, out of the many millions of worlds, seems absurd. Whether it exists at the present time on Mars is a fair problem to be decided according to the evidence. That its existence forms the most simple explanation of the peculiar features of the Martian landscape is probably doubted by most astronomers. Indeed, the objective reality of many of these peculiarities can not be said to have been established beyond doubt. It can at least be safely stated that nothing amounting to a demonstration of the existence of intelligent life on Mars has yet been accomplished.

S. I. Bailey

BOTANICAL NOTES

THE COMING BOTANICAL MEETINGS IN CHICAGO

In a short time the annual gathering of botanists will take place in Chicago in connection with the meetings of the American Association for the Advancement of Science. Through the persistent efforts of disinterested and patriotic men we do not now have a divided body of botanists in this country, all the botanical societies now having merged in the one organization—the Botanical Society of America. This merging has consolidated American botanists in a most satisfactory manner, and has done much to bring them together in a compact, harmonious working body. This is quite as it should be. Botany is not so large and wide as to make it necessary that it should be parceled out among a number of groups of workers.

But the merging of these affiliated societies does not wholly settle the question of the meetings, for we still have officially two bodies of botanists, namely the Section of Botany (G) of the American Association for the Advancement of Science, and the Botanical Society of America. Last year there was not a little confusion in the meetings of these two bodies, and on at least one occasion both were in session at the same time. It is to be hoped that the plans that are now being talked over by the officers of both organizations will result in avoiding such conflicts in the future. There is time enough, certainly, for all of the papers to be read that are worthy of taking the time of the botanists of the country, without having simultaneous sessions.

The writer has on more than one occasion urged that there should be a differentiation in the work of the section, and the society. Perhaps the easier plan is to make the meetings of the society "program" meetings, in which papers are read by invitation, while in the section we still allow practically any one to read almost any kind of a paper on nearly any subject in any way connected with botany. It is quite absurd to have two botanical organizations with no other difference than that of name and presiding officers. The writer holds that the section should always be maintained as a democratic body of botanists, before which one may volunteer to bring a paper. It must be maintained for the benefit of the young men who are constantly joining the ranks of the botanists. Here is where as strangers they may appear with papers which show their ability, or lack of it. Here, too, the older and more experienced men may read their less technical papers, and those whose purpose is more that of instruction, and the promotion of general discussion. Methods of teaching, the popularizing of botany, its applications in the arts and industries, and in fact anything which may advance this department of science, may certainly be included in the work of the section.

Possibly a practicable method for beginning the differentiation of section and society would be to have a joint committee on papers, to which all papers for either organization should be submitted. Such committee should be given the power to sort the papers, and to assign them to section, or society, for reading, in accordance with an agreed plan. The difficulty with this proposal is that such a committee can not meet personally before the meetings, and that the papers (or abstracts) are not to be secured long enough in advance of the meetings for the matter to be attended to by correspondence. However, if for the coming meeting every paper (or a good abstract) could be in the hands of such a joint committee by Monday morning, December 30, at 9 o'clock, it would not be a difficult task to make such an assignment as would differentiate the two organizations quite sharply.

For the present the society is preparing programs for at least a part of its sessions, and participation in these programs is by invitation. This is a good beginning, and should be followed by action on the part of the society and the section which will continue and extend it.

SHORT NOTES ON RECENT PAPERS

AN interesting and useful hundred-page pamphlet entitled "London Botanical Gardens," by Pierre E. F. Perrédès, is published by the Wellcome Chemical Research Laboratories, of London. In addition to the descriptive text it includes thirty-one full-page plates, mostly reproductions of photographs.

Among recent papers by Professor Doctor A. J. Ewart, the government botanist for Victoria, Australia, are "The Function of Silica in the Nutrition of Cereals," "Contributions to the Flora of Australia" and "The Movements of the Soluble Constituents in Fine Alluvial Soils."

J. G. Luehmann's "Dichotomous Key to the hitherto known Species of Eucalyptus," although read before the Australasian Association for the Advancement of Science nearly ten years ago, is worthy of mention now, as being most useful to persons interested in this genus of trees, as must be the case especially with our Pacific coast botanists.

"The Leguminosae of Porto Rico," by Miss Janet Russell Perkins, published as Part 4 of Volume X. of the Contributions from the United States National Herbarium, is a well-written and very interesting paper of almost ninety pages. The "local names" given for most of the species, must prove very useful to American residents or others who are interested in the botany of the island. A complete manual prepared after this model would be a most useful work.

Shortly after the death of Dr. Otto Kuntze a catalogue was made of his extensive herbarium, which is now offered for sale. It is contained in 467 cardboard boxes, and probably includes between twenty and thirty thousand specimens. Further information may be obtained by addressing "Villa Girola, San Remo, Italy."

Six papers have been received in advance of their publication in the Eighteenth Annual Report of the Missouri Botanical Garden, viz.: "The Literature of Furcraea with a Synopsis of the known Species," by J. R. Drummond; "Branch Cankers of Rhododendron" and "Frost Injuries of Sycamore Buds," by Hermann von Schrenk; "Plantae Lindheimerianae, part III.," by J. W. Blankinship; "Additions to the Genus *Yucca*" and "*Agave macroacantha* and allied Euagaves," by Dr. William Trelease. Most of these are contributions to our knowledge of Mexico and southwest United States botany, in continuation of similar work which has hitherto come from the Missouri Botanical Garden.

While there is no formal botany in the "Proceedings of the Iowa Park and Forestry Association" attention may be called to it here on account of its interest in the planting and preservation of trees, and the unusual beauty of illustrations, paper and presswork shown in this state report.

In the November number of the "Journal of Botany" there appears a portrait and an appreciative sketch of the life and work of the late Edward A. L. Batters, an English botanist, and well-known student of the marine algæ.

In the number of the "Berichte der deutschen Botanischen Gesellschaft" for August 28, A. B. Reagan publishes a list of plants observed on the Rosebud Indian Reservation of South Dakota, which contains so many obvious errors and omissions, as to give a wholly erroneous idea as to the flora of the country. This reservation is in the extreme southern portion of the state, adjoining Nebraska on the south, and lying on both sides of the one-hundredth meridian west of Greenwich. The flora of this part of the Great Plains has been pretty well known to western botanists for a decade or more, and yet we are asked to believe that *Vitis æstivalis, Rhus copallina, Rosa humilis, Rosa rubiginosa, Fraxinus americana, Quercus obtusiloba, Populus heterophylla* and *Pinus banksiana* occur in the region. These are certainly erroneous determinations. In passing we may enter a protest against such a nomenclatural monstrosity as *Prunus rosebudii,* which is proposed for what the author takes to be a new species of sand cherry.

