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VOL. LVI JULY 7, 1922 NO. 1436

CONTENTS

CONTRIBUTION OF BRYN MAWR COLLEGE TO THE HIGHER EDUCATION OF WOMEN[1]

THE retirement of Miss Thomas from the presidency of Bryn Mawr College, whose destinies she has guided since its formal opening thirty-seven years ago—for nine years as dean in association with President Rhoads, and for twenty-eight as president—and whose ideals, policies and achievements are in so large measure the work of her creative genius, turns our thoughts inevitably to the consideration of these ideals and achievements and to the contributions which this college has made to the higher education of women during her administration. These reflections may serve to lighten in some degree the feelings of sorrow and regret aroused by the severance of relations so long sustained, so rich in accomplishment and so warmly cherished by the students, graduates and other members and friends of this college.

Bryn Mawr began its work at an interesting period in the development of higher education in this country. The path had already been blazed for the collegiate education of women. Each type of institution now recognized—the coeducational, the affiliated and the separate college for women—had been in existence for several years—the coeducational, indeed, for over half a century—and with growing success. But the hard-fought battle was still on. In order to realize how complete has been the victory, how great the advance, recall the changed attitude of the public mind since those days toward college education for girls, indeed the present wide recognition of its vital importance for civilization under the new social order, the many problems then open and now solved—although there

[1] Address at the commencement exercises on June 8, 1922, upon the retirement of President Thomas from the presidency of Bryn Mawr College.

will always be open problems enough in the educational field—the many opportunities for advanced study and research and the careers now open to women and the large achievements of to-day as contrasted with the relatively meager results of those earlier years. In this forward movement Bryn Mawr under the leadership of President Thomas has held a position in the front rank.

Certain fundamental questions, once hotly contested, have been so completely and definitely settled that it is a waste of time longer to discuss them. My profession has at last given its reluctant consent to the proposition that the health of girls is generally benefited rather than impaired by the conditions of college life. The demonstration of the capacity of young women to meet all the mental tests of college work at least as successfully as men students is complete and convincing. College breeding, instead of sacrificing, enhances womanly charm, attractiveness and fitness for domestic happiness. Girls go to college for the same varied reasons, aims, motives and ambitions as their brothers, and seem destined to seek it in equal numbers.

It signifies much to have these and certain kindred questions settled by time and experience—the only way in which they could be settled—and their controversial discussion relegated to the popular pastime of summoning ghosts of the departed.

The debatable questions are really no longer strictly within the educational field. Women now can study what they like and practically where they like. The unsettled questions, such as the academic, scientific and professional opportunities, careers and rewards available to women, especially married women, after the educational period, are of great importance, but they do not fall within the subject of this address.

President Thomas's admirable and inspiring address on the twenty-fifth anniversary of this college, as well as other publications, have made unnecessary the rehearsal on this occasion of all the various influences and policies which have combined to make Bryn Mawr the renowned college which it is to-day. Inasmuch, however, as the highest distinction of this college is the intellectual life which it has cultivated and engendered and the high standards of scholarship which it has created and maintained I may be permitted to recall to your attention certain salient points, familiar as they may be to this audience.

Bryn Mawr entered fully into the heritage of the new ideas and methods introduced in 1876 by the Johns Hopkins University into higher education in this country, marking, as they did, a new era of American university education. I quote President Thomas's own generous words, re-echoed in the introductory remarks to which you have just listened: "Bryn Mawr's debt to Johns Hopkins is too great to be put into words. We owe it not only our group system, but our whole conception of what graduate and undergraduate work should be and our ideals of research and scientific thoroughness." Many times over, I may add, has Bryn Mawr repaid this debt, and most worthily has she guarded to this day these ideals, while adapting and expanding them in detail to meet the special conditions of undergraduate and graduate work of this college in its steady and rapid growth.

It will, I think, be universally conceded, with the fullest and most grateful recognition of the important pioneer work and the later large achievements of her sister colleges, that the entrance of Bryn Mawr into the educational world marked a new epoch in the higher education of women.

The first and most striking evidence of this was the emphasis, previously unexampled in women's colleges, placed by the Bryn Mawr administration in selecting its faculty upon the scholarly attainments and productive scholarship of its teaching staff, and this remains a chief distinction of this college. The excellence of its staff of teachers is the best test of college management and is the foundation of the reputation best worth having of any college or university.

To match the acumen and skill, the flair, one may say, displayed by President Thomas in searching out and securing teachers and investigators whose high promise in the glory of their youth was later realized, one must pass from the academic field to the manifestation of certain trained senses and qualities in the realms of sport, racing and hunting.

I asked to be supplied with the names of those who have taught here and later attained high distinction. I find, as I anticipated, that the list with the accompanying data is too long to be recited within the limited compass of this address, but it is so remarkable and illustrates so completely the standards of productive scholarship sought for the instructing staff that I can not forbear citing the more eminent names, some of which will be recognized by those unfamiliar with the reputations of technical scholars and men of science.

First in time comes Woodrow Wilson, who soon after receiving the doctor of philosophy degree at Johns Hopkins University and publishing his excellent book on Congressional Government was called to Bryn Mawr in 1885, where he organized the department of history and taught for three years before accepting appointment first at Wesleyan University and then at Princeton. In the same department of history taught for eighteen years Charles McLean Andrews before accepting a call to Johns Hopkins and later to Yale, where he is now Farnum professor of American history.

We can understand one of the reasons for the prominent position held by the ancient classics in the curriculum of Bryn Mawr when we recall that here taught for many years that brilliant Greek scholar, Paul Shorey, who left to head the department of Greek at the University of Chicago; E. Washburn Hopkins, who went to Yale as professor of Sanskrit and comparative philology; Herbert Weir Smyth, here for thirteen years before becoming Eliot professor of Greek literature at Harvard; Gonzales Lodge, for eleven years here and now professor of Latin at Columbia; Tenney Frank, who taught here for fifteen years before he was called to the chair of Latin of Johns Hopkins, and Moses S. Slaughter, who is now head of the department of Latin at the University of Wisconsin.

Indicative of the position accorded to the biological and physical sciences in the scheme of liberal education at Bryn Mawr and if possible even more remarkable than the roll of classical scholars is that of the biologists, which includes the names of Edmund B. Wilson and Thomas Hunt Morgan, now at Columbia, and Jacques Loeb, called here from a docentship at Strassburg and now at the Rockefeller Institute of Medical Research, who are to-day the most eminent biologists of America, perhaps of the world. To these are to be added the well known names of Frederic S. Lee, for many years head of the department of physiology at Columbia, and the chemists, Elmer P. Kohler, who after teaching here for twenty years became professor of chemistry at Harvard, and Edward H. Keiser, now holding the chair of chemistry at Washington University.

I must content myself with merely mentioning some of the familiar names in other departments: in mathematics, Harkness; in geology, Miller; in physics, Mackenzie; in experimental psychology, which he here founded, Cattell; in philosophy, Bakewell and Mezes; in English, Tinker and Upham; in Germanic philology, Collitz; in economics and sociology, Giddings.

When to this impressive list are added the far larger number of women graduates who hold important teaching or administrative positions in educational institutions, including Bryn Mawr herself, we can appreciate something of the richness of the gift contributed by this college in less than four decades of existence through the training and development of teachers and investigators to the education not of women only, but of men as well, and to the advancement of knowledge.

Should any one suppose that this continual migration of eminent men teachers to other colleges and universities has sapped the teaching strength of Bryn Mawr, he has only to regard the eminent women and men in her present faculty and the well equipped departments of instruction in order to realize that never were the educational advantages and the intellectual life of this college so great and so vigorous as they are to-day.

There are, however, certain significant inferences to be derived from the fact that it is mainly men and not women who have been withdrawn from this faculty to other institutions. One of these inferences doubtless points to the preference of many of the men for chairs in colleges and universities not exclusively for women students. But here an important consideration has also been the inability of Bryn Mawr until recently to compete with better endowed institutions for teachers desired by both. It is amazing that Bryn Mawr has been able to create and to maintain such high academic standards upon an endowment so slender. It is this success which has furnished the strongest possible appeal to her alumnæ and other benefactors of education, who have responded so generously in recent years in increasing her resources. But her needs still are and will continue to be great, and the record of benefits to women's education and thereby to mankind here to be obtained in a measure out of all proportion to the money invested will continue to make its strong, public appeal.

But the most interesting and in many ways the most important conclusion to be drawn from the circumstance that here women teachers stay, whereas so many men leave to join the faculties of other colleges, is that desirable positions in these other colleges and universities, including the coeducational ones, are open to women in so small number as to be practically negligible. This lack of wider recognition of their work by academic promotion deprives women in large measure of one of the most powerful incentives and highest rewards of productive scholarly and scientific work. Among other reasons I find in this situation, which is not likely soon to be remedied, a compelling argument in favor of the existence and generous support of independent women's colleges in spite of the high cost. Unquestionably coeducation is the best solution of the problem of professional and technical education for women, and even for their collegiate training it will continue to be the prevailing system throughout the larger part of this country, particularly in the west, but experience has abundantly demonstrated the need and special services of separate undergraduate colleges for women, and among the most valuable of these services I count the opening of attractive academic careers to women. Bryn Mawr has shown also the value of adding, when it can be properly supported, a graduate philosophical department, meeting especially the needs of prospective teachers and of workers in the field of social economics.

Bryn Mawr from the start laid still further emphasis upon high academic standards and productive scientific work and made an additional important contribution to the educational and research opportunities for women by the establishment of her system of resident fellowships and scholarships, open to graduates of all colleges of good standing, supplemented later by European traveling fellowships and the nine graduate scholarships for foreign women. Thereby the reputation and influence of Bryn Mawr both here and abroad have been greatly increased and extended. The presence of so many graduate students—ninety-two in the academic year now closing—engaged in advanced work has stimulated the intellectual life of the entire college and their example and the opportunities have led many to pursue their studies beyond the college period. There have thus been afforded to members of the faculty welcome opportunities for graduate teaching and the conduct of research which has led to valuable contributions to knowledge.

It is everywhere conceded that the Bryn Mawr degree of doctor of philosophy equals in rank that granted by any university in this country. One has only to examine in the register the lists of the ninety doctors of philosophy and the one hundred and sixty-five masters of arts of Bryn Mawr and to note their names and the positions which they hold or have held, predominantly in the teaching profession, in order to gain some appreciation of the immense service to education rendered by the graduate courses in this college and the system of fellowships and scholarships.

Permit me to quote the fine tribute paid to this feature of Bryn Mawr at the twenty-fifth anniversary by President Taylor of Vassar College, the first in the field of independent women's colleges of truly collegiate standing: "As I have regarded her career with intense interest from the point of view of a fellow worker since her second year, I am disposed to suggest as among her chief contributions, first, the splendid emphasis she has put upon advanced scholarship for women. I think her fine devotion of so large a part of her income to fellowships and scholarships perhaps without parallel in our country. It has been a steadfast devotion, too, untouched by the considerable variations of interest in the educational world that have sometimes forced the question as to the present desire for these great helps to higher scholarship. But Bryn Mawr has been steadfast; never has it yielded an inch of its purpose to offer women the best that can be had. I suggest again the generosity of her welcome to these scholarships of the graduates of other colleges and universities. All over our land there are women graduates of other institutions who owe to this one the encouragement and possibility of their higher attainments. Well may they rise up to-day and call her blessed!"

The president and faculty of Bryn Mawr have worked out with great care and thought a system of liberal training which in its totality as well as in certain special features constitutes a distinct contribution to higher education and is often referred to as the Bryn Mawr type. The essential features are these: a fairly uniform and sound foundation on which to build the college courses secured by the entrance examination in fixed subjects, certificates not being accepted; required courses of study, occupying half of the student's time, in language, letters, philosophy and science, which furnish the essential basis of liberal culture; freedom of choice of other subjects in accordance with the group system, permitting seventy-one combinations of courses; unrestricted elective courses for one sixth of the work, and before graduation evidence by examination of a reading knowledge of French and German (the latter language temporarily replaced during the war by Italian or Spanish).

The group system, so designated for the first time by Miss Thomas, the central feature of this plan, which in recent years has widely replaced the former Harvard system of unrestricted electives, was borrowed in 1885 from the Johns Hopkins University by Bryn Mawr, which, in amplifying and adapting it to the four years' undergraduate college course, has had an important share in its development and spread. This system, while securing on the one hand the definiteness of purpose of the traditional rigid curriculum and on the other the adaptation to the students interests and needs claimed for the free electives, is more than a compromise between these two rival systems, for it has the very real advantage not inherent in either of prolonged thorough training in some one branch of knowledge or group of kindred subjects which appeals to the individual's interest and aptitudes or is preparatory to future professional study, and this without too early over-specialization.

As regards certain modern, controversial tendencies in college education Bryn Mawr has taken a conservative, although by no means narrow position, and President Thomas has defended this attitude and participated in the lively discussions with all of her accustomed vigor, clearness of statement and intensity of conviction.

Bryn Mawr still stands for four years' study of Latin as an obligatory requirement for entrance and for one year's required study of either Latin or Greek in college. Shocking as it may appear to some of our educational reformers, she continues to emphasize the disciplinary and cultural value of the older, traditional subjects—the ancient classics, mathematics, philosophy and history—and the students follow suit in their electives.

That this zealous interest in the older humanities is compatible with the most open hospitality for those modern subjects of study which are considered to have legitimate place in a scheme of liberal education is demonstrated by the ample provision here made for the study of the natural and physical sciences, psychology, modern languages, English language and literature, which is a particularly strong department, long inspired by the teaching of President Thomas herself, the economic, political and social sciences, comparative philology, Semitic languages and literature, classical archeology, history of art, theoretical music, in a form somewhat reminiscent of the position of this subject in the medieval quadrivium, and still other branches of learning.

Even those who may prefer other types of college courses and methods of study will, I think, concede that Bryn Mawr's curricula and standards embody a noble conception of liberal culture and knowledge—a true Studium Generale—retentive of what is good in the older and receptive to what is best in the newer systems. No adverse financial conditions, no popular clamor and no pressure from outside have led to any sacrifice of quality to quantity, of excellence to numbers, in the maintenance of these ideals.

Modification of the college curriculum to meet the supposed special intellectual needs of women, which has been urged by men more frequently than by women, while it has from the beginning received the serious consideration of educators in women's colleges, has not found favor here or permanently so in other better colleges for women. The ultimate decision of this question rests entirely with the women.

Bryn Mawr resists the transformation of the college of liberal arts by the entrance of strictly vocational and professional studies and frowns upon such heresies as the bisection of the college at the belt line into a junior and a senior college, or the telescoping of the last year or two of the college course into the professional schools. In a word she stands with her sister colleges for preservation of the educational standards and the integrity of the American college in essence and in spirit. To the many who cherish the traditions of the older learning and liberal culture as represented in the American college of the past it may appear that the ark of the covenant is passing into the keeping of the colleges for women.

President Thomas has expressed in these admirable words her conception of the aims of college education for women: "If fifty per cent. of college women are to marry and nearly forty per cent. are to bear and rear children, such women can not conceivably be given an education too broad, too high or too deep, to fit them to become the educated mothers of the future race of men and women to be born of educated parents. Somehow or other such mothers must be made familiar with the great mass of inherited knowledge which is handed on from generation to generation of civilized educated men. They must think straight, judge wisely and reverence truth; and they must teach such clear and wise and reverent thinking to their children." This was fifteen years ago. To-day with the assumption by women of all the responsibilities of citizenship and with the vastly increased influence which college women will exert upon the life of the community and nation, how supremely important it is that the college should aim to discipline intelligence, to strengthen the ability to observe correctly and to form sound intellectual and ethical judgments, and to cultivate for the highest service of the race that fundamental instinct of woman's nature which seeks not less than the perpetuation of the species its safety and welfare!

To this audience it is not necessary to point out that the brilliantly successful efforts of President Thomas to bring to realization at Bryn Mawr certain clear and well defined conceptions of the place and functions of the college in education, as distinct from the secondary school on the one hand and graduate, professional and technical schools on the other, imply no lack of interest in providing opportunities for the training of women in practical and vocational subjects in their proper place. Quite the contrary is of course true.

Full evidence of this is found here at Bryn Mawr in the excellent provisions for the training of teachers and specialists in the graduate courses, particularly in the Graduate Department of Education, an integral part of which is the Phœbe Anna Thorne model school with its primary, elementary and secondary departments, and in the Carola Woerishoffer Graduate Department of Social Economy and Social Research with its admirably conceived theoretical and practical courses which furnish much needed opportunities for training women for ever widening useful and attractive careers in the immense fields of organized social, industrial and community activities and welfare, for which women are much better fitted than men.

What could make stronger appeal to human sympathy and generous support than the novel and interesting experiment, successfully launched here last summer and to be continued this one, of the Summer School for Women Workers in Industry, conceived and initiated by President Thomas?