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THE BIOLOGICAL SURVEY[1]

The Biological Survey is quietly working for the good of our agricultural interests and is an excellent example of a government bureau which conducts original scientific research, the findings of which are of much practical utility. For more than twenty years it has studied the food habits of birds and mammals that are injurious or beneficial to agriculture, horticulture and forestry; has distributed illustrated bulletins on the subject and has labored to secure legislative protection for the beneficial species. The cotton-boll weevil, which has recently overspread the cotton belt of Texas and is steadily extending its range, is said to cause an annual loss of about $3,000,000. The Biological Survey has ascertained and given wide publicity to the fact that at least forty-three kinds of birds prey upon this destructive insect. It has discovered that fifty-seven species of birds feed upon scale insects—dreaded enemies of the fruit-grower. It has shown that woodpeckers as a class, by destroying the larvæ of wood-boring insects, are so essential to tree life that it is doubtful if our forests could exist without them. It has shown that cuckoos and orioles are the natural enemies of the leaf-eating caterpillars that destroy our shade and fruit trees; that our quails and sparrows consume annually hundreds of tons of seeds of noxious weeds; that hawks and owls as a class (excepting the few that kill poultry and game birds) are markedly beneficial, spending their lives in catching grasshoppers, mice and other pests that prey upon the products of husbandry. It has conducted field experiments for the purpose of devising and perfecting simple methods of holding in check the hordes of destructive rodents—rats, mice, rabbits, gophers, prairie-dogs and ground-squirrels—which annually destroy crops worth many millions of dollars; and it has published practical directions for the destruction of wolves and coyotes on the stock ranges of the west, resulting during the last year in an estimated saving of cattle and sheep valued at upward of a million dollars.

It has inaugurated a system of inspection at the principal ports of entry on both Atlantic and Pacific coasts by means of which the introduction of noxious mammals and birds is prevented, thus keeping out the mongoose and certain birds which are as much to be dreaded as the previously introduced English sparrow and the house rats and mice.

In the interest of game protection it has cooperated with local officials in every state in the union, has striven to promote uniform legislation in the several states, has rendered important service in enforcing the federal law regulating interstate traffic in game and has shown how game protection may be made to yield a large revenue to the state—a revenue amounting in the case of Illinois to $128,000 in a single year.

The Biological Survey has explored the faunas and floras of America with reference to the distribution of animals and plants; it has defined and mapped the natural life areas—areas in which, by reason of prevailing climatic conditions, certain kinds of animals and plants occur—and has pointed out the adaptability of these areas to the cultivation of particular crops. The results of these investigations are not only of high educational value, but are worth each year to the progressive farmers of the country many times the cost of maintaining the survey, which, it may be added, is exceedingly small. I recommend to congress that this bureau, whose usefulness is seriously handicapped by lack of funds, be granted an appropriation in some degree commensurate with the importance of the work it is doing.

[1] President Roosevelt in his annual report to the congress.

FIELD MUSEUM OF NATURAL HISTORY[1]

The Field Museum is open to the public from 9:00 A.M. until 4:00 P.M.; visitors within the museum may remain until half-past four. The badge of the association admits members to the museum during the meeting. The museum is situated in Jackson Park at the continuation of 57th Street; is five minutes'

[1] Information for visitors attending the convocation week meeting.

walk from the Illinois Central Station, 57th Street, and ten minutes' walk from the University of Chicago.

The location of the offices of the building is as follows: the director's office is at the southeast corner of the South Court; anthropology, east end of East Court gallery; botany, north end of North Court gallery; geology, in halls 73 and 74; zoology, southwest corner of the West Court; the printing office is at the top of the west end of the West Court, and the section of photography, at the top of the east end of the East Court; the taxidermist's shop is at the northeast corner of the main structure, entrance to which is through hall 7.

The museum comprises four departments: Anthropology, Botany, Geology and Zoology.

The Department of Anthropology occupies the entire eastern half of the building. It may be most easily visited by pursuing the following plan: On entering the museum at the main door one finds oneself in the North Court, where is installed the exhibits of classified archeology from Italy and prehistoric archeology from Europe. The most remarkable specimens in the court are to be found in the south end of the court, where are exhibited several interesting Etruscan tombs as well as the contents of several trench tombs, and the mural decorations of bronze bath tubs from the Villa of Bosce Reale on the east side. From the North Court one may pass through the reading room—hall 28—to hall 34, devoted exclusively to archeology. From hall 34 one should proceed to examine halls 30 and 31, and pass from hall 30 into the West Court where the collections illustratiug the tribes of the Caddoan Stock may be seen in alcoves 1, 6, 7 and 8. From the West Court one may proceed to the South Court and examine the Tlingit collection in the alcoves on the east side and enter room 10, continuation of the Tlingit collection, and examine the collections of the northwest coast, which are found in halls 10, 11, 12, 13, 14, 15. Halls 16 and 17 represent the ethnology of the Hopi of Arizona and are of special interest on account of the life-sized reproduction of many important religious articles. From 17 one passes into hall 18 devoted to ethnology of the tribes of the plains. The East Court may next be visited by passing through hall 12. The East Court is devoted exclusively to archeology, the alcoves on the south being devoted to South American archeology, those on the north side to North American archeology. The cases in the center of the court are devoted to Mexican and North American archeology. In alcove 83 of this court is to be found the remarkable collection from Hopewell group of earth works in Ross Co., Ohio. Of special interest are the implements and ornaments of copper and meteoric iron, carvings in bone, stone and mica; large obsidian knives of unusual size, and a cache of over 7,000 flint implements of rough form. In this court is also found a remarkable series of large carvings from the North Pacific Coast, chiefly from Haidas and Kwakiutl, and from the East Court one enters through alcove 82 to hall 3, devoted to the ethnology of the Columbia River tribes, of special importance being a series of stone carvings from near The Dales; hall 4 is devoted to the Eskimo, hall 5 to Arapaho and Cheyenne and hall 6 to the Non Pueblo of the southwest. Passing through hall 9 one enters hall 8, containing the prehistoric collections from Arizona and New Mexico. To the east of hall 8 is the East Annex, temporarily closed to the public, but admission will be given those especially interested. In this section is being installed the ethnological collections from Asia, Africa and the Islands of the Pacific. The provision and assignment of halls is as follows: Halls 37, 38, 39, 40 and 55—Indonesia; 54—Polynesia; 53—Melanesia and Micronesia; 52, 51 and 50—Africa; 56, 57, 58 and 41—Asia; 49—Physical Anthropology. A temporary exhibition of skulls and skeletons, illustrating certain phases of anthropology, are to be found on the south side of the gallery of the East Court. From the East Court, or from hall 8, one returns to the North Court, passing through hall 9, which is devoted to the archeology of Egypt. This collection contains a large number of interesting and well-preserved coffins, a large series of mortuary stellæ, an interesting mortuary cedar boat about 4,500 years old, many large pieces of bronze, and a very rare sistrum. Objects of gold or those containing precious stones, including those from Peru, Bolivia, Ecuador, Columbia, Italy, Egypt and India, are found in hall No. 32, which may be entered from the West Court.

The Department of Botany occupies the galleries of the North, South, East and West Courts of the main building and may be reached by any of the four flights of stairs near the central rotunda, or by the stairs at one side of the east and west main doorways. The department is now being reinstalled. The old geographic arrangement, established in the beginning, is being replaced as rapidly as possible by a consecutive, systematic series; the early installation being on that account in a more or less chaotic and depleted state need not be visited.