Our Medical School at the Johns Hopkins and all women owe an inexpressible debt of gratitude to the vigorous efforts and persuasive arguments of Miss Thomas and the generous donation of Miss Mary Garrett in securing the Women's Endowment Fund which enabled the school to start in 1893 with its doors open to the admission of women upon the same conditions as for men, the blessing of coeducation in medicine being more adequately appreciated to-day than at that time. This is only one of the many large services to the women's cause rendered by President Thomas outside of Bryn Mawr College.

To that very important if not larger part of college education which is represented by students' life, association in college halls of residence and activities, here fortunately without intercollegiate athletics, clubs and fraternities, and without sacrifice of the primary collegiate aim, and which really creates the spirit and personality of the college, Bryn Mawr has made its full and delightful contribution, but this is for those who have lived the life to tell. Most charmingly and competently has this been done by the pen of a gifted alumna, Mrs. Helen Thomas Flexner, in the brochure entitled "Bryn Mawr—a Characterisation."

I may mention as a most notable contribution affecting the life of students the system of students' self-government, which was developed here in a more completely organized and unrestricted form than existed elsewhere. It "was born," President Thomas tells us, "of the temporary and wholly fortuitous coming together of marriageable men and maidens as professors and students."

We have only to look around us on these lovely grounds and beautiful buildings of grey stone in order to appreciate the significance of the contribution made under the directing mind and taste of President Thomas by Bryn Mawr's architects to the beauty of American colleges in creating here what has been designated as the American Collegiate Gothic style of architecture.

The best fruits of all the contributions of Bryn Mawr which I have sketched so incompletely and inadequately and of the inspiring personal influence and instruction of President Thomas are the lives and work of over 4,500 former and present students, of whom about 2,000 are alumnæ, of this college.

Who can estimate the benefits to American homes and communities, indeed to the whole nation, resulting from the activities and influence of these women who received their inspiration and training within these walls? Members of the graduating class! We have every confidence that these benefits are to be appreciably increased by your admission to-day to the goodly company of liberally educated women who bear forth to the world the spirit and the traditions of service of Bryn Mawr.

President Thomas! It is a great privilege and honor for me, personally and as a representative of the Johns Hopkins University, to be permitted to join with these loyal alumnæ of Bryn Mawr and your colleagues and with hosts of others in paying tribute to you on this occasion for your great and enduring work for this college, which, as I have endeavored to point out, has made important contributions to higher education. It was not really necessary to add the last two words to the title of this address.

You brought to this task, so triumphantly achieved, scholarly attainments and unswerving devotion to productive scholarship, force of character and intellectual ability of a high order, the boundless energy and enthusiasm of abiding youth, indomitable courage, resourcefulness and perseverance in overcoming difficulties, clear vision and steadfast loyalty to ideals, persuasive and vigorous speech, the inspiration of a cultured, radiant and vital personality, an unwavering and ardent devotion to the cause not of woman's education only but of her advancement in all ways and her emancipation from all shackles and disabilities.

In enjoying well earned release from the burdens of administrative responsibility and in turning to other tasks, for we can not think of you as inactive, you carry with you the durable satisfaction of great service rendered to the great cause to which you have devoted your life, the admiration, affection and gratitude of the thousands of students, alumnæ and friends of Bryn Mawr College, the appreciative recognition and felicitations of other institutions of learning, of scholars and of friends of education and of the cause of women everywhere.

We can hardly think of Bryn Mawr without you, President Thomas, but you are passing on to an able and experienced successor, a threefold graduate of this college, the torch of unquenchable flame which here you have kindled and which here will burn brighter and ever brighter in the coming years to illumine the path of women toward knowledge and wisdom, toward the attainment of the largest and best use of their intellectual and spiritual powers, toward appreciation and enjoyment of the best in life, in literature, in art, in science, in men and women, toward understanding and furthering of the agencies and forces which make for righteousness, peace and the betterment of mankind.

William H. Welch
The Johns Hopkins University

"THE FRIENDLY ARCTIC"

(Published by permission of the Deputy Minister of Mines, Ottawa).

Any one who is in the slightest degree familiar with the Arctic, or even with the history of Arctic expeditions, must have been amazed at the naïve review of Mr. Stefansson's book, "The Friendly Arctic," that appeared in the March 24 issue of Science for the current year. The writer of that review, Professor Raymond Pearl, admits that he is "in no wise a specialist in either geography or polar exploration." One may be permitted to wonder why he undertook the task of reviewing a book that is mainly concerned with those topics. His review, indeed, would be unworthy of serious notice were it not for the wide circulation of the journal in which is appeared; but on that account a reply seems called for.

The reviewer states that the importance which the history of science will attach to Mr. Stefansson's work will rest primarily on his application of a "new and strictly scientific method" to the problem of Arctic exploration; for, whereas earlier explorers depended for food, heat, shelter and clothing mainly on the supplies which they took in with them, Mr. Stefansson, acting on scientific principles, "carried through, over a long period of time [nearly five years, we are told in another place] and a wide range of area, travels in the polar regions, living entirely off the country as the Eskimos do."

Now this statement is unjust not only to earlier explorers, but to Mr. Stefansson himself. The practice of living off the country is *not* a new one in polar exploration. To quote but one example: Dr. John Rae, in 1846-7, supported himself and his party for a whole winter in Repulse Bay, although their only weapons were old, muzzle-loading guns. The method is really a very satisfactory one for a quickly-moving traveler who can choose his own hunting-grounds (*e. g.,* David Hanbury in 1902), and even for a small stationary party in certain well-favored regions; it is rarely satisfactory in the case of a large party working for any length of time within a prescribed area, because the game supply rapidly becomes exhausted. Hence the necessity for bases, and caches of food, employed not only by both the northern and southern parties of the Canadian Arctic Expedition, but by all polar expeditions. Every reader of Arctic literature knows that while game may be plentiful in certain places and at certain seasons, it is very scarce in other places and at other times of the year. All explorers, therefore, including Mr. Stefansson, have been careful to take supplies with them whenever possible, whether they are traveling by ship or by sled, in order to have something to fall back upon when the local supply of game fails. To do otherwise would be the sheerest folly. To take an example. One of the almost gameless areas in the north at the present time is the long stretch of coast between Barrow and the mouth of the Mackenzie River during the winter months; caribou are exceedingly scarce in this region and seals difficult to procure except in the spring and summer. Mr. Stefansson, during his last expedition, spent nearly a year in this portion of the Arctic, but, despite his reviewer, he does *not* claim to have lived off the country at this time, or even to have attempted to do so. He will probably himself admit that from September, 1913, when he first landed from his ship, the Karluk, until March, 1914, when he started on his ice trip, his rifle did not secure him a single meal. Similarly, on his exploration trips in the northern archipelago, where game is more plentiful than in most places, he prudently carried on his sleds all the supplies he could, as is shown by his statement of what he intended to carry on his *second* ice journey in 1915:[1]

I shall start about Feb. 15 with 2 sleds and 3 men beside myself . . . Fortunately our dog-feed is ready where we dried it at Norway Island—it will be dried caribou meat, caribou fat and blubber. *Our own grub will be chiefly rice, fat and sugar. We also have 50 pounds of malted milk, 50 pounds pea-meal and over 200 pounds pemmican* . . .[2]

The reviewer, being absolutely ignorant of the true conditions of polar travel, has uncritically taken certain general statements made by Mr. Stefansson about his living off the country and its advantages as an actual fact that occurred, not merely at certain times and in certain places, but invariably throughout the whole five years of the expedition. Mr. Stefansson, with better knowledge of the conditions that he would be called upon to face, wisely provided himself with three vessels loaded with all the necessary supplies of pemmican, sugar, rice and other foods.

There is also another side to this question of living off the country which seems totally unknown to the reviewer. It involves the destruction of entire herds of caribou and musk-oxen, males, females and young. On Melville Island, one of the largest islands in the north where musk-oxen are still found, Mr. Stefansson and his companions killed, on their own estimate, about one tenth of the total number of musk-oxen (400 out of an estimated 4,000).[3] One can easily imagine how long the supply of game would last under these conditions. The musk-oxen have already been almost exterminated on the mainland of America and in Greenland; on Victoria and Banks Islands they were destroyed by the Eskimos prior to 1913, and the only places where they still remain in any numbers are Ellesmere Island and a few smaller islands adjacent to it. The caribou too have seriously diminished in numbers; their extinction around Coronation Gulf is well within sight even now, although in 1913 they could be counted there by thousands.

The cautious reader, then, will hardly accept the reviewer's extravagant claims for this so-called "new and strictly scientific method" of polar exploration. Another of his statements, equally false, demands more serious attention. He says:

In point of fact a considerable number of the members of his [Mr. Stefansson's] expedition, logically excogitated the matter and came to the conclusion that in holding such views [*i. e.*, feasibility of living off the country] Stefansson was not merely silly but probably also insane, and in consequence felt justified in (*a*) disobeying his orders as commander of the expedition, (*b*) in refusing to render him any aid (*cf.* pp. 114-115 regarding chronometers), and (*c*) in actively hindering his preparations and subsequent operations.

Now no really scientific man would endorse unsubstantiated charges without considering whether there might not be another side to the question. A few official documents will show that there is another side. The three principal charges made by Mr. Stefansson in his book are:

Charge I.—Attempted mutiny, insubordination and disobedience at Collinson Point, 1914. Dr. Anderson, it is alleged, refused to supply the stores and equipment necessary for Mr. Stefansson's ice trip, and the topographers deliberately withheld chronometers that he needed ("The Friendly Arctic," Ch. XII).

The official orders issued to Mr. Stefansson by the Department of Naval Service before the expedition left Esquimalt, B. C., in 1913, read as follows:[4]

The first party, headed by yourself, will explore the Beaufort Sea, and the unknown waters in that vicinity. The second party, under the direction of Dr. Anderson, will busy itself with the scientific work in the extreme northern land of Canada . . .

[1] Copy of letter on file at the Department of Mines, Ottawa.

[2] The italics here and elsewhere are mine. The pemmican was the Underwood man pemmican. From the amount Mr. Stefansson carried with him on this occasion he must have rated its food value somewhat higher than would appear from his book (See "The Friendly Arctic," pp. 718f.).

[3] Testimony of S. T. Storkerson before the Royal Commission appointed May 20, 1919, to Investigate the Possibilities of the Reindeer and Musk-ox Industries in the Arctic and Sub-Arctic Regions of Canada.

[4] Copy of orders on file at the Department of Mines, Ottawa.

The relative importance for this party is as follows: (1) geological, (2) geographical, (3) anthropological, (4) biological, (5) photographical. *The chief of the Southern Party, as executive head, must afford every facility as circumstances permit to enable these sub-parties to carry out the above important work.*

The Summary Report of the Geological Survey of Canada for 1913 contains the following statement by the director (p. 9):

Scientific work within the scope of the Geological Survey was placed *under the jurisdiction of the Survey.* The expedition was divided into two parties, the northern exploration party under Mr. V. Stefansson, the leader of the expedition, and a southern scientific party under Dr. R. M. Anderson of the Geological Survey, whose field of operation was to be in the neighborhood of Coronation Gulf, Coppermine River and Victoria Land. [After naming the officials of the Survey who were on this southern party the director continues:] *The officers of the Survey are working under the direction of and reporting to the Geological Survey.*

From these official documents it is clear, (*a*) that the Southern Party was working on a definite program outlined by the Geological Survey, and (*b*) that its leader, Dr. Anderson, was responsible for providing it with all the necessary facilities in the way of food supplies, sleds, dogs, etc.

The old whaling steamer Karluk, which was to be used by Mr. Stefansson for his northern explorations, was caught in the ice in August, 1913, carried away towards the coast of Siberia and crushed in the following January. It had carried not only the whole of the Northern Party and its outfit, but much of the outfit of the Southern Party as well. The former was competely broken up by its loss, while the Southern Party, though nearly intact as far as personnel was concerned, was left inadequately equipped for its work in Coronation Gulf. Dr. Anderson, its leader, holding himself responsible for the carrying out of that work in accordance with the government instructions, refused to cripple his party any further for the sake of Mr. Stefansson's ice trip, or the formation of a new northern party. The topographers, for their part, were faced with two alternatives by Mr. Stefansson's demand for their chronometers; they could either hand them over, leave the expedition and return at once to Ottawa (for without their chronometers they could do nothing) or else refuse to give them up and proceed to carry out their work as originally planned. In view of the fact that their department had attached them to the expedition solely for the work in Coronation Gulf and had issued precise and detailed instructions to them concerning it, the topographers decided that it was their duty to retain their chronometers and carry out the orders of their department to the best of their ability. The question at issue was *not,* as both Mr. Stefansson and his reviewer state, whether the members of the Southern Party accepted Mr. Stefansson's views about living off the country (land or ice), or considered them "silly and insane," but whether the work outlined for the Southern Party was to be seriously curtailed in order to equip Mr. Stefansson's new party with scientific instruments, large quantities of condensed provisions and other supplies. Had the Southern Party consented, it could not have carried out its own program. The government sustained its action on receiving the full reports; even before their receipt it sent the following despatch, which reached Herschel Island in July, 1914:[5]

Department of the Naval Service,
Ottawa, 30th April, 1914.

V. Stefansson, Esq., Commander, Canadian Arctic Expedition (Northern Division), Herschel Island, via Athabasca Landing.

Sir:

With reference to the plans for a northern expedition during the coming summer

I have discussed with Mr. Brock[6] your suggestions for the movements of the men and ships this summer and the matter has been submitted to the minister with result that it has been decided that, should the Karluk and the men on board not be available for work this spring, it will mean that you will find yourself with the southern party practically intact and with two small vessels besides the motor launch and smaller boats. Under these circumstances it is considered that it would not be wise to break up the Southern Party and take some of its members for northern exploration.

[5] Copy on file at Department of Mines, Ottawa.

[6] R. W. Brock, then deputy minister of mines. See "The Friendly Arctic," p. 380.

Such a division of forces would probably defeat the object of sending out the Southern Party by weakening it and the results to be obtained by the exploration of Banks Land and Prince Patrick Island would not compensate for the sacrifice.

It has therefore been decided that the Southern Party should as far as possible be kept intact and that the program laid out for it should be carried out as far as circumstances will admit.

Your proposal that you should lead a northern party along the coasts of Banks Land and Prince Patrick Island is approved and you are authorized to engage the men of whom you spoke as being available for this expedition. Details of the arrangement must necessarily be left to you and will depend largely on developments in the Arctic regions. *But the main point to be borne in mind is that the work of the Southern Party should be carried out as originally proposed and that it should not be weakened for the purpose of organizing another northern party.*

Yours truly,
(Signed) G. J. DESBARATS,
Deputy Minister

Charge 2.—Dr. Anderson, the leader of the Southern Party, is accused of failing to forward to the government a copy of a very important letter of instructions from Mr. Stefansson outlining his plans and projected movements during and after his ice-trip of 1914 and to inform the press of Mr. Stefansson's movements ("The Friendly Arctic," p. 382).

Mr. Stefansson is clearly in error. Dr. Anderson forwarded copies of this letter by the first mail to the Department of the Naval Service and to the Geological Survey, Department of Mines. The copy sent to the Department of Mines is still on file in that department; that sent to the Naval Service was acknowledged by the deputy minister of the Naval Service, a copy of which acknowledgment is also on file in the Department of Mines.[7]

Charge 3.—Dr. Anderson is accused of disobedience in the summer of 1914 because he failed to send the schooner *North Star* to Banks Island, as ordered by Mr. Stefansson. The *North Star*, Mr. Stefansson states, was bought especially for the explorations around Banks Island, the schooner which was actually sent there, the *Mary Sachs*, being unsuitable for the work ("The Friendly Arctic," pp. 271-2).

Now on March 10, 1914, six days before setting out on his northern explorations and nearly three months after the purchase of the *North Star* ("The Friendly Arctic," p. 103), Mr. Stefansson gave the following instructions to Dr. Anderson:[8]

The work of the *Mary Sachs* as planned at present has two main objects—(1) the carrying forward so far as resources permit of the scientific and exploratory work of the *Karluk* and (2) establishing beacons and depots along the west coasts of Banks and Prince Patrick Islands against the possible landing there of either shipwrecked men or exploration parties from the *Karluk* . . .

A supply depot for the Southern Party shall be established from a portion of the supplies bought from M. Anderson [a local trader]. The *North Star* shall take these to some place agreed upon that is uninhabited and therefore safe—probably Liston Island—and leave them there to be picked up later by the *Alaska*. After that the *North Star* shall go about work later to be decided upon —probably either oceanography or establishing a depot on the west coast of Banks Island for the *Sachs* or against the possible arrival there of men from the *Karluk*.

Evidently Mr. Stefansson at this date considered the *North Star* less suitable than the *Mary Sachs* for his northern explorations. This is hard to reconcile with his statement ("The Friendly Arctic," p. 272) that "the *Star* was purchased especially for the Banks Island trip and the *Sachs*, through her twin propellers, was particularly badly suited to those more northerly and icy waters."

In his later instructions ("The Friendly Arctic," p. 158; the letter is dated April 6) Mr. Stefansson ordered both the *North Star* and the *Mary Sachs* to proceed to Banks Island. Dr. Anderson sent the *Mary Sachs* alone with a launch, for the following reasons:

(*a*) One of these schooners was required to carry the supplies of the Southern Party to Coronation Gulf. Mr. Stefansson had already issued orders to this effect.