The visitor should ascend the left stairway at the rotunda and on reaching the top of the stairs bear to the right to the transept gallery. Case I. begins the systematic installation with the Pines (9 cases), followed to the right by the Cycads, Typhaceæ, etc. The grasses (15½ cases) begin with a very interesting series of bamboos (3 cases) and end with a complete illustration of maize in all its forms and products (the door at this point leads to the herbarium). Bear to the right past the Cyperaceæ and the Palmæ (11 cases), noting the large and interesting series devoted to the Cocoanut; again to the right, following through the various orders (9 cases); to the Oaks (3 cases). Pass through the archway ahead containing the Moraceæ, etc. (5 cases) and bear to the right across the transept (6 cases Linaceæ). Bear again to the right through the archway (3 cases Urticaceæ) and turn to the right across the transept (Leguminosæ—5 cases), noting the large amount of products and interesting fruits of this order to the Laurels and Sumacs at the end of the transept. Again bear to the right through the transept arch to the Rubiaceæ, noting the complete installation of coffee, and still bear to the right along the transept (11 cases) to the Malvaceæ (4 cases), noting the exhaustive installation of cotton, illustrating its history and uses. To the right are two cases: the Tiliaceæ to Oleaceæ, then turn to the left to view the 7 cases, so far installed, containing the dendrological series, noting particularly the very exhaustive illustration of the timber products of Japan.

The curator's office and the herbarium are immediately above the main entrance to the museum. The most interesting feature of the herbarium, beyond its valuable collections of 250,000 sheets, is the systematic catalogue of every collection composing it. It is probably the only herbarium extant in which the series of plants of any collector can be reassembled for study at any time.

The collections of the Department of Geology occupy chiefly the West Annex of the building. They may be reached from the West Court or by turning to the right upon entering the building and passing through the reading room and hall 34. From the West Court, hall 32, containing a remarkable collection of gems and jewels, should be noted. The next six halls passing westward are devoted to paleontology. These are arranged in stratigraphic order, passing from Paleozoic to Cenozoic. Hall 33 contains the Paleozoic fossils, also series illustrating the mode of origin of fossils and comparative forms. Hall 35 is at present closed. Hall 36, devoted to Mesozoic fossils, contains, among other notable specimens, the largest skull of Triceratops, a great horned lizard, that is known. A femur of Brachiosaurus, also shown here, is probably the largest single bone ever discovered. In hall 59 may be noted an excellent series of Ichthyosaurus remains, one of the most perfect skeletons of a flying lizard ever discovered, and a representative series of White River mammals. The problematic Dæmonelix is shown in hall 60, and in hall 61 the extensive series of Titanotherium remains and a complete skeleton of Promerycochœrus are worthy of especial note.

The next hall, 62, contains the collection of meteorites, which is one of the largest in the world. It contains representatives of 300 falls, some of them complete. Perhaps the most important specimen is the meteorite of Long Island, Kansas, over 1,100 pounds of which are shown and which is the largest single stone meteorite known. The two following halls, 63 and 64, are devoted to the systematic mineral collection. The mode of installation employed here is especially designed with a view to the best display of the specimens and to permit a study of their more minute features. The larger specimens are shown in the wall cases. Series of special importance are the quartzes, calcites, barites and wulfenites. The radioactive minerals are illustrated by specimens and photographs. Several hundred specimens of cut gems and ornamental stones are shown in hall 64.

The Hall of Structural Geology, hall 65, contains a case illustrating cave formations and cave life, the cave formations being mounted in natural positions. The specimens of ripple marks, septaria and concretions shown in this hall are of special interest. Hall 66, devoted to lithological collections, is at present undergoing reinstallation, as is also the adjoining hall, 67. Clays, soils, sands and cements occupy hall 68, the different varieties being fully illustrated and their technical varieties shown. The large plate glass map in hall 69 shows the distribution of coal in the United States. Varieties of coals and hydrocarbons occupy hall 70, and petroleum in its varieties, origin and uses is shown in hall 71. Ores of the precious metals and lead in typical occurrences from various localities of the world are shown in hall 72. The statistical column in the West Dome shows the bulk of the different products of the mines of the United States for each second of time during the year of the World's Columbian Exposition. The ores of the base metals in great variety and completeness occupy hall 79. The specimens of Arkansas zinc, ore and Canadian nickel ore here shown are of remarkable size. Returning through the West Dome, halls 76 and 77, devoted to geographical exhibits, will be reached, the collections consisting chiefly of a series of relief maps illustrating important geographical and geological regions. Hall 78 contains collections of salts, abrasive, refractory materials, etc., gathered with a view to their economic uses and interest. The curator's office and the chemical and paleontological laboratories are located in the southwest corner of the Annex, and can be reached from hall 76. Material, which may be desired to be studied, in addition to that exhibited, may be seen in part in these laboratories and in part is stored in the exhibition halls.

To visit the Department of Zoology one should pass through the North Court to the rotunda and turn to the right to the West Court, which contains many groups of large mammals mounted by Mr. C. E. Akeley. Among the most important of these are the following: the hunting leopard, Beisa antelope, Swayne's hartbeest, orang-outang, striped hyena, and great koodoo, spotted hyena and Waller's gazelle. From the West Court one may pass to the South Court, which contains additional groups mounted by Mr. Akeley, the most important being that of the white-tailed, or Virginia, deer, which is probably unique. The South Court also contains a group of mountain sheep and polar bears. The court also contains the collection of Mollusca, which represents fairly well the subject of conchology. From the South Court one passes into hall 19, which, with hall 20, contains the systematic collection of Mammalia. Hall 22 is devoted to fishes and reptiles. Hall 23 and the adjoining alcove 97 of the East Court is devoted to the osteological collection consisting of mounted skeletons of over 225 species. Hall 24 is devoted to sponges, jelly fish, corals, etc. Halls 25 and 26 are occupied by mounted birds, there being represented about 550 species; the arrangement is systematic. Hall 27 is devoted exclusively to Illinois birds and their eggs. The study collection of birds, numbering about 40,000 specimens, is in the gallery of hall 27. The storage collections in entomology number about 70,000 specimens and are to be found in the gallery of the South Court, which also contains the study collections comprising about 20,000 specimens, representing all the most important species of North American mammals.

NORTHWESTERN UNIVERSITY

The departments of Northwestern are widely scattered and therefore fail to make the impression they would if they were all together. The College of Liberal Arts, the oldest department of the institution, is in Evanston, about ten miles north of the business center of Chicago. The campus extends half a mile along the shores of Lake Michigan, and is well worth seeing. The important buildings on it are the main University Hall, the Orrington Lunt Library, the Dearborn Observatory, the School of Music, Science Hall, the Garrett Biblical Institute and the School of Oratory. Ground has been broken for the buildings to house the new Department of Engineering, from which much is expected.

Northwestern University Building is a large six-story structure in the center of the business district of Chicago, in which are located the Schools of Law, Dentistry and Pharmacy. These departments are remarkably well equipped, and in reputation rank second to none in the country. The library of the law school is worth a visit, not only because of its collections of books, but also on account of the unique construction.

The Medical School is located on Dearborn street between 24th and 25th, in the vicinity of the important hospitals, Mercy and Wesley. The medical school is well known throughout the country on account of the position it took years ago on the question of graded medical instruction, and required laboratory work, and with the general advance has maintained its relative rank. This department is easily reached by the state street cars from down town.

THE UNIVERSITY OF CHICAGO

To American men of science the University of Berlin, the University of Leipzig, or the University of Munich connotes no collection of buildings but the published writings of men who in the laboratories of these institutions have achieved their results. To Europeans the name of the University of Chicago suggests, not high-raised battlements and towers, but the men who there carry on their scientific work. Those attending the exercises of convocation week, knowing the university as do the Europeans, will be interested also in observing the habitat of these men whose work they know.