(*b*) The *Mary Sachs* was the larger vessel, and Mr. Stefansson's original choice.

[7] See also Dr. Anderson's despatches to *N. Y. Times;* of May 16, 1914, published September 1; August 21, published September 23; and September 14, published March 5, 1915.

[8] Copy of letter on file in the Department of Mines, Ottawa.

(*c*) The *Mary Sachs* was sanctioned by the government for the Banks Island work, the *North Star* was not. [A copy of the instructions sanctioning the *Mary Sachs*, dated Ottawa, 5th May, 1914, is on file in the Department of Mines.]

(*d*) News of the *Karluk's* crew having reached Wrangell Island made provision for them on Banks Island unnecessary.

(*e*) Where orders were too contradictory to be reconciled, it was considered more ethical to follow out the carefully considered plans of the government.

The reviewer of Mr. Stefansson's book was unaware, of course, of all these documents; but a sense of justice and the exercise of a little critical acumen should have saved him from accepting Mr. Stefansson's charges at their face value. The real value to be placed on them, as well as on other statements made by Mr. Stefansson, the reader can determine for himself in the light of the documents quoted above.

D. Jenness

Victoria Memorial Museum,
Ottawa

SCIENTIFIC EVENTS

PASTEUR AS DRAMA[1]

Pasteur is the title of the play with which M. Lucien Guitry, the eminent French actor, has this week opened his repertory season in London. The piece, which was played last year in London on a few occasions by M. Guitry, was first produced in Paris in 1919. It no doubt owes something to the successful production in this country of *Abraham Lincoln,* for both plays depict a great man in selected scenes at different periods of his life. The author of *Pasteur* is M. Sacha Guitry, son of the actor, who admittedly found his inspiration in Vallery-Radot's biography of Pasteur, and designed the play especially to suit the talents of his distinguished father. The first act shows Pasteur in his study with his pupils at the outbreak of the war of 1870. In the second act there is a moving representation of a meeting of the Academy of Medicine, where Pasteur vigorously combats an attack upon his theories, in this scene the audience plays the part of the members of the Academy, with one or two actors speaking from the stalls. In the third act the boy Joseph Meister, who has been bitten by a mad dog, is brought to be inoculated by Pasteur, who sends for a doctor to perform the inoculation, for Pasteur himself held no medical qualification. The dramatist shows his art at the close of this act, for Pasteur, although he knows he can give no help, stays on all night in case something unexpected may happen. The scene changes in the fourth act to Pasteur's home in the country, where he is ill and on the verge of a breakdown; his friend the doctor tries to persuade him to take a rest, but Pasteur is deeply engaged in the study of epilepsy and cannot tear himself away. To him comes again Joseph Meister, now a youth, and a delightfully sympathetic scene ensues between the two. The last act is the crown of Pasteur's career, his reception by the president of the republic in the amphitheater of the Sorbonne, crowded by his friends, among whom is Lister, whose name is announced, although he does not actually appear on the scene. The play has no "love interest" and no female character, and follows no dramatic rules; it is practically a series of monologues, in which the actual words of Pasteur are often used, and its only unity is in the portrayal of its chief character. It is a triumph for M. Lucien Guitry, who appears to live the part of the simple, unaffected, kindly man of genius.

[1] From the *British Medical Journal.*

FOREIGN STUDENTS AND THE FEDERAL IMMIGRATION LAWS

Exemption of bona fide foreign students from the operation of the present immigration law is urged in a resolution adopted recently by the executive committee of the American Association of University Professors. The resolution states:

Whereas, The omission to exempt bona fide students desirous of entering American institutions of learning from the operation of the present immigration law is probably due to inadvertence, inasmuch as such students are expressly exempted from the operation of the Chinese exclusion act and the agreement with Japan;

Whereas, the actual operation of the immigration law has been attended with such deplorable annoyance to incoming students as to lower the prestige of the United States as a center of education;

Be it resolved, That Congress be petitioned to amend the existing three per cent. immigration act by exempting from its provisions all bona fide students.

Be it further resolved, That in case such amendment be not made effective before September 1, 1922, the government be petitioned to cause the adoption by the Bureau of Immigration of such administrative rulings as will preclude the possibility of incoming students being sent to Ellis Island or other detention stations.

TEXTILE RESEARCH INSTITUTE[1]

In the hearings before the Senate committee investigating dyes, the statement was made that there remain to be invested in education and research several hundred thousand dollars representing the profits of the Textile Alliance, in accordance with the original understanding with the State Department.

We urge that this fund be devoted to the establishment of an American Textile Research Institute. Notwithstanding the work of government bureaus, private corporations, and textile schools, there are concerted efforts abroad which surpass anything we have to offer. As an industry, textile manufacturers have not yet been convinced that they can conduct research as an association enterprise. We believe that unless the present opportunity is utilized it may be many years before adequate work will be supported here.

A simple effective plan can be devised. Cotton, wool, linen and silk should be represented in the institute. There are strong trade associations representing these fibers. There is a splendid association of finishers, and still other groups of spinners, dyers, dry cleaners, laundrymen, and other crafts directly concerned with textiles. From these groups a strong advisory committee can be formed and by utilizing the income from the fund to be available a deal of important work can be carried on in existing laboratories throughout the country. The initial staff of the institute could consist of a director with proper assistants, and if desirable an early activity could be the establishment of informational service and a statistical bureau and a proper medium for broadcasting new information.

To divide the capital sum among those now interested in textile research seems to us unwise, for provision should be made for study of new problems as they may arise in whatever laboratory may be best fitted for the investigation. By keeping the present sum as a fund other money is sure to be attracted, and there would be available annually a sum which under wise administration would eventually bring to the laboratories far greater support.

Plans should be perfected, and it is our hope that the committee appointed by the Textile Alliance to consider and recommend methods for the employment of the money in hand may decide upon some such program as we have here suggested.

[1] From the *Journal of Industrial and Engineering Chemistry.*

THE CHEMICAL FOUNDATION

President Harding on July 1 addressed the following letter to Colonel Thomas W. Miller, the alien property custodian:

My attention has been called by the Department of Justice to the fact that a corporation known as the Chemical Foundation has brought suit against the treasurer of the United States and certain licensees of the Federal Trade Commission for an accounting alleged to be due the said Chemical Foundation on royalties due it for the use of certain patents originally seized under the authority of the alien property custodian and sold to the Chemical Foundation by the custodian during the previous administration. On the face of such an action it became so apparent to me that an inquiry should be made that I asked for a report by the Department of Justice on the sale of this enemy property to the Chemical Foundation. It appears that the sale was made at so nearly a nominal sum that there is reason to believe that this government has not faithfully observed the trust which was implied in the seizure of this property. The circumstances relating to the entire transaction are of such a character that full investigation becomes a public duty. Moreover, I feel that your office is obligated to maintain the sacred character of the trust to which the alien property custodian is committed by the law.

You are therefore directed to forthwith proceed as follows:

1. Make written demand upon the Chemical

Foundation, Inc., in form to be approved by the attorney general, to immediately return, transfer and assign to the alien property custodian, all patents, trademarks, copyrights, contracts, applications or other properties or rights transferred to it by the alien property custodian as aforesaid, and to account to you for any and all rents, profits, license fees, or other proceeds thereof realized by said Chemical Foundation, Inc., from said properties, or rights or any of them from the date of transfer thereof to the Chemical Foundation, Inc., to the date of restitution.

2. Take any other action which may be advised or approved by the attorney general, by suit or otherwise, to fully and in every respect protect the rights or interests of the United States and any other person or corporation interested therein, in and to the properties and rights aforesaid, and any proceeds, income or profits therefrom in the hands of the Chemical Foundation, Inc., or its officers, agents or employees.

In carrying out these instructions you will act upon the advice of the attorney general.

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE Board of Scientific Directors of the Rockefeller Institute for Medical Research announces the following promotions, appointments and other changes:

Dr. Wade H. Brown, hitherto an associate member in pathology and bacteriology, has been made a member.

Dr. Homer F. Swift, hitherto an associate member in the department of the hospital, has been made a member.

Dr. Carl A. L. Binger, hitherto an assistant in the department of the hospital, has been made an associate.

Dr. Albert H. Ebeling, hitherto an assistant in experimental surgery, has been made an associate.

Dr. Laura Florence, hitherto an assistant in the department of animal pathology, has been made an associate.

Dr. Albert B. Hastings, hitherto an assistant in the department of the hospital, has been made an associate.

Dr. Philip D. McMaster, hitherto an assistant in pathology and bacteriology, has been made an associate.

Dr. Louis A. Milkeska, hitherto an assistant in chemistry, has been made an associate.

Dr. Ida P. Rolf, hitherto an assistant in chemistry, has been made an associate.

Mr. Fred A. Taylor, hitherto an assistant in chemistry, has been made an associate.

Dr. Hugh J. Morgan, in the department of the hospital, has been appointed resident physician at the hospital.

Dr. David I. Hitchcock, hitherto a fellow in general physiology, has been made an assistant.

Mr. James M. Neill, hitherto a fellow in the department of the hospital, has been made an assistant.

Mr. Henry S. Simms, hitherto a fellow in chemistry, has been made an assistant.

The following new appointments have been made:

Professor Karl Landsteiner, member in pathology and bacteriology.

Dr. Christian Lundsgaard, associate in the department of the hospital.

Dr. Thomas M. Rivers, associate in the department of the hospital.

Miss Lillian E. Baker, chemical assistant in the division of experimental surgery.

Dr. Edmund A. G. Branch, assistant in the department of the hospital.

Dr. George R. Brow, assistant in medicine and assistant resident in the hospital.

Dr. Harry W. Dahl, assistant in medicine and assistant resident in the hospital.

Dr. Douglas R. Drury, assistant in pathology and bacteriology.

Dr. Geoffrey C. Linder, assistant in medicine and assistant resident in the hospital.

Dr. Henry A. Murray, Jr., assistant in the department of the hospital.

Mr. Fredric M. Nicholson, assistant in pathology and bacteriology.

Miss Ida W. Pritchett, assistant in pathology and bacteriology.

Dr. Harold A. Salvesen, assistant in medicine and assistant resident in the hospital.

Dr. Harold J. Stewart, assistant in medicine and assistant resident in the hospital.

Dr. Chester M. Van Allen, assistant in pathology and bacteriology.

Miss Helena A. M. Tibbetts, fellow in the department of animal pathology.

Changes in position have taken place as follows:

Dr. Harold L. Amoss, hitherto an associate member in pathology and bacteriology, has accepted a position as associate professor of medicine at Johns Hopkins Medical School.

Dr. Lloyd D. Felton, hitherto an associate in pathology and bacteriology, has accepted a position as assistant professor in preventive medicine at the Harvard Medical School.

Dr. Raymond G. Hussey, hitherto an associate in bio-physics, has accepted a position as assistant professor in pathology in Cornell University Medical College.

Dr. Robert L. Levy, hitherto an associate in the department of the hospital, has accepted a position as associate in medicine at the College of Physicians and Surgeons, Columbia University, and assistant visiting physician at the Presbyterian Hospital.

Dr. Edgar Stillman, hitherto an associate in the department of the hospital, has accepted a position as associate in medicine at the College of Physicians and Surgeons, Columbia University, and assistant visiting physician at the Presbyterian Hospital.

Dr. Goronwy O. Broun, hitherto an assistant in pathology and bacteriology, has accepted a position as assistant in the Thorndyke Laboratory, Boston, Mass., and assistant resident physician at the Boston City Hospital.

SCIENTIFIC NOTES AND NEWS

ALFRED GOLDSBOROUGH MAYOR, director of the department of marine biology of the Carnegie Institution, died on June 25, at Key West, Fla., aged fifty-four years.

PRINCE ALBERT DE MONACO, distinguished for his oceanographic studies, died in Paris on June 27, at the age of seventy-four years.

DR. F. G. COTTRELL has been appointed director of the Fixed Nitrogen Research Laboratory. He succeeds Dr. Richard C. Tolman, who goes, as has been already announced, to the California Institute of Technology.

THE Albert Medal of the Royal Society of Arts for 1922 has been awarded by the council to Sir Dugald Clerk, in recognition of his important contributions, both theoretical and practical, to the development of the internal combustion engine.

THE John Fritz medal has been presented by the board representing the leading engineering societies to Senator Guglielmo Marconi. The medal is presented for achievement in applied science as a memorial to John Fritz, who was the first recipient. Other recipients of the medal have been Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas Alva Edison, Charles T. Porter, Alfred Noble, Sir William Henry White, Robert W. Hunt, John Edison Sweet, James Douglas, Elihu Thomson, Henry Marion Howe, J. Waldo Smith, George W. Goethals and Orville Wright.

JOHN LYLE HARRINGTON of Kansas City, Mo., has been nominated as president of the American Society of Mechanical Engineers, succeeding Dean Dexter S. Kimball, formerly of the Cornell University College of Engineering. The newly nominated vice presidents of the society are: W. S. Finlay, vice president of the American Water Works and Electric Company, New York; William H. Kenerson, professor of mechanical engineering, Brown University; Earl F. Scott, Atlanta, Ga.; H. H. Vaughan, Montreal.

ON June 4, at the special invitation of the governors and the medical school, Professor Harvey Cushing took over the directorship of the surgical unit of St. Bartholomew's Hospital and replaced the director, Mr. Gask for ten days. The compliment was, as it were, a return for a like compliment paid to Mr. Gask last year, when he acted as temporary chief of the Peter Brigham Bent Hospital, Boston, to which Dr. Harvey Cushing as professor of surgery at Harvard is surgeon.

THE honorary degree of Doctor of Laws was conferred by Wesleyan University on June 19 on Dr. John Campbell Merriam, president of the Carnegie Institution of Washington.

AMHERST COLLEGE at the recent commencement conferred the degree of doctor of science on Dr. Walter W. Palmer, a graduate in the class of 1905, professor of medicine in Columbia University.

MR. GEORGE ROCKWELL PUTNAM, commissioner of lighthouses, U. S. Lighthouse Service, received the honorary degree of doctor of science at the fiftieth commencement of Stevens Institute of Technology.

A LARGE meeting was held at the Sorbonne on June 14 to do honor to M. Camille Flammarion, the astronomer, who celebrated his eightieth birthday. M. Paul Painlevé, of the Institute, lectured on "Man and the signs of the heavens." M. C. E. Guillaume followed on "The work of Flammarion." Distinguished artists of the Comédie Française read extracts from Flammarion's works, and astronomical photographs were thrown on the screen.

Professor Herbert F. Moore, professor of engineering materials at the University of Illinois, received the degree of doctor of science at the commencement of the New Hampshire College.

The following geographers were elected honorary members of the Hungarian Geographical Society at its fiftieth anniversary meeting in Budapest in May, 1922: MM. de Margerie (Paris), Mackinder (Oxford), Hellmann (Berlin), Beltran y Rozpide (Madrid), Machatschek (Prague), Marinelli (Florence), Lawrence Martin (Washington), and the presidents of the Spanish and Italian geographical societies.

Dr. William Libbey, professor of physical geography at Princeton University, and M. S. S. Smith, professor of civil engineering, have retired with the title of professor emeritus.

Dr. John Lorenzo Heffron resigned as dean of the Syracuse University School of Medicine on June 15. This resignation terminates the connection which Dr. Heffron has held with the teaching staff of the medical school for forty years, during fifteen of which he has served as dean. Dr. Heffron was made dean emeritus.

Mr. Hubert Vickery, Ph.D. (Yale '22), has been appointed research assistant in biochemistry in the laboratory of Dr. Thomas B. Osborne, Connecticutt Agricultural Experiment Station, New Haven.

Professor T. H. Goodspeed, of the University of California, is at present working at the University of Oxford, and will spend the latter part of the summer at the John Innes Horticultural Institution at Merton, Surrey.

Dr. Walter L. Bierring, Des Moines, sailed for Scotland on June 27, to attend the ceremony of his election as an honorary member of the Royal College of Physicians, Edinburgh.

Professor Adolph E. Waller of the Ohio State University, will devote the current season to the further study of economic botany in Europe, later returning to America via England in time to attend the annual meeting of the Britiesh Association.

Mr. Frank C. Baker, curator of the Museum of Natural History, University of Illinois, will spend the summer in Wisconsin, continuing his study of the molluscan fauna of that state for the Geological and Natural History Survey.

The twelfth season for the Laguna Marine Laboratory of Pomona College began on June 21. The summer school will last six weeks. There are the usual courses in zoology and marine biology, with eight private rooms for investigators. As in the past ten years the work is under the charge of Dr. W. A. Hilton.

The new plant breeding station and chemical laboratories established in connection with the agricultural department of the University College of Wales, Aberystwyth, were formally opened on May 20. The station has been made possible by the endowment provided by Sir Laurence Philipps, who, in addition, will for ten years contribute a substantial sum towards the annual cost of the farm of ninety-two acres.

As reported in the *Journal* of the American Medical Association, the new laboratory building, erected by the Harvard Cancer Commission for the study of cancer and biophysics in Boston, was opened recently with appropriate exercises, in the amphitheater of the Harvard Medical School. This building adjoins the Huntingdon Memorial Hospital and will be known as the John Collins Warren Laboratory, in recognition of the services rendered to the university by Dr. Warren, former chairman of the cancer commission. In the basement of the new building a vault for the storage of the commission's radium is provided, together with the necessary pumps and apparatus for collecting and purifying the gaseous emanation from the radium solution. The first floor contains the reception and examination rooms for outpatients, together with the Roentgen ray laboratory for Professor Duane. Free diagnosis service will be maintained by the State Department of Health, under the supervision of Dr.

James H. Wright. Material removed at surgical operations can be sent to the laboratory by any registered physician in Massachusetts, and a pathologic examination of the tissue will be made, with a report as to its nature, and returned without expense to the physician or his patient. Dr. Henry P. Wolcott, chairman of the cancer commission, and Dean David L. Edsall, of the Harvard Medical School, who was the presiding officer, gave addresses at the ceremony.

We learn from *Nature* that a prize of $5,000 is offered by Mr. Frank J. D. Barnjum of Montreal for a practical method of combating and suppressing the spruce bud worm, bark beetle and borer, which have caused such tremendous damage in the forests of Eastern Canada and the United States. The Province of Quebec alone has suffered a loss during the past ten years of 150,000,000 cords of standing pulpwood by these pests, which represents a market value in pulpwood of three billion dollars, or if manufactured into paper, of seven billion dollars. This represents a loss of wood sufficient for forty-five years' requirements for newsprint for the North American continent. The competition will close on August 1, and the $5,000 will be given for the successful suggestion that is accepted by the judges, who will be Sir William Price of Messrs. Price Bros., Quebec; Dr. C. D. Howe, dean of the faculty of forestry, Toronto University; Mr. Fred A. Gilbert, Great Northern Paper Company, Bangor, Maine; Mr. G. C. Piche, chief of forest service, Quebec, and Mr. Ellwood Wilson, Laurentide Company, Grand Mere, Quebec. Competitive suggestions should reach Mr. Frank D. J. Barnjum, New Birks Building, Montreal, Canada, before August 1.

At the time of the celebration of the centennial of Pasteur's birth, in Strasbourgh, a congress of hygiene and bacteriology will be held for discussion of questions relating to disease. In order to show the sympathy of Great Britain with the projects of the French committee, a British committee composed of the following members has been formed: Sir Charles Sherrington, chairman, A. Chaston, H. E. Field, Professor Percy R. Frankland, Sir John M'Fadyean, Professor C. J. Martin, Sir W. J. Pope, Sir James Walker and Sir Almroth Wright.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of Frederic C. Penfield, who last served the United States in Austria as ambassador, $80,000 each is left to New York University, the University of Pennsylvania and the Catholic University, for Penfield scholarships in diplomacy and international affairs.

By the will of Seymour Coman of Chicago, the University of Chicago is made trustee of his residuary estate, estimated to be approximately $145,000, the net income to be used for scientific research, with special reference to preventive medicine and the cause, prevention and cure of diseases. This bequest to be known as the Seymour Coman Research Fund.

Stevens Institute of Technology has secured from the United States government the two buildings erected by the Navy Department for the use of the steam engineering school conducted by the Navy at Stevens during the war. The smaller building has been remodeled to house the college library and the museum. One wing of the larger building has been adapted as a laboratory for the department of electrical engineering. The United States government has paid back to the trustees of the Stevens Institute of Technology a tax of $45,750 paid by the original trustees on the bequest providing for the foundation and endowment of the institute in 1870.

The gift of £100,000 by an unnamed benefactor was announced by Lord Haldane on June 14 on the occasion of the laying of the foundation-stone of the new University College, Nottingham, which is to form the nucleus of the East Midlands University. The buildings will be situated in a large park lying between Nottingham and Beeston. This was given by Sir Jesse Boot, who had already made donations, amounting to £110,000.

Five additional professors for the medical department of the University of Georgia are announced as follows: Dr. Eliot R. Clark, from the University of Missouri, professor of anatomy; Dr. Richard V. Lamar, professor of pathology; Dr. Virgil P. Sydenstricker, Augusta, professor of medicine; Dr. Ralph H. Chaney, Rochester, Minn., professor of surgery, and Dr. Harry B. Neagle, Adrian, Mich., professor of preventive medicine and hygiene.

DR. ARTHUR J. HILL, of the department of chemistry of Yale University, has been promoted to an associate professorship in organic chemistry, and Herbert W. Rinehart, Ph.D. (Yale, 1922) has been appointed an instructor.

DR. LLOYD L. SNAIL, of the University of Washington, has been promoted to an assistant professorship of mathematics.

DR. HARRY V. ATKINSON, of the University of Illinois Medical School, has been appointed associate professor of pharmacology in the department of medicine of the University of Texas.

DISCUSSION AND CORRESPONDENCE

BACTERIAL PLANT DISEASES IN THE PHILIPPINE ISLANDS

THAT fungus diseases of plants are numerous and destructive in the Philippine Islands is a well established fact. The extent of damage resulting from this class of organisms is great. Cane is reduced by Fiji disease up to 30 per cent.; the mung bean has suffered so severely that entire crops have been total losses, seedlings of tobacco, tomato and some other plants are severely handicapped by being parasitized by soil harbored fungi. Rusts take their toll yearly, not to mention the serious losses due to forest and timber destroying fungi.

On the other hand, bacterial diseases are scarce and especially so on hosts which have not been introduced from a temperate climate.

Tobacco and other solanaceous as well as some non-solanaceous plants are attacked by *Bacterium solanacearum* E. F. S., an organism which, without a doubt, has been introduced with certain host plants from temperate regions.

Citrus is attacked by the citrus canker organism, cabbage by *Pseudomonas campestris* (Pamm.) E. F. S., beans by *Pseudomonas phaseoli* E. F. S., cotton by *Ps. malvacearum* E. F. S., and parsley by an organism not previously described. So far as present information is concerned these bacterial diseases represent the entire number which are parasitic on economic hosts in central and southern Luzon. With the possible exception of citrus canker and the previously undescribed disease of parsley none of the diseases, or even more, none of the hosts are indigenous to the Philippines and there is no doubt that the diseases were imported for the most part with the hosts, from temperate regions.

The writer has been searching carefully for bacterial diseases and has made many isolations from numerous hosts in an effort to discover the cause of certain unreported maladies. In every case, with the exception of the parsley disease, no bacterial organism capable of initiating disease was found.

The scarceness of bacterial diseases is obvious and those which are commonly found, with the exception of citrus canker, have been brought, in all probability, with their respective hosts. This statement holds true for central and southern Luzon, only, for no work has been possible elsewhere.

COLIN G. WELLES

COLLEGE OF AGRICULTURE,
LOS BANOS, P. I.

SWORDFISH TAKEN ON TRAWL LINES

MR. HENRY D. WHITON, of New York, recently informed me of the capture of several swordfishes near New York late in December, on trawl lines set for tilefish, the information coming to him through Mr. Haroldson, the sailing master of his yacht. At my request Mr. Whiton asked the sailing master to look up details. He reported that four schooners took 13 swordfishes as follows: *William A. Morse* 2, *Columbia* 3, *Ruth M. Martin* 3, and *Benjamin W. Latham* 5. The swordfishes were all entangled in trawl lines set for tilefish at a point 110 miles southeast of Ambrose Channel lightship, the trawels being set at depths varying from 95 to 125 fathoms. All the swordfishes were taken during the period between December 20, 1921, and January 1, 1922. Their weight varied from 250 to 300 pounds.

With this information I called at the office of the Atlantic Coast Fisheries Company, owners, at Fulton Market, where Mr. J. M. Matthews, in charge of the office, after interviewing Captain Emil Rasmusen of the schooner *Ruth M. Martin*, made the following statement:

While fishing for tilefish 120 miles E. S. E. of Ambrose Channel lightship, a swordfish was found on the trawl line when hauled to the surface. The fish was entangled in the trawl apparently in an effort to obtain some of the tilefish that had been hooked. The tilefish near where the swordfish was entangled were cut and bruised, indicating that they had been attacked. There was no indication that the swordfish had been hooked or had taken any bait. The trawl line was looped around the sword close up to the head and wrapped around the body several times. On this trip three swordfish were taken on the trawls in the same manner. One weighed 265 pounds and had a sword about five feet in length. The other two weighed 254 and 185 pounds, respectively. The tilefish trawl had 320 hooks nine feet apart. The fishing ground is on the edge of the Gulf Stream.

I then interviewed Captain Jack Rasmusen of the schooner *Benjamin W. Latham*. He reported having taken five swordfish on tilefish trawls during the holidays, with a total weight of 990 pounds, the trawls being set at depths of 70 to 115 fathoms.

The masters of all four vessels stated that swordfish had never been caught in this manner before so far as they knew. There were no signs of swordfish at the surface when any of the trawl catches were made.

In going into the details of the matter, I was interested chiefly in ascertaining whether the swordfishes had actually gone to the bottom in search of food, but there does not seem to be any positive evidence on this point. The masters of the vessels thought that the unusual catches on the trawl lines were first felt at about 25 fathoms below the surface. All the swordfishes were much tangled up in the lines and most of them were dead when brought up. They probably attempted to raid the trawls while they were being lifted, and it is possible that some of them did so at depths considerably greater than that at which they were first noticed.

CHAS. HASKINS TOWNSEND

THE AQUARIUM,
NEW YORK,

MEXICAN ARCHEOLOGY

TO THE EDITOR OF SCIENCE: A somewhat inaccurate account of the communication on "Recent archeological discoveries in Mexico" that I made to the Royal Anthropological Society in London on November 22, 1921, having been reprinted in SCIENCE (April 7, 1922) from *Nature*, I would be obliged if you would permit me to refer those interested in the subject to the exact report of my text printed in *Man* (January, 1922), to rectify the following inaccuracies:

It was in 1909, not "in 1920" that specimens of the sub-gravel type were first brought to my notice. It was in the great pyramid of the Sun at Teotihuacan and not in the recently uncovered and reconstructed "small pyramid" that Señor Gamio pierced a tunnel. It was an age of two thousand years and not of "twenty thousand years" that the late distinguished volcanist, Dr. Temple Anderson, tentatively assigned to the lava bed at Coyoacan under which a second type of clay figurines was discovered. In his remarks Mr. T. A. Joyce referred to a figurine acquired by the British Museum "from Michoacan, Mexico," and not from "Ecuador."

ZELIA NUTTALL

QUOTATIONS

THE ISOTOPES OF TIN

THE insensitivity of the photographic plate in recording positive rays when compared with its sensitivity to light has long been observed, and has been accounted for by the fact that the action of positive rays is purely a surface effect. There has, therefore, always been the hope that considerable improvement could be made in this direction by increasing the concentration of the bromide particules on the surface of the gelatine. This hope has now been realized to some extent by the use of a method which, I understand, has been devised for the production of

Schumann plates. It consists essentially in dissolving off more or less of the gelatine by means of acid. I have not yet succeeded in obtaining certain or uniform effects, but in the most favorable cases the sensitivity of the "half tone" plates used in the mass-spectrograph has been increased ten to twenty times without seriously altering their other valuable properties.

The immediate result has been the definite proof of the complex nature of the element tin which had been previously suspected (*Phil. Mag.*, xlii, p, 141, July, 1921). Tin tetramethide was employed, and a group of eight lines corresponding approximately to atomic weights 116 (c), 117 (f), 118 (b), 119 (e), 120 (a), 121 (h), 122 (g), 124 (d) was definitely proved to be due to tin. This conclusion was satisfactorily confirmed by the presence of similar groups corresponding to $Sn(CH_3)$, $Sn(CH_3)_2$ and $Sn(CH_3)_3$. The intensities of the various components indicated by the letters in brackets agree quite well with the accepted chemical atomic weight 118.7, and incidentally preclude the possibility that any of the lines, with the possible exception of the extremely faint one at 121, are due to hydrides.

The spacing of these eight lines, which are only just resolved, show that their differences are integral to the highest accuracy, but the lines themselves compared with known lines on the plate give atomic weights always tending to be 2 or 3 parts in 1,000 too light for the above whole numbers. That this remarkable divergence can not be explained as experimental error is very strongly indicated by the following consideration. The discharge tube had been used previously to investigate some very pure xenon. The line due to $Sn^{120}(CH_3)$ should therefore have appeared exactly halfway between the two strong xenon lines 134, 136. It was actually quite unmistakably nearer the former, so much so that the two were only partially resolved. The same irregular grouping repeated itself in another portion of the field in the following spectrum. It seems, therefore, difficult to resist the conclusion that the isotopes of tin have atomic weights which are less than whole numbers by one fifth to one third of a unit of atomic weight, but satisfactory settlement of this important point will probably have to be deferred till a more accurate mass-spectrograph has been made.

Incidentally I may add that the presence of the two faint components of xenon 128 and 130 previously suspected has now been satisfactorily confirmed.—F. W. Aston in *Nature*.

SPECIAL ARTICLES

CRATERLETS IN EAST-CENTRAL ARKANSAS PROBABLY DUE TO THE NEW MADRID EARTHQUAKE

The following brief description of six craterlets occurring on and about the border between the southeast quarter of Sec. 31 and the northeast quarter of Sec. 32, T. 8 N., R. 7 E., is of interest because it apparently extends the sphere of destructive violence of the New Madrid earthquake from that illustrated in Bulletin 494, United States Geological Survey, to within about 20 miles northwest of Memphis. These are also of interest because few, if any, larger than these have been described.

Occurrence: Five of the craterlets occur on the upper surface of one of the low ridges of the Mississippi flood plain. The sixth is a double craterlet, occurring on the slope of the ridge. They apparently bear no relationship to each other except as regards origin and age. With the exception of the double craterlet, they are saucer-shaped, with diameters ranging from 10 to 40 feet, and depths ranging from 2 to 6 feet. One part of the double craterlet is about 15 feet by 10 feet along the diameters of its elliptical outline. The smaller craterlet is about 10 by 8 feet along similar directions. They are separated by a ridge about three feet high. The bottoms of both craterlets lie about 4 to 5 feet below the surrounding surface. These craterlets are all located within a radius of 800 feet.

Origin: The ridge on which these craterlets occur has long been cultivated, and between cultivation and sporadic attempts to fill them up, any evidences of rims that may have surrounded the craters have disappeared. However, the material about the craterlets is made up of the characteristic fine sand and clay that appears in all the dredgings in this vicinity, together with rocks that range in size from 1 inch through to 11x4x5 inches. These rocks very clearly are not indigenous to the flood plain materials that form the ridge. The supposition is that they were forced up from below by gaseous and water pressure that gave rise to the craterlets.

Age: No evidences as to age was obtained by the writer. However, as similar craters are found farther to the north and are there shown to have been formed at the time of the New Madrid earthquake, it is logical to assume that these were formed during the same disturbances.

E. T. Thomas
University of Arkansas

AZOTOBACTER IN SOILS[1]

Some time ago the writer[2] called attention to the apparent relation existing between the presence of Azotobacter in soils and the absolute reaction of the soil. At that time less than one hundred soils, all local, had been examined and the reaction was determined colorimetrically upon an extract of the soil. Since then 418 samples of soil collected from 39 counties in Kansas and 25 states other than Kansas have been cultured for Azotobacter and their presence or absence in such cultures compared with the absolute reaction of the soil determined colorimetrically upon an extract of the soil, and also with the reaction of the soil determined electrometrically upon a suspension of the soil.

These soils have been arbitrarily divided into two groups: those, the hydrogen-ion concentration of which was found to be greater than 1×10^{-6}; and those with a lower hydrogen-ion concentration. This particular division point has been chosen because the large amount of data that have been accumulated indicate that the maximum hydrogen-ion concentration tolerated by Azotobacter is very near this point. Comparing the presence and absence of Azotobacter in these two soil groups with the reaction we can, by making use of Yule's[3] association correlation formula, obtain a mathematical expression for the association or correlation existing between the reaction and the presence or absence of Azotobacter.

An application of this formula to our data gives, when the reaction of the soil was determined colorimetrically, a coefficient of 0.956. When the reaction was determined electrometrically the coefficient was found to be 0.942.

It has been demonstrated in this laboratory that when Azotobacter are introduced into a soil with a hydrogen-ion concentration greater than 1×10^{-6}, and not containing Azotobacter, they can exist therein for an appreciable length of time. Considering the relative ease with which soils may become inoculated under natural conditions, and also the probability that other conditions may inhibit the growth of Azotobacter in soils the reaction of which is favorable, it is believed that an association, or correlation coefficient as high as that indicated above is significant in indicating the influence of the hydrogen-ion concentration of a soil upon the ability of that soil to support Azotobacter.

P. L. Gainey
Kansas Agricultural Experiment Station

[1] Contribution No. 47, Department of Bacteriology, Kansas Agricultural Experiment Station.