As one stands at the west end of the Midway Plaisance and looks eastward almost a mile he sees to the north and the south of this beautiful thoroughfare the campus of the university; north, there confronts him the earliest building, Cobb Hall and the dormitories straggling to the south of it. Cobb is a recitation building housing the classical departmental libraries and the library of the modern language group, as well as most of the administrative offices and an information office. East of Cobb is Haskell Oriental Museum, on the top floor of which there is the library of the Divinity School; on the second floor, some valuable Oriental collections, including those in Biblical history, Comparative Religion, Assyrian and Egyptian life, and the work of the Oriental Exploration; on the first floor, the faculty room and the office of the president. As one leaves the east door of Haskell he gazes upon the tall windows of the Law Building, a structure modeled somewhat on the King's College Chapel at Cambridge, though the mitre-like towers are somewhat shortened and the buttresses lack the graceful English finials. The first floor of the Law Building is given over to large lecture rooms, to be used for many of the section meetings. Up the massive stairway one goes to the great reading room, a hall with high timbered ceiling, 160 feet long and 50 feet wide. South of the Law Building and Haskell will be erected the William Rainey Harper Memorial Library, extending with its two wings from the men's halls on the west to the women's halls on the east. Those interested in the housing of women in the university will do well to call for a moment at Nancy Foster Hall, the most southerly of the four women's halls, before passing north of the women's quadrangle to Walker Museum. As one stands in front of Walker he can see immediately to the east the Quadrangle Club at the corner of Fifty-eighth and Lexington, and just south of it a temporary recitation building for women called Lexington Hall wherein luncheon will be served during the convocation. Two blocks to the east are the structures of the School of Education, including the University High

School, the University Elementary School, and the College of Education. Here, too, some of the meetings will be held and here likewise luncheon can be secured. Westward beyond Cobb Hall one sees a structure like Lexington Hall erected as a temporary recitation building for men. Here may be found the campus headquarters of the Astronomical Department though the departmental library is in Ryerson Laboratory. Just north of Ellis stands at the corner of Ellis and Fifty-eighth a red-brick structure, the Press Building. Here for the present are the business offices, the general library and the university press. The last-named division of the university has charge of all printing and publishing for the institution and of the purchase and distribution of books and supplies. The list of published books numbers about 375. Last year thirty-three books were issued. Fourteen journals are printed at regular intervals. The function of the press and the attitude of the university toward the same are things worthy of attention. And beyond the Press Building is the power house whence come the heat and light and filtered water for all of the thirty-odd structures.

Having taken this survey of a miscellaneous group of buildings of minor importance to scientists the visitor will desire to enter the building where Professor Chamberlin and his colleagues do their work. The collections in Walker are estimated to embrace over one million specimens, including the general geological, the anthropological, and the paleontological collections. The general geological collection contains material illustrating structural phenomena, fossils, geographical material, economic geology, mineralogy and petrography. In addition to the anthropological collection of ethnographic archeologic material there are the Ryerson collections in Mexican archeology and from the cliff-dwellings and cave houses of Utah, the Clement collection from Japan, and the material collected by Professor Starr among the Ainu of Japan and the native tribes of the Congo Free State. The paleontological collection of invertebrates contains a large amount of material, especially from the Paleozoic horizons. Here also are the collections of Hall, Gurley, James, Washburn, Krantz, Weller, Sampson, Faber, Bassler and Van Horne. The collection of vertebrate fossils includes extensive series of the American Permian reptiles, Triassic reptiles and amphibians, Niobrara Cretaceous birds, reptiles and fishes, with a considerable material from the Laramie Cretaceous and White River Oligocene.

Across the campus are the first two laboratories erected. Kent Chemical Laboratory was erected in 1893. The basement contains a furnace room for crucible work, muffle work, tube-heating, and other purposes; a constant temperature room, a room fitted with steam and other appliances for work on a large scale, a mechanical workshop, and storage-rooms. On the first floor are one small and two large lecture rooms, and a large lecture hall seating three hundred persons, fitted for use as a chemical lecture room, if desired. This floor also contains a chemical museum, a large private laboratory, a room with northern exposure, especially fitted for use as a gas-analysis laboratory, and also apparatus and preparation rooms connected with the lecture rooms. On the second floor are two large laboratories for research and quantitative analysis; three private laboratories for the professors; balance, combustion, and air-furnace rooms; a balcony for out-of-door work; and the chemical library. On the third floor are three laboratories for general and analytical chemistry, a storeroom, a preparation room, a room especially fitted for optical and photographic work, a balance room, and two private laboratories.

East of Kent is the Ryerson Physical Laboratory. The central part of the fourth floor forms a hall for experiments requiring a large space. The roof above this portion is flat and suitable for observations in the open air. The third floor is devoted to a general laboratory for the undergraduate work in general physics, which with its adjoining apparatus and preparation rooms occupies the entire floor of the east wing. On the same floor are found two general laboratories and class rooms. On the second floor are found a large general laboratory for advanced undergraduate work, optical laboratories, a chemical laboratory, a large dark-room, two developing rooms, and the large lecture hall with its adjoining apparatus and preparation rooms. The first floor is devoted to laboratories for research. Two large constant temperature rooms and the mechanician's room where all tools and appliances necessary in the construction or repair of physical apparatus are stored are here. In the small room in the southeast corner Michelson carried on the experiments which have won for himself and American scholarship the great honor of the Nobel prize.

As one passes north between Kent and Ryerson he enters Hull Court surrounded from left to right by the Physiology, Anatomy, Zoology and Botany Buildings. In the first Loeb and Stewart did their work; in the second, Barker and Donaldson and Herrick; in the Zoology Building, Whitman and his colleagues; and in the structure to the right, Coulter and the other botany men make use of the material from as near at hand as in the pond beside their windows or from as far away as Mexico, the Yukon and Java. Hull Court is the center for the men preparing to take up medicine. Here is found the effort to link the work of the medical college to that of the university in the way so forcefully advocated by the retiring president of the association.

As one passes through Hull Court he will do well to turn for a moment to the west and look at least into the library of Hitchcock Hall, one of the men's dormitories, before passing eastward to Hutchinson Court and the magnificent Tower Group of buildings. The rich interior of the Leon Mandel Assembly Hall will become familiar to all attending the general meetings of the association. The Reynolds Club, reminding one somewhat of St. John's at Oxford, is entered from the cloister. On the first floor, north of the elaborate Elizabethan stairway, is the library; to the south, the billiard room. On the second floor, in addition to several committee rooms, is a large reception room. On the third floor, in addition to other committee rooms, is a small theater with trusses of open timber and an interesting stage curtain representing a fête day in a medieval town. These decorations, indeed, all the decorations in the Tower Group, are by Mr. Frederick Bartlett, of Chicago. The basement contains bowling alleys and a barber shop. The Reynolds Club serves that function in the University of Chicago which the Houston Club serves at Pennsylvania and the Union at Harvard. Hutchinson Hall is a replica of Christ Church Hall at Oxford. The main entrance is through a large arch at the base of the tower. The great room is forty feet wide, one hundred and fifteen feet in length. About the oak wainscoting with its series of shields of British and American Universities rise delicately traceried windows and, higher still, at least fifty feet from the floor, are magnificent trusses of open timber work from which hang beautiful pendant lanterns of oak decorated in red, blue and gold. At the west end of the room hang the portraits of the founder of the university, a picture by Eastman Johnson; of President Harper, a portrait painted by Gari Melchers; and the President of the Board of Trustees, Martin A. Ryerson, a painting by Lawton S. Parker. On the south wall are a small portrait of Silas Cobb and a picture by Frederick Vinton of Professor Galusha Anderson. At the east end of the room hangs a picture of the first head of the History Department, Professor von Holtz, painted by Karl Marrof Münich. On the north wall is a likeness of the president of the university, painted by Lawton Parker. Leaving the tower one will desire to look into the Frank Dickinson Bartlett Gymnasium, particularly at the mural decorations by the brother of the young man for whom the building is named, the window presented in his memory by Mr. William G. Hibbard of his father's firm, and the large exercising floor of the gymnasium.