[2] P. L. Gainey: Science, N. S., 48, pp. 139-140; *Jour. Ag. Res.*, 14, pp. 265-271.

[3] G. Udny Yule, *Phil. Trans. Roy. Soc.*, Ser. A, Vol. 194, pp. 257-319.

GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY

The sixty-third general meeting of the American Chemical Society was held at Birmingham, Alabama, Monday, April 3, to Friday, April 7, 1922, inclusive. The council meeting was held on the third, the general meeting on the morning and afternoon of the fourth and divisional meetings all day Wednesday and Thursday. Excursions were enjoyed in Birmingham on Friday, and some fifty of the members took a special excursion to Muscle Shoals on Saturday. Full details of the meeting and program will be found in the May, 1922, issue of the *Journal of Industrial and Engineering Chemistry.* The registration was 381, coming from 36 states and one from the island of Mauritius. Twenty-eight ladies attended the meeting.

General public addresses were given by Carlile P. Winslow, director, U. S. Forest Products Laboratory, on "The development of the forest products industry in the south," and by William H. Stone, associate editor of the *Manufacturers' Record,* on "The remarkable development of the south and its relations to the American chemical industry," and a public address to the people of Birmingham by Professor Marston Taylor Bogert on the evening of April 5 under the title, "The flower fields and the organic chemist. Perfumes—natural and synthetic."

At the general business meeting held on Tuesday morning, April 4, resolutions and tributes were presented to the general society on our late honorary member, Giacomo Ciamician, and a long time councilor and active member, the late Dr. Charles Baskerville, the society remaining standing for a few moments as a tribute to the memory of each.

Following these tributes to members of the society, Dr. W. A. Noyes referred to the work of Adolph von Baeyer and Emil Fischer.

At the general meeting on Tuesday afternoon the following general papers were presented:

The manufacture of phosphoric acid in the electric furnace by the condensation and electrical precipitation method: Theodore Swann.

The pioneer's field in petroleum research: Van H. Manning.

Information needs in science and technology: Charles L. Reese.

Recent developments of the chemistry of rubber: W. C. Geer.

Some research problems in the canning industry: W. D. Bigelow.

Chemistry in the old south and the new: Francis P. Venable.

The following divisions and sections met: Divisions of Agricultural and Food Chemistry, Biological Chemistry, Dye Chemistry, Industrial and Engineering Chemistry, Organic Chemistry, Physical and Inorganic Chemistry, Rubber Chemistry, Sugar Chemistry, and Water, Sewage and Sanitation Chemistry; sections of Cellulose Chemistry, Chemical Education, History of Chemistry, and Petroleum Chemistry. Full details of their meetings will be found in the May issue of the *Journal of Industrial and Engineering Chemistry.*

On Tuesday evening a very enjoyable smoker was tendered by the Alabama Technical Association to the society at the Southern Club. The Country Club, the Roebuck Country Club and the Southern Club were open to the members throughout the meeting. On Friday excursions were made to the industrial plants around Birmingham and a barbecue was given at noon, which was a unique experience to many of the members and was enjoyed by all. The scientific program was extensive, 237 papers being presented.

Division of Agricultural and Food Chemistry

T. J. Bryan, *chairman*

C. S. Brinton, *secretary*

Composition, grade and baking qualities of self-rising flour: Benjamin R. Jacobs. The author discusses briefly grades of wheat and flour, and the process of milling ordinary flour. Examination of forty-seven samples of commercial self-rising flour and a few samples of this product made in the laboratory was made. The data give determinations of moisture, protein, total ash, added salt, P_2O_5, SO_3, CO_2 available and residual, microscopic count of bran and hair particles and baking tests. From these data the author shows that approximately 25 per cent. of the commercial product is of a grade inferior to what is commonly known as "straight" grade of flour. He also shows that a large number of samples contain excessive amounts of acid-calcium-phosphate and are deficient in CO_2. The baking experiments which are accompanied by photographs show that many of these self-rising flours make biscuits of inferior quality, this inferiority being due to the grade of flour used as well as to deficiencies in CO_2.

Bleached and self-rising flours: Juanita E. Darrah. This paper discusses the nutritive values of bleached and self-rising flours and gives the results of a series of experiments in feeding rats. The author's conclusions are that bleached flour is inferior. Self-rising flour is not necessarily inferior, if not bleached and if milled and compounded correctly and marketed in original packages. She recommends that stringent measures should be adopted to standardize such flours, and for protection of the honest miller there should be required a statement of the proportion of all ingredients on the label. It is concluded that the better growth of rats fed on products made from self-rising flour over those fed on bleached flour diet must be due to the presence of the phosphates in the leavening agents added in the manufacture of self-rising flour. This has led to a comparison of the phosphate and tartarate baking powders in addition to the flour problem. This work is still under way.

Composition and nutritive value of yeast grown in vitamine-free media: Juanita E. Darrah. The problem here was to determine the nutritive value of yeast grown from such substances as extracts of wheat and alfalfa, after a series of treatments to destroy the vitamine content. The media of B. MacDonald and McCollum was adopted for the experiments, but with a higher concentration of sugar. In addition, oats with vitamine destroyed were added. Rats and guinea pigs were given various diets, and the results were recorded. The author's conclusions are: 1. Yeast may be readily grown in vitamine-free media through an exceedingly large number of transfers. 2. Yeast grown in this way contains protein and nitrogenous bases of undoubted nutritive value. 3. Evidence of dietetic value of yeast grown in such media is not substantiated. There was only very slight indication of presence of water-soluble B, and none of fat-soluble A or water-soluble C.

New sources of water-soluble C and fat-soluble A in the southeast: Juanita E. Darrah. New sources of these vitamines have been found; water-soluble B and C are abundant in Jerusalem artichokes, and fat soluble A is fairly abundant in Avocado pears. Five guinea pigs were fed scurvy diet and succumbed in three weeks in so far as to show unmistakable symptoms of scurvy. Two of these died. One had just been through a previous attack of scurvy and had recovered. Another died, due to chilling on a cold day, when there was a delay in securing the artichokes. The other three recovered entirely on addition of the Jerusalem artichokes in five gram quantities per diem, added to the usual scurvy ration. When protein and mineral salts are supplied in suitable amounts, there is sufficient water-soluble B in Jerusalem artichokes to promote normal growth in white rats, when fed as the sole source of this vitamine in quantities of three grams dried artichoke to ten of the dry water-soluble B free mixed diet. There is sufficient fat-soluble A in Avocadoes to promote considerable growth in white rats; and to prevent sore eyes for a very long period, no xerophthalmia was induced. This is true of a diet adequate in other respects in protein, vitamine content and energy value. No reproduction tests have been secured.

Foods, facts, fancies and follies: Edward Gudeman. This paper discusses the subject of foods from the viewpoint of, firstly, their production, distribution, inclusive of adulteration and substitution, and secondly, from the viewpoint of national habits and follies as to consumption and conservation. It calls attention to the exhausting and wastage of good agricultural lands, the same as with other natural resources, and recommends the reclamation and occupation of the 2,225,000,000 acres of tillable land now lying barren, by employment of the unemployed, the same suggestion as made by President Roosevelt and Secretary Lane for returned soldiers in 1919, such work to be under direct control and supervision of the federal government. Such action would provide labor for thousands of men, would greatly increase the resources of the nation and would create a demand for the products of the government's nitrogen fixation plants, without coming into competition with existing fertilizer manufacturers. It is a paper for the layman without the use of scientific or technical terms.

The determination of hydrogen sulfide by foods when cooked at various temperatures: Edward F. Kohman. A method has been developed in which the food is heated in a flask in an autoclave. The flask is fitted with a stopper carrying two glass tubes. The inlet tube passes to the bottom of the flask and opens in the autoclave. The outlet tube passes through the pine wood stopper of the flask and up through the top of the autoclave and carries a glass stopcock. The autoclave is supplied with steam from a boiler. By this device food may be heated at any temperature for any length of time, while the water content remains constant. At the same time the hydrogen sulfide formed can be collected and determined as barium sulfate. The method is a quantitatively accurate one. Its application to other steam distillations under pressure is considered. It should have wide application in many organic preparations.

Studies of the availability of organic nitrogenous compounds. II (by title): C. S. Robinson.

The interpretation of mechanical analysis of soils as affected by soil colloids: R. O. E. Davis. So-called mechanical analysis of soils is one in which the soil is divided into its mineral constituents according to the grain sizes of the material. This mechanical analysis has an important bearing on indicating the character of the soil and its physical properties. From the results of such an analysis may be judged the water-holding capacity of soils and their relations to tillage operations, and, more important, their probable productivity. In carrying out such an analysis it becomes absolutely necessary, first, to break up all aggregates of soil material and then to go through the operations by which the different sizes are separated. The various methods employed have used various means for deflocculation of the soil material, but the method adopted as most satisfactory by the Bureau of Soils has been that of shaking the sample of soil with water for a period of about seven hours. Experiments recently carried on have demonstrated that the colloid content of soils is considerably greater than has been generally believed. These experiments have shown that the so-called clay separate obtained in the mechanical analysis, consisting of material grains smaller than .005 of a millimeter in diameter, is made up partly of aggregates of colloidal material. These aggregates have withstood the shaking operations without breaking down, but it has been demonstrated that they can be broken down and obtained in a dispersed state by rubbing lightly with the finger or rubber pestle. These results indicate the insufficiency of our present methods of mechanical analysis and show that in addition to the separations as obtained at present this method may have to be supplemented by a determination of the amount of colloid contained in the soil and the main separate groups, such as the clay and silt.

Studies on flavors, beverages and related products. 1. The determination of methyl anthranilate:[1] J. W. Sale and John B. Wilson. A colorimetric method for the determination of methyl anthranilate in genuine and imitation grape products which depends upon the formation of a red azo dye, is described. The reagent used is sodium-1-naphthol-2-sulphonate. Experimental data are given which show that the method is quantitative. Advantages of the method described over others in current use are: first, the method is quantitative; second, the test is applied directly to distillate, thus avoiding possible loss of ester through extraction and subsequent evaporation of solvent; third, use of hydrazine sulphate in place of urea for destroying excess of nitrous acid. The method is recommended in the examination of products which are believed to be sophisticated.

Studies on flavors, beverages and related products. 2. Determination of methyl alcohol in extracts:[2] John B. Wilson and J. W. Sale. The merits of a number of well-known tests for methyl alcohol are discussed and data are given which show their relative value and delicacy. The Denigée and Lyons' tests are found to be the most satisfactory for examination of flavoring extracts suspected of containing methyl alcohol. Flavoring extracts contain a variety of esters and essential oils which interfere unless the analysis is conducted properly. The sample to be analyzed should be adjusted so that it will have a volume of 100 cc and contain not more than ten per cent. of ethyl alcohol. Interfering substances are eliminated by salting the sample, extracting it with petroleum ether previous to distillation, and distilling, using a fractionating column. Thirty cc of distillate are collected in which will be found practically all the ethyl and methyl alcohols. The colorimetric tests to be applied are described in detail.

Relations between the active acidity and the lime-requirement of soils: Edgar T. Wherry. Lime requirement is stated in parts per thousand of CaO, and, because of the ease with which relative values can be appreciated, active soil acidity is stated in the form of specific acidity. The ratio between these in a given soil may be expressed by a correlation coefficient C, obtained by the equation: $L.R. = C \times (S.A. - 1)$. The value of C is believed to be a measure of the adsorptive power of the soil colloids for hydrogen-ion. The coefficient C has been found to vary so widely from one soil to another, from an untreated to a limed soil, and even from one depth to another in the same soil, that it is impracticable to calculate lime-requirement from acidity determinations in general, as has been proposed. Soils may be roughly classified on the basis of the value of C, a convenient ratio between classes being 3/10; but only if some simple procedure is first devised for classifying a given soil can there be obtained from its specific acidity a value for its lime-requirement.

Characteristic proteins in high and low protein corn: M. F. Showalter and R. H. Carr. The protein content of corn is subject to wide variations by breeding and selection. The highest protein ear the writers have been able to produce contained 18.43 and the lowest 7.62 per cent. protein. A study has been made of the relative abundance of the different proteins in corn, and it was found that zein was the important protein which varied most, averaging 50.28 per cent. in high protein and only 31.85 per cent. in low protein corn. The averages for the other proteins are: glutelin 38.11, glolulin 3.70, albumen 3.92,

[1] Contribution from Water and Beverage Laboratory, Bureau of Chemistry.

[2] Contribution from Water and Beverage Laboratory, Bureau of Chemistry.

and amide 2.81 per cent. in the high protein and 52.15, 1.53, 8.21 and 6.25 respectively in the low protein corn. The zein is higher yet in high protein popcorn, averaging 57.24 per cent.

Errors in the determination of fat in cream: E. G. MAHIN and R. H. CARR. The use of hydrocarbon oils, non-miscible with butter fat, for eliminating the upper meniscus in the necks of Babcock bottles has become quite natural. More recent experimental results in the Purdue laboratory have shown that in the hands of the ordinary dairy tester this results in readings averaging about 0.5 per cent. lower than when the bottom of the meniscus, obtained without added oil, is used. As the latter has formerly been shown to be about 0.5 per cent. lower than is given by the gravimetric method, the use of such oils (such as "glymol") ordinarily results in a loss of about 1.0 per cent. of fat for each test. Ten large creameries in Indiana averaged 100,000 cream tests in 1917. Upon the assumption that each test represented a five-gallon lot, this represented approximately 500,000 gallons of cream. An experimental error of 1.0 per cent. in the fat determination therefore meant a loss to the producer of more than 40,000 pounds of butter fat, if the "glymol" method was used in all cases. The value of this fat was approximately $20,000. The reading error has been found to vary according to the method of adding the oil. If the latter is added slowly and carefully, little or no error occurs. If the oil is run in rapidly, as is ordinarily the case, it momentarily sinks into the liquid butter fat, and as it rises it carries some of the latter upon its surface, thus decreasing the length of the residual fat column. It is conclusively shown that the method is not safe in the hands of the average dairy tester, but the use of amyl alcohol for this purpose, substituted for hydrocarbon oils, gives reliable results in all cases.

The commercial purification of phosphoric acid by crystallization: WILLIAM H. ROSS, C. B. DURGIN and R. M. JONES. Commercial phosphoric acid contains among other constituents such poisonous impurities as lead, arsenic and fluorine. Acid intended for use in the manufacture of foodstuffs must therefore be treated for the elimination of these materials. This is done, at present, by precipitation with the aid of suitable reagents. The effectiveness of this method is limited by the solubility of the precipitate in the acid. It has been found that by concentrating phosphoric acid, at a temperature below 105°, to a specific gravity of 1.85 at 20° and inoculating with a crystal of phosphoric acid, the greater part of the acid will crystallize, leaving the impurities in the mother liquor. The crystallization may be repeated by centrifuging, melting the crystals at a temperature above 40° C., cooling to ordinary temperature, adding water to bring to a specific gravity of 1.85 and again inoculating. Two or even one crystallization will usually be sufficient for acid of commercial quality, but by repeated crystallizations acid of any desired degree of purity may be obtained. When phosphoric acid is prepared by the volatilization process and collected in a Cottrell precipitator, it is usually of such a concentration that it may be crystallized with little or no initial concentration. The crystallization method is therefore especially adapted to the purification of volatilized phosphoric acid and experiments on the commercial development of the method are now in progress.

Do velvet beans contain vitamin B? E. R. MILLER. Fourteen pigeons were fed on an exclusive diet of polished rice until pronounced symptoms of polyneuritis appeared. Seven of these were restored by feeding each five grains of corn. The other seven were fed five velvet beans each with the result that all were improved temporarily, but all died within two to six days. Of another group of six which were fed polished rice, two died, apparently from starvation. Of the four brought down with polyneuritis, three were completely restored by administering to each 0.5 grams of an alcoholic extract of velvet beans and one was partially restored. This amount of extract represented three beans of average size. The more favorable results obtained with the second group is probably due to the greater availability of the vitamin and is believed to show that the velvet beans contained a fair amount of vitamin B.

The occurrence and composition of some Alabama phosphates: B. B. ROSS.

The mineral requirements for the nutrition of wheat during the seedling phase: H. H. KING and M. C. SEWELL. Wheat was grown in sand cultures, the nutrient solution consisting of KH_2PO_4, $Ca(NO_3)_2$ and $MGSO_4$ and the concentration of the salts in each pot having a calculated osmotic value of 1.00 atmosphere but differing by increments of ⅛ in salt proportions. The pots were arranged in duplicate triangles of twenty-one pots each. The experiment was carried through the seedling phase of five weeks' length. Solution R_4S_2 which was chosen as best consisted of KH_2PO_4, $Ca(NO_3)_2$ and $MgSO_4$ in the following proportions, 3:2:3, and the respective partial volumes molecular concentrations being 0.0072, 0.0048, 0.0072. The basis for the determination of the best solution was the dry weight of tops. To five pots vitamines extracted from yeast was added. This increased the growth of the plants quite noticeably.