After one has surveyed the many buildings of the university and at the gymnasium stands thinking of the material resources of the institution, of the fact that although most of the $27,590,994 was the contribution of one man, the citizens of a sister city, twenty-three of the twenty-eight permanent buildings were presented by citizens of Chicago, and the number of donors is upwards of 3,000, most of them Chicagoans, he should realize on looking south toward the Chicago copy of the Magdalen Tower, the beautiful edifice whence soon will ring the chimes in memory of the gracious first Dean of Women, Alice Freeman Palmer, that a genuine appreciation of the men who make the connotation for the buildings possesses the singer of the university song:

> The City White hath fled the earth,
> But where the azure waters lie,
> A nobler city hath its birth,
> The City Gray that ne'er shall die.
> For decades and for centuries,
> Its battlemented tow'rs shall rise,
> Beneath the hope-filled western skies,
> 'Tis our dear Alma Mater.

David A. Robertson
University of Chicago.

LOCAL ARRANGEMENTS FOR THE CHICAGO MEETING

To those who intend attending the fifty-eighth meeting of the American Association for the Advancement of Science at Chicago, from December 30 to January 4, and have never been in the City-of-the-Lake, it may be well to mention that Chicago does not lie at the southern extremity of Lake Michigan, as many maps indicate, but on its western shore; and that therefore to become properly oriented in the city one should remember that the lake lies to the east, not to the north. To those who were so fortunate as to be able to visit the great world's fair it will be sufficient to state that the campus of the University of Chicago, the meeting place, lies on the north side of the Midway Plaisance at about the center of its extent. The Midway is now returned to its former estate, that of a broad parkway uniting Jackson Park, in which the fair was held, to Washington Park, a mile to the west.

It is the aim of the local committee of the association to locate the meeting places, both of the various sections of the association and of the affiliating societies, as contiguous as possible, in order that no time may be lost nor confusion occur. To this end the university has placed all its lecture halls in the various buildings at the disposal of the association, and provision has been made whereby those in attendance at the meeting may secure luncheon without leaving the compus.

While the Auditorium Annex will be the headquarters of the association, it may be suggested for the information of those who may wish hotel accommodation near the campus that the Del Prado Hotel, Fifty-ninth Street—Madison Avenue and the Midway (60th Street Station, Illinois Central R. R.)—adjoins the campus on its eastern end; the Windermere Hotel (57th Street Station, Illinois Central R. R.) is at the north end of Jackson Park within easy walking distance; and the Chicago Beach Hotel (50th Street Station, Illinois Central R. R.), while somewhat farther away on the lake shore north of Jackson Park, is still within fair distance of the university. Those who intend locating in the city itself will find hotels and rates detailed on page 15 of the Preliminary Announcement of the meeting. They will note that the readiest method of reaching the meeting place will be *viâ* the Illinois Central Suburban Railway from the station on the Lake Front nearly opposite the Auditorium and Annex Hotels, on Michigan Avenue. The trains are frequent, the expresses making the run south to Fifty-seventh Street in twelve minutes. On arriving at this station (the second stop of the express trains) the lake and the Field Museum of Natural History will be in view to the east and the tower of the university to the west. Leave the station in the direction the train continues and on reaching the exit turn to the right. A 'bus may be taken to the campus or the short distance walked in a few minutes. The main entrance to the tower arcade, directly beneath the tower itself, brings the visitor immediately to the registration desk, the information bureau and the general headquarters of the association, from which each of the halls of meeting may be readily reached.

SCIENTIFIC NOTES AND NEWS

In accordance with the desire of the Royal Society, Lord Kelvin was buried in Westminster Abbey on December 23. The last man of science buried in the abbey was Charles Darwin, who died in 1882.

Professor Simon Newcomb, of Washington, and Professor Emil Fischer, of Berlin, have been elected foreign members of the Göttingen Academy of Sciences.

The freedom of the city of Glasgow will be conferred on Lord Lister.

The Lavoisier medal of the Paris Academy of Sciences has been awarded to Professor Adolf von Baeyer, of Munich, eminent for his work in organic chemistry and especially for the synthetic production of indigo.

The Lalande prize of the Paris Academy has been awarded to Mr. Thomas Lewis, of the Royal Observatory, Greenwich, and secretary of the Royal Astronomical Society. *The Observatory* states that during the last twenty years there have been twenty-one recipients of this prize, of whom nine were American, nine French, one South American, one Italian and (the present award) one Englishman.

The Wilde medal of the Manchester Literary and Philosophical Society has been awarded to Professor J. Larmor, of Cambridge. Professor Larmor will deliver on March 3 the Wilde lecture on "The Physical Aspect of the Atomic Theory," and at that time the medal will be presented.

A portrait of Dr. Arthur J. Evans, keeper of the Ashmolean Museum, Oxford, has been presented to the university by a number of those interested in archeology, including fifty-five American subscribers. The portrait, which is the work of Sir William B. Richmond, R.A., depicts Dr. Evans in the ruins of the Palace of Knossos.

Among those who have promised to deliver addresses before the International Congress on Tuberculosis, to be held at Washington from September 21 to October 12, 1908, are Dr. R. W. Philip, of Edinburgh; Dr. Theodore Williams, of London; Dr. Newsholme, of Brighton; Dr. C. H. Spronck, of Utrecht; Dr. Karl Turban, of Davos Platz; Dr. Gotthold Tannwitz, of Charlottenburg; Professor von Behring, of Marburg, Professor Calmette, of Lille; Dr. Maurice Letulle, of Paris; and Professor Kitasato, of Tokyo.

Professor J. C. Kapteyn, of the University of Gröningen, will hereafter spend several months of each year at the Solar Observatory of the Carnegie Institution on Mount Wilson.

Dr. Strömgren, of Kiel University, has been appointed director of the Copenhagen Observatory, in succession to Professor Thiele, retired.

According to *The Observatory*, M. Stephan is about to retire from the directorship of the Observatory of Marseilles. The selection of the occupant of such posts is entrusted to the Academy of Sciences, which selects two candidates to be presented to the minister of public instruction, the name of them being indicated as preferable. The selected candidates for Marseilles are M. Bourget and M. Simonin (given in this order). The candidates similarly submitted for the directorship of the Algiers Observatory, vacant by the death of M. Trépied, are M. Gonnessiat and M. Fabry.