A dietary study of some state institutions: E. H. S. Bailey. This is a study of the dietary of each of the groups at the different institutions under the care of the Kansas State Board of Administration, where shelter, food and clothing are provided. The calculations are made from a complete report of all the food used for a series of months, sometimes during the entire year. The proteins, fats and carbohydrates and the calories per day per capita are worked out for each institution according to a commonly accepted method. The number of inmates at these institutions being large, and the conditions varied, an excellent opportunity is afforded for a comparison and for constructive criticism on the quantity, variety and cost of the food furnished.

Studies on the electropure process of treating milk: Floyd W. Robison. This paper gives a résumé of previous work on the treatment of milk by electricity and gives in detail the results of the author's studies on the improved apparatus. The apparatus is described in detail and its essential characteristics emphasized. Results of studies on bacterial reduction; keeping qualities of the treated milk; effect on cream line, etc., are given and include a very thoroughly conducted experiment on the effect of the process on bacteria of tuberculosis in milk. The great value of the process is pointed out and certain automatic control features dwelt upon. The application of the electric current and the method of preventing the electrodes from becoming hot, thus eliminating any heated taste, are important features in the light of their effect on the treated milk. The process produces a milk free from pathogenic organisms and with a phenomenal bacterial reduction. The keeping quality of the treated milk is excellent and its commercial values otherwise greatly enhanced. The apparatus is illustrated.

The rôle of manganese in plants: J. S. McHargue. The purpose of this investigation was to determine if manganese has any definite function to perform in plant economy. The method of attack has been the preparation of plant nutrient compounds and quartz sand, free from manganese, and the growing of plants in different portions of nutrient solutions or sand cultures from which manganese was withheld and in another equal number of portions of these media to which manganese was added. All the plants were grown until those that received manganese showed signs of fructification and a few to maturity. The plants from which manganese was withheld made a normal growth for about six weeks only. Thereafter they became chlorotic and the young leaves and buds died back and the plants made no further growth of any consequence, whereas the plants to which manganese was available grew in a normal way and fructified where the plants were grown to that state of maturity. The author concludes that manganese is necessary in the plant economy and that, therefore, eleven elements are necessary for the normal growth of autotrophic plants, whereas it has been taught previously that only ten are necessary.

The absorption of water by soil colloids: W. O. Robinson. A method is given for determining the amount of water absorbed by the air-dried colloid under specified conditions. It was found that the water absorbed by purified colloids from thirty-five different soils was nearly a constant, the average being .298 grams of water absorbed per gram of colloid. A tentative method is proposed for determining the amount of colloid in a soil by finding the amount of water absorbed and dividing this figure by .298. The assumptions involved are discussed.

Division of Physical and Inorganic Chemistry
S. E. Sheppard, *chairman*
R. E. Wilson, *secretary*

Theory of the structure and polymorphism of silica: Robert B. Sosman. There exists a wide variety of experimental data on the forms of silica, and particularly on quartz, which have never been assembled and explained on the basis of a single consistent set of hypotheses as to the ultimate structure of this substance. This paper attempts to provide such a set of hypotheses, based upon the general knowledge already gained concerning the structure of matter in general and silica in particular. It is believed that the silica atom-triplet maintains a certain degree of individuality in its amorphous and crystalline states as well as in its compounds, and the freedom of its oxygen atoms to change their positions with respect to the silicons is restricted. The triplets are assumed to assemble into chains or threads in the liquid and glassy states, and a thread structure persists in the crystalline states (cristobalite, tridymite, chalcedony, quartz). The high-low or alpha-beta inversions in all the forms are thought to be due to the same underlying change, namely, a change in the shape of the silicon atom and in the relative positions of the two oxygen atoms attached to it.

A general conception of acids, bases and salts: HAMILTON P. CADY and HOWARD M. ELSEY. General definitions are suggested for acids, bases and salts which it is believed will include all systems whether containing hydrogen as one of the constituents of the solvent or not. According to this view, an acid is defined as a substance which ionizes to yield the same cation as is given by the direct ionization of the solvent. A base is a substance which, by its direct ionization, yields the same anion as the solvent. General definitions may be easily derived for salts, neutralization, hydrolysis and other terms. These definitions are applied to solutions in sulfur dioxide.

Crystallography and atomic structure: EDGAR T. WHERRY. Instead of treating crystal structure from the viewpoint of point-systems, it is desirable for some purposes to consider the atomic domains, or spaces, with which each atom acts. The most important domains which are geometrically possible are figured, and summaries given of the elements known to possess each. It is held that in any atom in the crystalline state the electron arrangement possesses the same symmetry as the domain within which that atom lies. The structures on the basis of Langmuir's synthesis of earlier theories and of Bury's modification of it are compared with the simplest possible structures reconcilable with the geometrical requirements. It is thought that in some atoms the two electrons of the helium nucleus are not stationary, but revolve so as to produce a spherical external field of force. From lithium up to calcium the arrangements are simply related to those accepted by both Langmuir and Bury, but in the elements of higher number the arrangements suggested by Langmuir are not capable of passing into those fulfilling the geometrical requirements as readily as are those of Bury. The conclusions as to the simplest structures reconcilable with the domain symmetry in the cases of most of the elements of which the domains are known are shown in a final tabulation.

Equilibrium in the reduction of iron oxides and in the oxidation of iron by steam: A. S. RICHARDSON, F. C. VIBRANS and W. P. BELL. Equilibrium in the systems H_2-H_2O-Fe-FeO, H_2-H_2O-FeO-Fe_3O_4, CO-CO_2-Fe-FeO, and CO-CO_2-FeO-Fe_3O_4, have been commonly supposed to apply to the reducing and steaming phases of the steam-iron process of hydrogen manufacture. The literature on these equilibria is itself conflicting, but in still worse agreement with the authors' observations on the first stages of both reducing and steaming the iron contact mass used in hydrogen manufacture. Higher conversion of steam to hydrogen and higher conversion of reducing gases to oxidized gases have been obtained than the equilibrium data indicate to be possible.

Solubility measurements on sulfur dioxide: STEWART J. LLOYD. The solubility of sulfur dioxide was determined in naphthalene, acetone, ether, ethylene bromide, butyric acid, ethyl acetate, trichloracetic acid, carbon tetrachloride and chloroform. Distinct irregularities were observed with trichloracetic acid, chloroform and carbon tetrachloride, and a further study of them is under way.

Esterification equilibria in the gaseous phase: GRAHAM EDGAR and WM. H. SCHUYLER. The equilibrium in the gaseous phase between acetic acid, alcohol, ethyl acetate and water has been measured by distilling a small amount of vapor from the liquid equilibrium mixture, chilling and analyzing. The composition of the distillate differs widely from that of the liquid. Calculations of the equilibrium constant in the gaseous phase are complicated by the partial association of the acetic acid, but indicate a much more complete esterification than in the liquid phase. The results are in accord with qualitative results of Berthelot and Pean de Saint Gilles, and have an important bearing upon the high yields of ester obtained by Reid when passing alcohol and acetic vapor over silica gel.

Partition ratios and solubility numbers: N. E. GORDON and E. EMMET REID. Formic acid has been partitioned between water and a number of organic solvents in which the solubility of formic acid has been determined. From the partition ratios and the solubilities an attempt has been made to estimate the tendency of formic acid to dissolve in water.

The amphoteric ionization of hypochlorous acid: WILLIAM A. NOYES and THOMAS A. WILSON. The ionization constant of hypochlorous acid as an acid was determined by measuring its conductivity in 0.001 normal solution and also the conductivity of solutions 0.001 normal for sodium hypochlorite and for calcium hypochlorite, prepared by mixing a solution of pure hypochlorous acid with solutions of the respective bases. The solution of hypochlorous acid was prepared by distilling, under diminished pressure, chlorine water in contact with yellow mercuric oxide. The ionization constant found was between 6.60 and 6.79×10^{-10}, a value somewhat smaller than that of Sands calculated from entirely different data. No measurable difference could be found between the conductivities of 0.001 and 0.0001 normal nitric acid and the conductivities of solutions which were 0.001 or 0.0001 normal for both nitric and hypochlorous acids. In other words, the ionization of hypochlorous acid as a base, to positive chlorine and hydroxyl ions, can not be shown by this method. It was shown by determining the composition of the vapors carried away from solutions of pure hypochlorous acid by a current of air that these contain chlorine monoxide, Cl_2O, and not hypochlorous acid, HClO. The chlorine monoxide is evidently formed by the union of positive chlorine ions with hypochlorite ions, showing very clearly the amphoteric ionization of the acid. Jakowkin has shown by the freezing point lowering that solutions of hypochlorous acid contain chiefly the unionized acid.

The ionization of butyl mercuric hydroxide: W. V. Evans and Louise Otis. It is generally stated in the literature that substances of the type RHgOH are strong bases, but no experimental data exist. Preliminary conductivity measurements show that butyl mercuric hydroxide is a weak base. Because of its hygroscopic nature weighing out samples is unsatisfactory. Ordinary titration of the base offered difficulties which were overcome by adding sodium chloride, thus precipitating out butyl mercuric chloride and leaving NaOH to be titrated. Molecular weight determinations by the freezing point method showed ionization varying from about 10 per cent. in .1N solution to about 40 per cent. in .02N. This preliminary study has shown several interesting properties of the base. A trace of the base in water changes the surface tension of the water in such a way that the solution does not wet glass. A solution of butyl bicarbonate on boiling loses all of its carbon dioxide, leaving a solution of the pure base.

Ammono nitric acid: Edward C. Franklin. Assuming a structure represented by the formula H-N-N-N hydrazoic acid may be looked upon as a nitric acid of the ammonia system. In agreement with this view it has been found first, that a mixture of hydrazoic acid and hydrochloric acid dissolves the noble metals; second, that sodium oxide (sodium ammono nitrate) nitridizes sodium cyanide (sodium ammono carbonite) to sodium cyanamide (sodium ammono carbonate); third, that potassium nitrate (potassium aquo nitrate) may be ammonolyzed to potassium oxide (potassium ammono nitrate); and fourth, that nitrous oxide (a mixed acid anhydride acid anammonide) reacts with potassium hydroxide to form potassium nitrate.

The drainage error in viscosity measurements of viscous materials by the capillary tube method: Eugene C. Bingham and H. L. Young. Tests with bulbs of 8 to 24 ml capacity show that the amounts of liquid left on the wall of the bulb for a given time of efflux are nearly independent of the size of the bulb, but they are directly in proportion to the viscosity of the liquid. The authors have constructed a tube which shows the drainage correction for any particular viscosity at the different rates of efflux.

Hydrogen ion concentration and the properties of the emulsoid colloids: Robert H. Bogue. It is shown that the various physical properties of the emulsoid colloids, as viscosity, jelly strength, melting point and joining strength (of glues) are at a minimum at a hydrogen ion concentration corresponding to the isoelectric condition. As the acidity or the alkalinity of the solution is increased from this point, these properties rise in value to certain maxima. It is shown that salt precipitations for gelatin content should be made at the isoelectric condition if maximum precipitation is desired. The necessity for a careful control of hydrogen ion concentration in investigational work on the emulsoid colloids is emphasized, and the desirability of a similar control in the plant during manufacture is pointed out. The limitation of benefit from such control makes questionable, however, the practicability of such methods for the purpose of the improvement of grade. The estimation of hydrogen ion concentration as one of the tests in evaluation is urged, but it is not recommended that all tests for viscosity, jelly strength, etc., be made at a specified p_H value.

The elasticity of ash-free gelatin jellies: S. E. Sheppard and S. S. Sweet. In an earlier paper on "The elastic properties of gelatin jellies" the authors gave results on the measurement of the modulus of rigidity of gelatin jellies from commercial gelatins, at various concentrations and p_H values. Certain anomalous results were obtained on variation of p_H. It was suspected later that these anomalies might depend upon the (inorganic) ash constituents, and elastic measurements have been repeated on carefully de-ashed gelatin at various concentrations and p_H values. The new results show that for this purified gelatin a maximum of rigidity (jelly-strength) is obtained at about $p_H = 8$, at all concentrations; the curves show a "shoulder" near the isoelectric point ($p_H = 4.8$) but no definite maximum or minimum. On adding aluminum salts, to give as low as .01 per cent. Al_2O_3 on dry gelatin, the course of the curve was greatly altered, a secondary maximum being produced at $p_H = 5$, and the maximum on the alkaline side displaced.

The formation of inorganic jellies: general theory: HARRY B. WEISER. Factors that influence the formation of jellies in general are: A jelly may be expected to form if a suitable amount of a highly hydrous substance is gotten into colloidal solution and allowed to precipitate at a suitable rate without stirring. If the concentration of the hydrous substance is too low, no jelly or only a very soft jelly can result. If the precipitation from colloidal solution is too rapid, contraction is likely to occur with the formation of a gelatinous precipitate instead of a jelly; if too slow, the particles are likely to grow and settle out in a granular or sandy mass. The effect of the presence of salts on jelly formation is determined by the agglomerating and stabilizing action of ions, in so far as these affect the rate of precipitation.

The adsorption and orientation of molecules of dibasic organic acids and their ethereal salts in liquid-vapor interfaces: H. H. KING and R. W. WAMPLER. Adsorption values are given for oxalic, malonic, succinic, fumaric, maleic and d tartaric acids and the di-ethyl esters of all the above acids with the exception of oxalic and maleic. The values were calculated using Gibbs' equation. Hydroxyl groups and double bonded carbons increase the surface tension, as is shown by the fact that d tartaric acid has the highest surface tension, and in order maleic malic to succinic, which has the lowest. The higher surface tension of the acids as compared with the esters is due to their polarity. The influence of the polar groups in the esters is similar. The esters are adsorbed more than the acids due to the replacement of the polar groups with the insoluble ethyl group. The molecules are orientated so that the polar groups are in the liquid leaving the carbon chains in the surface. Tartaric acid is negatively adsorbed, the surface tension of an 8 M solution being 74.125 and a .125 M solution being practically that of water.

The atomic weight of lanthanum: B. S. HOPKINS and F. H. DRIGGS. The lanthanum from 182 kg. of cerium group double sulphates was purified by fractional crystallization of the double magnesium nitrates until free from neodymium followed by fractional crystallization of the double ammonium nitrates. The arc and absorption spectra of the insoluble end of this series showed it to be free from all other rare earths. The material was further purified by eight alternate precipitations with ammonia and oxalic acid. The pure oxide was converted to the chloride in a quartz flask with pure dry HCl and weighed. A nearly equivalent amount of pure silver was weighed out, dissolved in HNO_3 and added to the solution of $LaCl_3$. The deficiency of silver or chloride was added from a standard solution of $AgNO_3$ and NaCl. Equivalence was tested for with the nephalometer. From the ration, $LaCl_3$: 3Ag, the atomic weight of La was calculated. The average of five determinations was 138.91.

Thermo-regulator: E. B. STARKEY and NEIL E. GORDON. A thermo-regulator, designed to meet the needs of the individual student in physical chemistry. It has an accuracy to .05° C., and does not require a relay or battery. Furthermore, the point of contact is enveloped in an atmosphere of inert gas, and hence there is no oxidation at the point of contact.

The concentrations of alkali halide solutions of the order of 0.0001 N most favorable to adsorption by barium sulphate: JACK P. MONTGOMERY. Each halide was used in concentrations progressing from 0.00004 N to 0.001 N in a series of 50 cc cylinders each containing 0.01546 gram barium sulphate. The upper half of each solution was withdrawn for titration with 0.004 N silver nitrate. There was a regular progression of the volume of silver nitrate required until a certain concentration of the halide was reached, at which concentration less than the expected volume was required. Having passed this concentration the progression became regular as before. Plotting the halide adsorbed against the concentration, the curves are regular except for a dip at the point showing the most favorable concentration. Favorable concentrations are LiCl, 0.00088 N; NaCl, 0.00072 N; KCl, 0.00034 N; RbCl, 0.00014 N; LiBr, 0.00068 N; NaBr, 0.00056 N; KBr, 0.00016 N; LiI, 0.0001 (?).

The transposition of insoluble oxalates by sodium carbonate solution: L. J. CURTMAN and D. HART. Working under the most favorable conditions for the transposition of calcium oxalate by sodium carbonate solution, it was found that 91 per cent. was transposed. With the oxalates of barium, strontium, ferric and ferrous iron, aluminum, nickel, cobalt, manganese, zinc, bismuth, copper and stannous tin, a transposition of 98 to 100 per cent. was obtained. The oxalates of calcium, magnesium, lead and cadmium were transposed from 91 to 97 per cent. Silver oxalate on the other hand was transposed only to the extent of 77 per cent. In determining the amount of transposition it was necessary to analyze the insoluble oxalates for their oxalate content. In this work it was necessary to devise special procedures wherever the oxalate content could not be directly determined as in the cases of ferrous, cobalt, lead and stannous oxalates. These special procedures are given in the original article.

A new method for the volumetric determination of iron: L. J. Curtman and N. H. Hecht.. In a previous communication (*Chem. News,* CXXII, 1921, p. 254) the authors proposed a rapid method for roughly estimating the iron in systematic qualitative analysis. In this method the iron, if not already in the ferric condition, is first oxidized, treated with KCNS and the deep-red $Fe(CNS)_3$ which form is bleached with a standard solution of $SnCl_2$. The results obtained by this method were so surprisingly accurate that we undertook a special study of the procedure to determine whether or not it could be used as a substitute for the standard volumetric methods for iron. Numerous analyses of iron ores were made by our method as well as by the Zimmerman-Rheinhart and gravimetric methods. The results agreed very well, showing the new method to be a reliable one. The various factors which influence the results by this method were studied and a suitable apparatus was devised for preventing the oxidation of the standard $SnCl_2$ solution. Once the apparatus is set up, our method will be found much more rapid of execution than any of the old volumetric methods in which the iron is first reduced and then oxidized.

Two new pieces of apparatus for use in analytical work: Louis J. Curtman. Having experimentally demonstrated that 48 per cent. HF was without appreciable action on transparent bakelite, the author had prepared for him from this material a 10 cc graduate and a medicine dropper. The former has been found very serviceable in measuring definite quantities of HF. These graduates are less brittle than glass, they are non-inflammable, retain their shape and can be readily cleaned. They are provided with a flared top to facilitate pouring the HF from the usual wax containers in which HF is supplied. The medicine dropper made of transparent bakelite has been found superior to the improvised lead tubes which have heretofore been used in carrying out one of the best qualitative tests for silica and silicates.

Rapid electrolysis without mechanical stirring: Graham Edgar and R. B. Purdum. By the use of an electrolytic cell consisting of a wide glass tube provided with three glass "air lifts" sealed into its side and entering tangentially at their upper ends, a vigorous stirring, both rotational and vertical, may be effected by blowing or sucking an air current through the air injectors. With a cylindrical platinum gauze cathode and a spiral anode in such a cell, rapid and accurate determinations of copper have been made, using a current of as much as three amperes and a time as low as fifteen minutes. Zinc does not interfere. The apparatus is readily constructed, and the technique for its use is extremely simple.

The relation of yield value and mobility to the so-called painting consistency of paints: Eugene C. Bingham and Herbert D. Bruce.

Hydroux oxide IV: Hydrous Stannic Oxide: Harry B. Weiser. The so-called alpha or stannic acid and beta or metastannic acid are not isomeric compounds but are the two extremes of a series of hydrous stannic oxides that differ from each other in solubility, peptizability, adsorbability, the structure of the mass and the amount of water contained. Peptization and adsorption experiments on stannic oxides prepared at various temperatures show that each is a chemical individual and not a mixture of a definite alpha with a definite beta oxide. Contrary to the usual observation, stannic oxide jellies may be prepared by precipitation of the hydrous oxide from colloidal solution, under suitable condition.

The interfacial tension between toluol and ash-free gelatin solutions: S. E. Sheppard and S. S. Sweet. Measurements were made by means of a drop pipette, the interfacial tension being calculated from the weight of a drop by Harkin's formula, the accuracy being checked by measurements on water. It is found that gelatin lowers the interfacial tension between water and toluol considerably, a one per cent. at 30° C. lowers it some 10 dynes/cm, and this increases with the concentration of gelatin. The interfacial tension or p_H curve was determined for 1.0 per cent. ash-free gelatin at 30°, 40° and 50°. Between $p_H = 1$ and $p_H = 10$ there is but little variation, except for a well-marked and significant "kink" at $p_H = 4.8$, the iso-electric point. At 30° and 40° C. there is but little change with time, but at 50° C. the change is considerable, except at the iso-electric point, indicating hydrolysis.

The nitration of toluene: James M. Bell.

Charles L. Parsons,
Secretary

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CONTENTS

EDUCATION AND EXPLORATION BY THE AMERICAN MUSEUM

THE report of President Henry Fairfield Osborn, of the American Museum of Natural History, for the year 1921 is a concise recountal of the accomplishments of the institution and records the firm establishment of the policy inaugurated in 1917—the policy of a broader and more varied service calculated to prove of scientific and educational value, not alone to the citizens of New York, but also to those of the entire nation.

The most conspicuous event of the year last past was a favorable attitude adopted by the city administration toward this institution—the decision to begin the construction of additional wings which have been urgently needed for more than fifteen years, but which because of the war and the high cost of building immediately following, it was found impracticable to start before the current year. At a meeting of the Board of Estimate and Apportionment, held on December 26, 1921, the sum of $1,500,000 was unanimously voted to erect the southeast wing on Central Park West and the southeast court building adjacent thereto as planned in 1875. In providing these additional halls, the city administration is liberally supporting the public educational activities of the museum's work. During the past year the museum, which serves alike the schools of the five boroughs, reached 1,500,000 school children, 869 natural history collections were in use among the elementary schools. This is exclusive of the number of lantern slides distributed which illustrate the work of the museum in all parts of the globe and provide the latest accepted methods of visual instruction in geography, zoology, forestry and history, totaling 210,000, or a service of 182 schools. The number of schools reached outside the museum was 477 in all of the boroughs, and the number of scholars was 1,247,515. By the methods initiated in this museum, the observations and results of its field workers in Australia, Asia, South America, Africa, Polynesia and Western Europe are made acceptable to the use of the teachers of our public schools in less than twelve months, and this phase of the museum's activities has far outgrown the space capacity of the insttution to care for it properly. On a single day as many as 2,500 boys and girls may be found in the museum preparing for their examinations. For this purpose adequate space must be provided. Still greater care is necessary for the large classes coming for a day from the outlying sections of the city or from neighboring cities in New York and New Jersey, which also are finding the museum in increasing numbers. To care properly for this enormous number of school children, a special school service building has been planned in the southwest court, to be devoted exclusively to their use.

On April 21, 1922, the Board of Estimate and Apportionment of the City of New York unanimously appropriated $570,000 for the construction and equipment of the School Service Building of the American Museum of Natural History. This action of the city authorities opens a new period in the history of the museum's relation to the schools and is significant appreciation of what the museum is doing in bringing nature to the boys and girls of the city. The work of the museum with the schools during the last eighteen years has been carried on with inadequate facilities. The Department of Public Education, which has immediate charge of these activities, has been housed, for the most part, in corridors, basements and anterooms in various parts of the present edifice. In fact, under the circumstances, it is surprising that the museum has attained the position of usefulness that it now holds in the educational system of the city.

The School Service Building is to be located in the southwest court of the museum. It will be a four-story and basement structure, connected by covered bridges in the first and second floors with the north wing on the east and the southwest wing on the west. The basement and the first floor will be 160 x 88 feet, and the second, third and fourth floors will be 160 x 53 feet. The height from the basement to the peak will be 91 feet and the cubical space approximately 1,000,000 feet. It is estimated that from 3,000 to 5,000 children may be properly taken care of daily in the School Service Building, or from ten to twenty times the number that the present facilities of the museum will permit.

How highly the educational service of the museum is estimated may be inferred from a reading of the following resolution adopted by the Board of Superintendents of the Board of Education of New York City on March 27 by way of endorsement of the application of the American Museum for funds for the School Service Building:

Whereas, The American Museum of Natural History since 1881 has been conducting educational work with teachers, and since 1904 has been supplying the public schools of the City of New York with lectures and with nature-study material of all kinds, with lantern slides and other visual education aids in teaching geography, history and natural science; and

Whereas, The American Museum, entirely at the expense of the trustees, through its explorations in all parts of the world, is bringing to New York rare and valuable educational specimens which are made freely available for the use of the teachers of the city; and

Whereas, The museum is lacking in adequate facilities for receiving the school children who visit the museum and for housing the administrative work connected with its operation with the public school system of the city, and has therefore made application to the Board of Estimate and Apportionment for the appropriation of $570,000 for the erection of a four-story School Service Building in the southwest court of the American Museum of Natural History.

Resolved, That the Board of Superintendents of the Board of Education of the City of New York desires to record its unreserved approval of the valuable service which the American Museum is rendering to the schools of the City of New York, and heartily indorses the plans of the trustees for making it more thorough and effective and hereby recommends to the Board of Education that it request favorable consideration from the Board of Estimate and Apportionment of the museum's application for funds to erect and equip the School Service Building.

While the practical side of the school work of the museum is cared for by the city, the scientific side is entirely cared for from trustees' funds. It is interesting to record that during the past sixteen years the total amount contributed by the trustees, members and friends of the museum to the endowment and to the enrichment of the collections was $11,871,722. Although the present city government has been more liberal than any of its predecessors, providing for annual maintenance the generous sum of $352,025.52, the generosity of citizens of New York so far exceeds this provision by the taxpayers that it nearly doubles it. Thus, for every dollar contributed by the city from tax funds, the citizen receives $3.00. The growing appreciation of the museum by the public is shown by the attendance which has risen from 613,152 in 1910 to 1,174,397 in 1921. Sunday opening, which was one of the most warmly debated questions in the early history of the museum, leading to the resignation of some of our strict Sabbatarians, during the year 1921 totaled 327,888, showing that the museum is sought for wholesome and inspiring education during the Sunday afternoon hours by constantly increasing numbers. The Sunday attendance during January, 1922, alone has been 51,062.

Like all other educational and municipal institutions, the operating cost of the museum has doubled during the last decade. This increase, however, is not due to the increased number of employees or to extravagance, but to the necessary increase in salaries and material required for the proper upkeep. For the year 1921 the museum experienced a deficiency of $88,249.48, to meet which $56,000 was contributed from the accrued interest on the Margaret Olivia Sage Fund and $32,348.42 was contributed individually by the trustees. For the year 1922 the trustees have reluctantly cut down the work of the museum by the amount of $81,059.56, and have guaranteed to raise $40,000 through their personal contributions and the gifts of members and friends. Realizing that this deficiency can only forever be obviated by increasing the general endowment fund and that for the immediate future the sum of $2,000,000 should be raised, the trustees announced at a meeting of the executive committee of the board, held on May 20, 1922, that their efforts to raise $2,000,000 during the present year by public contributions to its permanent endowment fund were receiving united and generous support from public spirited citizens, who, after a thorough investigation of the educational activities of the museum, were convinced of the worthiness of the undertaking.

The initial subscription of $250,000 came from Mr. George F. Baker, who, in addition to his previous gifts, now contributes that sum to the capital fund of the museum, the income from which is to be at the disposal of the trustees. Closely following Mr. Baker's gift, Mr. John D. Rockefeller, Jr., wrote to President Osborn that he long had felt that the American Museum of Natural History was an important factor in the educational and scientific life of New York City, and that it gave him pleasure to contribute $1,000,000 toward the permanent endowment, the income of which was to be available for any of the current needs of the museum. Mr. Rockefeller stated that he realized the unwisdom of seeking to forecast the requirement of the distant future, and was fully conscious of the dangers attendant upon the establishment of any endowment fund in perpetuity and, therefore, it would be agreeable to him, if in the judgment of the trustees it was wise, to have the whole or any portion of the principal of this gift devoted to any of the corporate purposes of the museum. To the above sums is to be added the amount received from the Eno bequest by which, according to the settlement of the contested will, the museum receives $272,000, of which $200,000 is to be added to the endowment fund.

Through the generosity of friends and from museum funds, work in the field has been undertaken with renewed efforts. The third Asiatic expedition, under the leadership of Roy C. Andrews, has begun preliminary work in China and has already forwarded valuable zoological material. This expedition will be in the field for five years. Rollo H. Beck, working under the auspices of the Whitney fund, is securing thousands of specimens of bird, animal and plant life from the remote islands of the South Seas. In Australia, Dr. W. K. Gregory and Harry C. Raven established most cordial working relations with the government authorities and as a result the small collections of fauna of that continent which we now possess will be greatly enriched. Captain Harold E. Anthony and George K. Cherrie, on an expedition to Ecuador, secured 4,000 specimens of birds and mammals. On this expedition the little-known country of the head hunting Jivaro Indians was penetrated, and valuable photographs secured. In Africa, Carl E. Akeley has been successful in obtaining a family of five gorillas. With the photographs and accessories which this well-known taxidermist, sculptor and hunter has secured, it will be possible to complete the finest group extant of these man-like apes. Entomological work has been carried on by Dr. F. E. Lutz in the Pine Barrens of New Jersey and Northeastern United States. Ethnological studies were made in Utah, New Mexico, California and Peru. By far the most important work in this field of science has been made possible through the funds provided by Mr. Archer M. Huntington for the completion of a restoration of the ruins at Aztec, New Mexico. Earl H. Morris, who has this work in charge, has forwarded highly important specimens found in these ruins and his observations will go far toward establishing the cultural area of the early inhabitants of our great southwest. Mr. Barnum Brown has sent important paleontological specimens from Egypt, Abyssinia and India, and Albert Thomson has continued, with success, work in the fossil fields of Nebraska. Through exchange and by gift, as a result of the Neolithic tour in Europe. Professor Henry Fairfield Osborn secured collections enriching our European archeology and established most agreeable working relations with eminent scientists of England, Norway, Sweden, Denmark, Belgium and France, to the end that new discoveries bearing on the antiquity of man in those countries will at once be forwarded to the American Museum.

At the beginning of the year the trustees recommended the grouping of the scientific work of the museum into four divisions in order to harmonize the work of the different departments, and in order to produce greater efficiency and economy for the future harmonious development of the exhibition halls of the museum. The following scheme of work is now in effect:

I. *Division of Mineralogy, Geology, Paleontology and Paleography:* Curator William Diller Matthew, F.R.S., in charge. Under leadership of Curator Matthew, Curators Whitlock, Hovey, Reed, Osborn, Granger and Brown will confer and cooperate in the development of their respective subjects and exhibition halls.

II. *Division of Zoology and Zoogeography:* Curator Frank Michler Chapman, N.A.S., in charge. This division will include mammals, birds, reptiles, amphibians, fishes, insects and marine and terrestrial invertebrates. Curators Andrews, Anthony, Gregory, Chapman, Murphy, Noble, Dean, Nichols, Gudger, Lutz and Miner will confer and cooperate in the development of their respective lines of exhibition and scientific work.

III. *Division of Anthropology:* Curator Clark Wissler, Ph.D., in charge. This division will be coordinate with the present Department of Anthropology but will include direction of the Galton Laboratory and progress of the Galton Society, also William K. Gregory as represeutative of comparative anatomy, J. Howard McGregor in human anatomy, Honorary Curator Osborn in geologic relations and prehistory of man.

IV. *Division of Education, Books, Publication and Printing:* Curator George H. Sherwood, M.A., in charge. This division will include the officers and chief of the Department of Public Education, of the library, of *Natural History*, of the printing and publication departments, and of public information.

Outstanding Publications: The publications of the American Museum of Natural History for the year have been the *Bulletins*, the *Memoirs*, the *Anthropological Papers*, the *Novitates*, *Natural History*, and the *Museum Journal*.

THE NECESSITY OF BALANCING DIETARIES WITH RESPECT TO VITAMINES

THE fairly recent discovery that small amounts of unknown substances are necessary constituents of a complete diet has opened up a large and evidently attractive field of research. The enthusiasm with which this work is being prosecuted and the novelty of many of the results obtained, have apparently led to the conviction in many quarters that vitamines are of great importance in practical dietetics, and that human dietaries should be deliberately balanced with respect to these factors. It may be fairly questioned, however, whether this attitude is not premature. Investigators in this field should remember that their experiments are being performed upon animals chosen particularly because they are known to be readily susceptible to a deficiency of this or that vitamine. Pigeons are used for experimental investigation of the anti-neuritic vitamine, because they so readily succumb to a diet devoid of this factor, and because the symptoms induced are so characteristic of the dietary deficiency. Similarly with guinea pigs and monkeys and the anti-scorbutic vitamine, and with rats and the growth vitamines. It is of great significance that when other animals are used in these studies, the results obtained are often not clear cut. When guinea pigs, rabbits or monkeys are used in the study of vitamine A, or when rats are used in the study of vitamine C, inconstant or entirely negative results are observed.

It is of course permissible to use animals known to be highly sensitive to vitamine deficiencies in the study of the relative distribution of vitamines in food materials. Rats may be used, for example, in determining the relative concentration of vitamine A in cereal grains, tubers, green leaves, etc. From the results obtained it may be concluded that green leaves are much richer in the factor than are cereals, or, if the work is conducted on a quantitative basis, that certain green leaves are so many times richer than a certain cereal seed in the vitamine. This conclusion would evidently bear no relation to the species of animal used, but would have a general application to all animals. However, as is so often done, if it is concluded that oats or white corn or potatoes are *deficient* in vitamine A, the conclusion has no general applicability whatever. It should be rigidly restricted to the rat, which has been chosen because of its relatively great requirement for this vitamine. The statement that a food is *deficient* in a certain vitamine, defines a relation between the vitamine content of the food and the vitamine requirement of the experimental animal, and hence can not with any degree of certainty be applied to other animals.