Theodore Whittelsey, Ph.D., associate professor of chemistry in Northwestern University, has been granted leave of absence to serve as chemist of the department of investigation of the Continental-Mexican Rubber Company, which is engaged in the manufacture of rubber from guayule. Dr. Whittelsey will make a chemical study of the industrial possibilities of the plant life on a tract of land covering 2,500,000 acres that this company has recently purchased. His address is Hacienda de Cedros, Mazapil, Zacatecas, Mexico.

Mr. Walter E. Collinge has resigned the professorship of economic zoology in Birmingham University to accept the directorship of the Cooper Research Laboratory, Berkhamsted.

Mr. R. J. D. Graham, M.A., B.Sc., Carnegie scholar in botany, St. Andrews University, has been appointed to the Agricultural Department in India.

The University of Vienna recently conferred the medical degree on Count Vetter von der Lilie after he had completed the usual course. He is now fifty years old and has been prominent in political life, having served as president of the lower house of the Austrian parliament.

MESSRS. L. J. DE G. DE MILHAU and J. W. Hastings, who accompanied the South American expedition from the Peabody Museum, Harvard University, in 1906–7 as ethnologists, have returned to this country after a successful trip to the region of the Madre de Dios. Dr. Farrabee and Dr. Horr will continue the work in the field.

A MISSION under the command of M. Félix Dubois, the French explorer, which left Southern Oran in November, 1906, is now reported to have reached Gao, on the Eastern Niger. Its object is to study the Algerian and Saharan oases.

DR. J. COSSAR EWART, F.R.S., is this year giving the Swiney lectures on geology at the British Museum of Natural History. His subject is "Horses in the Past and Present."

INAUGURAL lectures were delivered by the Martin White professors of sociology at the London School of Economics, on December 17, by Professor L. T. Hobhouse on "The Roots of Modern Sociology" and by Professor E. A. Westermarck on "Sociology as a University Study."

PROFESSOR D. W. JOHNSON is giving a course of fifteen lectures on "The Physical Geography of the Lands," under the direction of the Teachers' School of Science, Boston. The lectures are given on Saturday afternoons, and are followed by laboratory exercises on the subjects discussed. The class at present numbers 156, of whom all but twelve are teachers in the schools of Boston and neighboring cities.

FREE illustrated lectures on legal holidays are to be delivered at the American Museum of Natural History, New York City, as follows:

Christmas Day, "Hiawatha's People," by Harlan I. Smith.

New Year's Day, "An Ornithologist's Travels in the West," by Frank M. Chapman.

Washington's Birthday, "Mines, Quarries and 'Steel Construction,'" by Louis P. Gratacap.

WITH the assistance of Yale University, and at the initiative of the Connecticut Academy of Arts and Sciences, the publication is planned of a volume of several hundred pages illustrating the collection of prehistoric relics obtained by the late Professor O. C. Marsh, and gathered in the province of Chiriqui, Panama. There will be some seven hundred illustrations, on which draughtsmen from New York are already at work, besides a set of chromolithographs made in Germany. George Grant MacCurdy, Curator of the anthropological section of Peabody Museum, will prepare the volume.

PROFESSOR ALFONSO SELLA, who held the chair of experimental physics in the University of Rome, died on November 25, at the age of forty years. He was known for his work on the Röntgen rays and radioactivity and as one of the principal leaders establishing the Italian Association for the Advancement of Science, which held its first meeting at Parma last September. A marble bust of Professor Sella will be erected in the Physical Laboratory at Rome.

THE east wing of the Museum of the Brooklyn Institute was formally opened to the public on Saturday, December 14. This wing completes the north front of the building, which has a length of a little more than 500 feet. The first and third floors of the east wing are devoted to art. The ground floor contains work rooms. The basement will contain the library, map collections, herbarium and some offices. The second floor will be used for the display of minerals and invertebrates. Owing to lack of cases this floor is at present only partially filled; its contents include a portion of the Ward collection of sponges and corals, the collections illustrating the difference between the faunas of temperate and tropical seas and a part of the collection of insects. There is sufficient material now in storage or in the hall to fill the entire second floor as soon as cases are provided.

IT is announced that Mr. Emile Berliner, of Washington, one of the perfectors of the telephone and the inventor of the gramophone, has given $12,500 as endowment of a research fellowship for women who have demonstrated their ability to carry on research work in physics, chemistry or biology. The foundation, which is in honor of the donor's mother, will be known as the Sarah Berliner Research Fellowship for Women. The award will be made by a committee of women, of which Mrs. Christine Ladd Franklin, of Baltimore, is to be the chairman.

English exchanges state that the annual meeting of the British Science Guild will be held at the Mansion-house, January 15. The Lord Mayor has consented to preside and to become one of the vice-presidents of the guild. It is hoped that Mr. Haldane, the president of the guild, and others will address the meeting. Steps are being taken by the guild to bring the proposals for legislation for the prevention of the pollution of rivers before many societies and local bodies.

A chemical laboratory has recently been established at Tananarivo in Madagascar. Besides purely scientific researches, it is intended for the analysis of foodstuffs and other purposes of practical importance.

The Journal of the American Medical Association states that the International Medical Association of Mexico, which was to have met at Monterey in November for its third annual congress, has been postponed until January 23–25, on account of the prevalence of dengue fever at Monterey. This association combines English-speaking and Spanish-speaking physicians on an equal footing, the programs and summaries being printed in both languages, the speakers using their mother tongue. Dr. J. S. Steele of Monterey, is the secretary of the congress, and he states that unusual interest has been manifested in the meeting this year.

At a meeting of the commonwealth cabinet at Melbourne, on December 2, the postmaster general announced his decision to call for tenders for wireless telegraphy installations at some half dozen places round Australia, including King Island, Tasmania, Rottnest Island, some convenient center on the northern coast, Port Moresby, and Yorke Peninsula. Tenderers are to sell their Australian rights to the commonwealth. Parliament has decided not to allow directly or indirectly the establishment of a private monopoly. The installations will be capable of receiving messages from passing steamers equipped with any of the recognized systems.

In the reorganization of the Bureau of Forestry, Philippine Islands, Major George P. Ahern, director, the work of the field force has been placed in two divisions, viz., the Division of Forest Administration, in charge of Forester H. D. Everett, and the Division of Forest Investigation, in charge of Forester H. N. Whitford. As the name implies, the Division of Forest Administration is in charge of all administrative work of the bureau, such as granting licenses, inspection of cuttings, applications for homesteads, etc. Practically all of the timber land of the Philippine Islands is government property, of which this division is the guardian. The work of the Division of Forest Investigation is to discover the forest resources of the islands, and to bring this information to the notice of the public. A detailed system of mapping has been inaugurated, which shows areas of commercial and non-commercial forest, grass and agricultural lands. Considerable portions of the islands have already been mapped, and the work is being pushed as rapidly as possible. Special tracts of land are being studied in detail for working plans, and botanical collections, including both herbarium and wood specimens are being made. Herbarium sheets show altogether 1,109 tree species in the islands. It is probable that with further investigation, this number will be increased to 1,600 or 1,800. The museum now contains about 3,500 wood specimens, representing nearly 350 different species, and including all of the principal timbers. It is hoped that within a few years the bureau will be able to show by maps the different types of vegetation of the islands; to locate the different tracts of timber, with an estimate of the stand, etc.; to know the silvicultural habits of the principal timber trees (nearly 100); and to increase the knowledge in general of the tropical forests of the Philippine Islands.

Sir William Ramsay gave the Aldred lecture before the Society of Arts on December 11, his subject being "The Emanation given off by Radium." According to the abstract given in the London *Times* he said that the emanation, whether a compound or not, was certainly endothermic; if left alone, it changed and presumably decomposed with an almost incredible evolution of heat. A ton of it would boil away 200 pounds of water in an hour, and would serve as efficient fuel to warm a house, do all the cooking, and provide hot baths for a large family, not only during their own lives, but for about twenty generations, without much falling off. If the emanation were dissolved in water it produced another effect, also involving a loss of energy—it decomposed the water into oxygen and hydrogen. But in this way there was always produced a small excess of hydrogen over that required to combine with the oxygen. One hypothesis to account for this excess was that hydrogen, too, was one of the products of the decay of the emanation, though on the whole that was unlikely. At the same time, there was formed a trace of dioxide of hydrogen, though not enough, so far as he could judge, to account for the excess entirely. Further, on removing the oxygen and hydrogen, there was left neon, another of the inactive atmospheric gases discovered by himself and Dr. Travers in 1898. With the hope of accounting for the excess of hydrogen, he exposed a solution of sulphate of copper to the action of the emanation; the gases evolved contained argon, but no recognizable helium or neon. Some of the copper, too, appeared to have changed, for the residue of the liquid, after removing all copper from it, contained a small trace of the element lithium, a member of the sodium group, which was easily recognized by its spectrum. It was probable, though not yet proved, that the element sodium was also a transmutation-product of copper, because the residue, obtained by evaporating the copper-solution, deprived of copper, which had been treated with emanation, was more than twice as heavy as that obtained from untreated copper sulphate. It must be explained that these solutions were contained in glass bulbs, and that glass contained silicate of sodium; experiments were now in progress in which glass was excluded, the bulb used being constructed of silica, free from sodium. Now these results corroborated each other, in a certain fashion, and admitted of a provisional theory. The emanation was a very inactive gas, unattacked by any reagents. Now this was the characteristic of the argon group alone—namely, helium, neon, argon, krypton and xenon. Again, we knew a similar series, though a longer one, the first member of which was lithium and the second sodium, to which copper, silver and gold also belonged. It appeared possible, to say the least, that the emanation degraded, split, was transformed, or transmuted itself into helium, neon or argon, all members of the same natural group, according to circumstances; and that, similarly, copper might turn, under the enormous influx of energy brought to bear on its atoms, into lithium, sodium and potassium, all of which had smaller atomic weights than copper and all of which were usually classified in the same chemical group.

In 1906, for the second time, the total value of the mineral production of the United States exceeded the enormous sum of $1,500,000,000. The exact figures for 1906 are $1,902,505,206 as compared with $1,623,928,720 in 1905, a gain of $278,576,486, or 17.15 per cent. This great increase in the total value of our mineral production is due to gains in both metallic and nonmetallic products, the metallic products showing an increase in value from $702,453,101 in 1905 to $886,110,856 in 1906, a gain of $183,657,755, and the nonmetallic products showing an increase from $921,075,619 in 1905 to $1,016,194,350 in 1906, a gain of $95,118,731. To these products should be added estimated unspecified products, including molybdenum, bismuth and other minerals, valued at $200,000. As heretofore, iron and coal are our most important mineral products, the value of the iron in 1906 being $505,700,000, and that of the coal $513,079,809. The fuels increased from $602,257,548 in 1905 to $652,398,476 in 1906, a gain of $50,148,298. The values of the mineral products of the United States in 1905 and 1906 are summarized by Dr. William Taylor Thom, of the United States Geological Survey, in an advance chapter from "Mineral Resources of the United States, Calendar Year 1906," which will soon be ready for distribution by the survey. This summary includes two tabular statements that differ radically. Both give the value of the mineral products of the country in the years 1905 and 1906; but the products of the whole country in their first one gives the net value of the mineral marketable form, excluding all unnecessary duplication. The manufactured coke product, for instance, amounting in 1906 to 36,401,217 short tons, is excluded, as it is represented in the quantity and value of the coal used in its manufacture, which are included in the coal statistics. Similarly white lead, red lead, sublimed lead, zinc lead, litharge and orange mineral, whose average aggregate value for the last ten years has greatly exceeded $10,000,000, are not given in the table, the base from which they are made being included in the output of pig lead. The second table, however, under the heading of "Output and Value by States and Territories," gives the value of both the raw material produced in the region and of certain derivatives in their first marketable condition.

The Faculty of Medicine of Harvard University offers a course of free public lectures, to be given at the new buildings of the Medical School, Longwood Ave., Boston, Saturday at 8 P.M., and Sunday at 4 P.M., beginning January 4, and ending April 26, 1908. No tickets are required. Following is a list of the lecturers and their subjects, with dates:

January 4—"Some Recent Discoveries in the Physiology of Digestion" (illustrated by lantern slides and zoetrope demonstrations), by Dr. Walter B. Cannon.

January 5—"Human Gait" (illustrated by lantern slides), by Dr. Edward H. Bradford.

January 11—"The Modern Crusade against Typhoid Fever," by Dr. Elliott P. Joslin.

January 12—"Common Salt," by Dr. Lawrence J. Henderson.

January 18—"The Causes of Nervous and Mental Disease," by Dr. Philip Coombs Knapp.

January 19—"Fatigue: Its Effects and its Treatment," by Dr. George A. Waterman.

January 25—"Nervous Disorders of Children," by Dr. William N. Bullard.

January 26—"Nervous Breakdown during Adolescence and Adult Life," by Dr. James J. Putnam.

February 1—"Some of the Nervous Disorders of Adult Life, with Especial Reference to 'Habits,'" by Dr. Edward W. Taylor.

February 2—"Popular Fallacies regarding Insanity and the Treatment of the Insane," by Dr. Henry R. Stedman.

February 8—"Alcoholism and Insanity," by Dr. Charles P. Bancroft.

February 9—"The Ear and the Telephone," by Dr. Clarence J. Blake.

February 15—"The Interest of the Public in Surgical Progress," by Dr. James G. Mumford.

February 16—"The Sick Child," by Dr. Thomas Morgan Rotch.

February 22—"The Causes of Disease in Infants and Children," by Dr. Charles Hunter Dunn.

February 23—"Rational Infant Feeding," by Dr. John Lovett Morse.

February 29—"Syphilis: Its Nature and Dangers," by Dr. James C. White.

March 1—"Smallpox and Vaccination," by Dr. John Hildreth McCollom.

March 7—"The Problem of the 'Nervous Temperament' in Children," by Dr. George A. Craigin.

March 8—"Florence Nightingale and the Beginning of Surgical Nursing," by Dr. J. Bapst Blake.

March 14—"Modern Methods for the Care of the Insane" (illustrated), by Dr. Owen Copp.

March 15—"The Relation of the Hospital to the Community," by Dr. Abner Post.

March 21—"Mental Hygiene and the Prevention of Insanity," by Dr. George T. Tuttle.

March 22—"Psychic Treatment of Disease: Its Limitations and Uses," by Dr. Richard C. Cabot.

March 28—"What the People should know about Tumors. Prospects of Cure of Malignant Disease in the Light of Our Present Knowledge. Importance of Early Cooperation on the Part of the Laity," by Dr. Howard A. Lothrop.

March 29—"The Development and Maintenance of Good Teeth," by Dr. Charles A. Brackett.

April 4—"The Inflammations due to the Commoner Pus Germs: their Local and General Effects. Blood-poisoning," by Dr. Charles A. Porter.

April 5—"Certain Dangerous Popular Delusions concerning Grave Surgical Diseases," by Dr. Maurice H. Richardson.

April 11—"Foods in Health and Disease," by Dr. Maurice Vejux Tyrode.

April 12—"The Development of the Microscope," by Dr. Harold C. Ernst.

April 18—"Some Preventable Diseases of the Skin," by Dr. Charles J. White.

April 19—"The Relation of Animal Life to Human Diseases," by Dr. Theobald Smith.

April 25—"The Cocaine Evil," by Dr. Charles Harrington.

April 26—"Tumors," by Dr. William T. Councilman.

Professor Erasmus Haworth, professor of geology in the University of Kansas, was elected president of the Kansas Academy of Sciences at its annual meeting held at Emporia on November 29 and 30. The academy will meet next year at Topeka.

Professor Arthur W. Goodspeed, professor of physics in the University of Pennsylvania, is giving a series of lectures on scientific subjects in middle western cities.

Professor John Craig, professor of horticulture at Cornell University, has been granted a leave of absence, and will spend several months in Europe.

The *Yale Alumni Weekly* states that the senior class of the Forest School this year, as in the past four years, will spend the spring term in practical field work on a large tract of forest land. The classes of 1904 and 1905 were at Milford, Pa.; the class of 1906 was at Waterville, N. H., on the land of the International Paper Company, and last year the seniors spent three months in the Ozark Mountains near Grandin, Mo., on the J. B. White Lumber Company tract. The forest map and estimates which the class of 1907 made for this company proved so valuable that this year several lumber companies have applied to Professor Graves to have the senior class come and camp on their land. From among these offers the tract of the Caul Lumber Company in Coosa County, central Alabama, has been chosen as the location of the camp for the spring of 1908. This region is midway between the coastal plains and the mountains, in a rolling country where the forests of long-leaf pine and many other trees make a delightful field for forestry work. The students will live in a camp located at an elevation of about 800 feet above the sea, 25 miles from Hollins, Ala., and near a spur of the logging railroad. The work will be similar to that done last spring, including the making of a topographic map of the whole tract and estimating and describing all the stands of timber. There will also be abundant opportunity to study in detail methods of logging and railroad construction, and an interesting part of the work will be to devise a practical plan by which the tract can be managed with financial profit in such a way that reproduction of the most valuable species of trees can be secured, the young timber protected from fire, and a future yield attained. Part of the term will be spent in the mill and lumber yards at the town of Hollins, Ala., where the senior foresters will be instructed in saw-mill operations, grading and handling lumber and office management.

The London *Times* notes that till within the last few years the African elephant was represented in British museums by very few specimens of small size. Of these the most noted was perhaps that sent home to Saffron Walden in the thirties of the nineteenth century by John Dunn, and mounted in amateur fashion by local naturalists. This was brought up to the Great Exhibition of 1851, and used to display the magnificent howdah and trappings presented to Queen Victoria by some Indian princes. Recently, however, matters have changed for the better. In fulfilment of a commission, Mr. Rowland Ward obtained and mounted the very fine Rhodesian animal, standing nearly 11 feet 6 inches high, and without doubt the largest museum specimen in existence, for the British Museum (Natural History), where it forms the most striking object in the Great Hall. The same naturalist has just forwarded to the Royal Scottish Museum, Edinburgh, an equally fine specimen, a little under that measurement, the tape giving 11 feet 3 inches, and it has already proved a great attraction, the attendance having increased considerably since it has been on view. Both these elephants were obtained by Englishmen expressly for museum purposes. With regard to the question of height it may be noted that both exceed that of the famous Jumbo, and probably approach the maximum limits. A famous hunter expressed his disbelief in twelve-foot elephants, and he claimed to know more about the subject that those who maintained that such a measurement had been reached. In the character of the ears, which Mr. Lydekker recently made the criterion for distinguishing the different races of the African elephant, the Edinburgh specimen, obtained by Major Powell-Cotton in the Lado enclave, approaches one shot near Lake Rudolf by Mr. Cavendish, and named in his honor. Of quite a different type is the Orleans elephant of North Somaliland, with a lobe or lappet at the lower part of the ear. The head of the type-specimen adorns the walls of the Duke of Orleans's private museum at Wood Norton, the whole of which was arranged by Rowland Ward, who also mounted the trophies, the groups being set up from the duke's notes, photographs and sketches, under the royal owner's personal direction.

UNIVERSITY AND EDUCATIONAL NEWS

Bowdoin College has received a gift of $50,000 from Mr. Andrew Carnegie, to endow a chair of physical science, history and political science in memory of the late Thomas B. Reed. The college has now received $150,000 of the $200,000 required by the General Education Board to make available its gift of $50,000.

Professor Thomas Barker, from 1865 to 1885 professor of mathematics at Owen's College, now Victoria University, Manchester, who died on November 20, has bequeathed most of his estate to the university to establish a professorship of cryptogamic botany and to found scholarships in mathematics and botany. The bequest will amount to about $200,000. Professor Barker also left his microscopes, apparatus, botanical books and herbarium, and his mathematical and general scientific books to the university.

By the will of the late Mrs. Annie E. Fulton, the University College of South Wales and Monmouthshire receives a bequest amounting to about $45,000.

The Educational Times states that Macdonald College, Quebec, established and endowed by Sir William Macdonald, of Montreal, was opened to students on November 7. The college property comprises 561 acres, and has been divided into the campus of 74 acres, where the buildings are located, with demonstration plots for grasses and flowers; a farm of 100 acres for horticulture and poultry keeping; and a live stock and grain farm of 387 acres. The buildings have been planned in accordance with the most modern scientific principles. The cost of the buildings and equipment exceeds £300,000, and in addition Sir William Macdonald has provided a permanent endowment of £400,000. The college is incorporated with McGill University, and Dr. James W. Robertson, C.M.G., is the principal. The college includes a school for teachers, a school of household science, and a school of agriculture. Tuition is free to residents in the Province of Quebec.

The daily press states that Professor Albert Ross Hill, of Cornell University, formerly dean of the Teachers College of the University of Missouri, is soon to succeed Dr. Richard H. Jesse as president of the university.

At the Pennsylvania State College, Professor J. P. Jacksou has been appointed dean of the School of Engineering, and Professor Hugo Diemer, dean of the mechanical department.

Mr. W. Bateson, F.R.S., fellow of St. John's College, Cambridge, since 1885, who recently came to this country to give the Silliman lectures at Yale University and to attend the meeting of the International Zoological Congress, has been appointed reader in zoology at Cambridge University.

Dr. J. G. Frazer, of Trinity College, Cambridge, has accepted the new chair of social anthropology in the University of Liverpool.

Correction: In Mr. Bateson's address, Science, November 15, 1907, p. 655, col. 1, par. 4, for 41:7:7:9 read 177:15:15:49.