In many of the original articles reporting the results of feeding experiments relative to the distribution of vitamines in food materials, this loose interpretation may be found. As a result certain foods are generally classed as being deficient in certain vitamines. We are told that the cereals and many of their milling products, white potatoes, white bread, meats, and animal fats are deficient in vitamine A, that white bread and milk are deficient in vitamine B, and that most dried and preserved foods are deficient in vitamine C, when the facts only warrant the statement that they are relatively poor in these vitamines. For all that is known to the contrary, the vitamine contents of these foods may be considerable in relation to human requirements, and hence in dietetics they can not be considered deficient in them in any strict sense of the word. To illustrate the point, meat seems to be distinctly deficient in vitamine C for the guinea pig, since very large amounts of meat or meat extract in the ration of guinea pigs will not adequately protect them against scurvy. On the other hand, for human beings, even the relatively low concentration of the vitamine in meats is still so considerable in relation to human requirements that a moderate consumption of fresh meats will prevent the outset of scurvy indefinitely. In human experience, therefore, fresh meats can not be considered deficient in vitamine C.

In the total lack of quantitative data on the vitamine requirements of humans, and in the very general absence of malnutrition or disease among people in this country which can with any degree of probability be diagnosed as involving vitamine deficiencies, it seems premature to formulate recommendations for the balancing of diets with respect to vitamines. The richness of milk and butter in vitamine A, for instance, has been made the basis for an extensive campaign in favor of substituting these products in the diet for foods not so rich in this factor. That this vitamine is ever a limiting factor in human dietaries is questionable, and any statement to that effect is not based upon evidence, but upon uncertain analogy with laboratory animals. That human dietaries are so frequently deficient in the fat-soluble vitamine as to warrant general recommendations for an increased consumption of foods rich in this dietary factor, is a presumption still further removed from fact. The latter statement may also be made relative to any of the known vitamines.

In regard to vitamine A in particular, the fact is sometimes overlooked that this seems to be a peculiarly growth vitamine, its functions in the animal body probably being confined largely if not entirely to the period of active growth. Adult rats have been maintained in good health for over a year on rations devoid of this vitamine as judged by current standards. At the Illinois Agricultural Experiment Station, four sows have been maintained for nearly a year on a ration of white corn (Silver Mine) and tankage, and have successfully raised two litters of pigs each, though the ration, according to tests on rats, is nearly if not entirely devoid of vitamine A.

In a recent report on vitamines prepared by the Medical Research Committee of the (British) National Health Insurance Commission, the relation of vitamines to the public health is discussed somewhat fully, and the conclusions reached have been widely circulated in this country. The tenor of their conclusions is that "a deficiency in food, which when complete or extreme leads to actual disease, may, when only relative, be responsible for ill health of a vague but still important kind," and in particular that "a deficiency of an accessory factor (vitamine) may be of a much smaller order than that necessary to produce the typical syndrome of the disease usually associated with the deficiency, but may nevertheless be sufficient to induce a distinct failure of nutrition and health." No criticism can be made of such hypothetical statements as these, but when the argument is made to converge upon a definite proposition that "there is a very real danger that the improperly balanced dietaries consumed in many cases may lead to a partial deficiency of one or more of the necessary substances (vitamines), if not of other components as well," one may be pardoned for questioning the reality of any such danger. The reasons for transforming a possibility into a "very real danger" are not at all obvious. And yet such a transformation is tacitly involved in any general recommendation that vitamine foods should be substituted in the bill of fare for other food materials less rich in vitamines, or that vitamine preparations having little other food value should be regularly consumed.

In the issue of Science for October 28, McClendon argues for the use of tablets containing vitamines A, B, and C. His plea is based upon premises of doubtful soundness. He points out the low content in vitamines of wheat flour, cane sugar, and hydrogenated fats, but does not consider the possibility that other staple articles of food, available the year round, including dairy products, meats, potatoes, and canned and preserved vegetables and fruits, may entirely supplement the diet with respect to vitamines. Nor does he consider that the general consumption of fresh vegetable foods, rich in vitamines, during the spring and summer months may result in a considerable storage of vitamines in the body which may aid in tiding over a period of low vitamine intake. The statement made that "there are many families who do not, under the present system, receive sufficient vitamines in their food," has no claim to credence, since it does not seem to be based upon any evidence whatsoever. Nor is there any particular reason why it should be assigned any high degree of probability.

The attitude taken in this brief discussion of the practical bearing of the recently acquired fund of information relating to vitamines, is admittedly conservative, though only to the extent of insisting that the connection between general conclusions and recommendations on this matter and experimental or other evidence should be sufficiently tangible to constitute at least a fair deduction. At a time when popular periodicals are widely publishing irresponsible articles on vitamines, ignorantly or deliberately creating an entirely distorted popular conception of them, and when commercial concerns are widely advertising purely hypothetical advantages of vitamine preparations, it is particularly important that investigators in nutrition exert great care in the wording of statements as to the practical significance of vitamines in every day life. Otherwise they may become unwilling accomplices in the perpetration of a gigantic fraud upon the American public.

H. H. Mitchell
College of Agriculture,
University of Illinois

ANSEL AUGUSTUS TYLER

The sudden death of Professor Tyler of Millikin University (Decatur) on March 31 from pneumonia has taken from the institution and the college circle of the state a quiet and faithful worker whose place will be hard to fill.

Ansel Augustus Tyler was born at East Bridgewater, Pa., on March 7, 1869. He received his A.B. at Lafayette College in 1892, and won the Ph.D. at Columbia University in 1897. Thereafter he taught botany or biology for a year each at Union College, Syracuse and Arizona, with such success that in 1900 he was called to take charge of this work at Bellevue College in Omaha. At that date the prospects before Bellevue were alluring and he threw himself wholeheartedly into the work of building up not only his own department but also the college itself. The high appreciation in which his efforts were held was manifested by his election as dean of the college in 1911, a position which he held as long as he remained there. But the fortunes of Bellevue suffered serious reverses and, although Tyler devoted himself unsparingly to its service, he found the institution steadily losing ground through influences which he could not control or modify. So in 1916 he accepted a call to take charge of the department of biology at Millikin University. Here again he was formed to carry a heavy load of teaching during a transition period, but a year ago was granted some much needed aid in his department and had just started to realize his cherished ambition of developing that work when his career was so prematurely terminated.

Tyler's ability as a college student won him the Latin salutation on graduation and also election to Phi Beta Kappa. His later work brought him in 1898 membership in Sigma Xi. He was a fellow of the American Association and a working member of the State Academies in Nebraska and Illinois. In 1908 he was honored by election as president of the Nebraska Academy. Although quiet and retiring in personality, he was always ready to carry his part in enterprises of public merit. Thus in 1910 there was organized a movement to secure and preserve for Omaha a splendid and unique tract of wild forest near that city. Tyler served as secretary of this organization, the Fontanelle Forest Association, until he left Bellevue, and did much to develop public sentiment in favor of the project, which has recently realized much of its hopes through a generous gift from a public spirited citizen of Omaha.

But Dr. Tyler's greatest work was after all in his department. He inspired many college generations with his own high ideals of service and love of the truth. From his class room went out a steady stream of students filled with love of science and steadied by his calm and thoughtful leadership to test the offerings of life, to reject the hollow and false, and to cherish the true. Such service to the college and the state can not be measured in formal terms but will always be held in grateful remembrance by his students and his colleagues, as well as by the many other friends to whom he devoted himself equally unselfishly.

Henry B. Ward
University of Illinois

SCIENTIFIC EVENTS

RESEARCH WORK IN COAL MINING

Through the efforts of the coal operators of western Pennsylvania, another year of extensive research work in coal mining will be conducted by the cooperative department of mining engineering of Carnegie Institute of Technology and the Pittsburgh Experimental Station of the United States Bureau of Mines. The research will be carried on through teaching and research fellowships appointed by the Carnegie Institute of Technology and supervised by senior investigators in the Experimental Station.

The establishment of four fellowships to do this work in 1922 and 1923 is an endorsement of similar investigations conducted this past year at these institutions. Four fellowships were established a year ago by the advisory board of coal operators of the cooperative department of mining engineering at the institute. They also chose the problems for the research work The Pittsburgh district is the first to take this progressive step in solving the problems of coal mining. When the results of the research work are broadcasted, the whole industry should be benefited.

The investigations of the four research fellows conducted the past year are completed and reports will soon be available to the coal industry. For the coming year, appointments have already been made by the cooperative department of coal mining to begin the work in September. The problems selected by the advisory board of operators have been assigned to the fellows in accordance with their specific training and adaptability. In making the appointments, applications were considered from all parts of the United States, reflecting the wide interest at large in research work of coal mining problems.

The four problems to be investigated, as recommended by the advisory board, are: (1) De-sulphurization of coke. (2) Corrosion problem with regard to acid mine waters. (3) Microscopic study of the Pittsburgh coal seam. (4) By-product study of the roof coal of the Pittsburgh coal seam.

The appointments and assignments for 1922-3 are:

Teaching Fellows: John H. Thompson, B.S. metallurgy, 1922, University of Washington, under Dr. Alfred R. Powell, physical chemist, of the United States Bureau of Mines, and V. F. Parry, B.S. mechanical engineering, 1922, University of Utah, under Joseph D. Davis, fuels chemist, U. S. Bureau of Mines.

Research Fellows: J. Richard Adams, B. S. physical chemistry, 1922, Cornell University, under R. J. Anderson, metallurgist, U. S. Bureau of Mines, and James U. Staud, B. S. geology, 1922, Pennsylvania State College, under Dr. Reinhardt Thiessen, research microscopist, U. S. Bureau of Mines.

THE OPTICAL SOCIETY OF AMERICA

THE seventh annual meeting of the Optical Society of America will be held at the National Bureau of Standards, Washington, Thursday, Friday and Saturday, October 26-28, 1922. The regular sessions for the reading of papers will be open to all interested persons.

Members and others desiring to communicate results of optical research are invited to submit titles of papers for the program to the secretary any time before September 25. Titles received after that date can not be included in the program. Address Irwin G. Priest, secretary, Optical Society of America, care of Bureau of Standards, Washington, D. C. Each title must be accompanied by an abstract of not more than 300 words. These abstracts will be printed in the program and in the minutes of the meeting. The purpose of the abstract is to give: (1) a more definite description of the *nature* and *scope* of the paper than can be conveyed in the title, (2) the essential results in so far as may be possible in the limited space allowed. It is hoped that the advance publication of these abstracts will prepare those attending the meeting to consider the papers more intelligently and with much greater interest. Authors are urged to cooperate in this effort by preparing their abstracts carefully with this end in view. They are also asked to submit with each abstract a careful estimate of the time which will be necessary and sufficient to present the paper briefly but adequately. In preparing the program the secretary will be guided by these estimates insofar as time will permit.

No title will be printed to be presented "by title." Titles should not be submitted unless the author has a bona fide intention to actually present the paper orally or have it presented by some one else.

One session will be devoted to vision and physiologic optics.

An exhibit of optical instruments and apparatus will be held at the Bureau of Standards in connection with this meeting. Communications relative to this exhibit should be addressed to Professor C. A. Skinner, chairman, exhibit committee, Optical Society of America, Bureau of Standards, Washington, D. C.

The program will be mailed to members about October 1. Others desiring programs in advance may obtain them by applying to the secretary.

Irwin G. Priest,
Secretary

ADDITIONS TO THE SCIENTIFIC STAFF OF THE FIELD MUSEUM OF NATURAL HISTORY

The following additions have been made to the scientific staff of Field Museum of Natural History:

Mr. Ralph Linton has been attached to the staff of the Department of Anthropology with the rank of assistant curator of North American Ethnology. Mr. Linton received his M.A. degree from the University of Pennsylvania and continued his anthropological studies at Columbia and Harvard Universities. He has carried on extensive investigations, principally archeological, in the eastern, central and southeastern United States, several reports of which have been published, as well as in Central America and Polynesia. Only recently he returned from an expedition to the Marquesas Islands for ethnological and archeological researches, undertaken under the auspices of the Bishop Museum of Honolulu, Hawaii, the results of which will be published shortly by that museum.

A new division of taxonomy has been created in the Department of Botany and Mr. J. Francis Macbride, now in Peru at the head of a botanical expedition for Field Museum, has been designated as assistant curator of taxonomy. Mr. Macbride is a graduate of the University of Wyoming of the class of 1914. Since graduation he has been connected with the Grey Herbarium of Harvard University.

In the Department of Zoology Dr. C. E. Hellmayr, known for his extensive work on neotropical birds, has been appointed associate curator of birds. Dr. Hellmayr was formerly connected with the Rothschild Museum at Tring, England, and more recently has been with the Museum of the University of Munich. He will arrive in this country early in September. Mr. Edmund Heller, former associate of Theodore Roosevelt, and Mr. John T. Zimmer have recently been appointed assistant curator of mammals and assistant curator of birds, respectively, and are now engaged in field work in central Peru, where they will remain until 1923. Mr. Karl P. Schmidt, formerly with the American Museum of Natural History, New York, has been appointed to the zoological staff as assistant curator of reptiles and batrachians.

HONORARY DEGREES AT THE UNIVERSITY OF PENNSYLVANIA

Among five honorary degrees awarded by the University of Pennsylvania at its recent commencement two were doctorates of science. In conferring the degree on Professor William Duane Dr. Penniman, the acting provost, said:

> Graduate of Pennsylvania with the degree of bachelor of arts in 1892; afterward a student at Harvard and at Berlin; research worker in the Radium Institute of the University of Paris; professor of physics at Colorado, and since 1913 at Harvard; member of the National Academy of Sciences; John Scott medallist for scientific research; author of numerons important scientific papers, particularly on radium and related topics.

In conferring the degree of Professor George A. Piersol Dr. Penniman said:

> Beloved by your colleagues and by your students. You have recently laid aside the active duties of the professorship of anatomy in our School of Medicine, from which in 1877 you were graduated, and in which for many years you have been one of the outstanding members of a distinguished medical faculty. Learned in your own field of research, lucid and eloquent as a teacher; the author of many papers and volumes on anatomy, histology and kindred subjects containing contributions to knowledge.

SCIENTIFIC NOTES AND NEWS

At the annual meeting of the Pacific Division of the American Association for the Advancement of Science held in conjunction with the summer session of the American Association for the Advancement of Science, from June 22 to 24, the University of Utah conferred the honorary degree of doctor of laws on Dr. Barton Warren Evermann, president of the Pacific Division, and director of the Museum of the California Academy of Sciences and the new Steinhart Aquarium, now being constructed in Golden Gate Park, San Francisco. On the same occasion the honorary degree of doctor of laws was conferred on Dr. James Harvey Robinson, director of the New School for Social Research of New York. It is understood that this degree had been conferred previously by the University of Utah on but six persons in the seventy-three years' history of the university.

The degree of doctor of laws has been conferred by Lafayette College on Dr. Alfred Stengel, professor of medicine in the University of Pennsylvania.

At the eighty-fifth annual commencement exercises of Marietta College, Dr. Charles E. Humiston, of Chicago, received the honorary degree of doctor of science in "recognition of his efforts to raise the standard of the medical profession in all parts of the country."

The Harvard Chapter of Phi Beta Kappa has elected as honorary members Roland Burrage Dixon, professor of anthropology, and George Howard Parker, professor of zoology.

Dr. William B. Owen, president of the Chicago Normal College, was elected president of the National Education Association at the meeting held last week in Boston.

The Jenner medal of the Royal Society of Medicine was presented to Dr. J. C. McVail at the annual dinner of the society on July 6.

A presentation was made on June 6 by professional and other friends to Sir John Macpherson, M.D., in recognition of his long and eminent services devoted to the interests of the insane. He recently retired from the post of commissioner of the General Board of Control, and is about to proceed to Sydney as professor of psychiatry. The ceremony took place in the hall of the Royal College of Physicians of Edinburgh, with Professor Sir Robert Philip, president of the college, in the chair. Lord Polwarth made the presentation of a piece of plate and a check to Sir John Macpherson and a diamond brooch to Lady Macpherson.

Dr. Peyton Rous, member in pathology and bacteriology of the Rockefeller Institute for Medical Research, has been appointed coeditor of the *Journal of Experimental Medicine.*

Appointments effective July 1, 1922, at the New York State Agricultural Experiment Station, at Geneva, include the following: Dr. D. C. Carpenter, formerly assistant professor of physical chemistry at the University of Iowa, associate in research (chemistry) for investigations of milk proteins; Dr. W. H. Rankin, formerly officer-in-charge of the Laboratory of Plant Pathology of the Canadian Dominion Experimental Farms at St. Catharines, Ontario, associate in research (plant pathology) for investigations of raspberry diseases:; Dr. E. E. Clayton, formerly extension plant pathologist of Ohio State University, and Mr. Hugh C. Huckett, a graduate student at Cornell University, plant pathologist and entomologist, respectively, for the newly established laboratory for the study of insect pests and plant diseases affecting vegetable crops on Long Island; George L. Slate, assistant in research (horticulture); Walter F. Morton, assistant chemist.

Dr. T. F. Aschman, of Pittsburgh, Pa., chemist to the Pennsylvania Bureau of Foods, has been elected chairman of the Board of Chemists of the bureau, to succeed the late Dr. William Frear.

Mr. S. M. Kintner has been recently appointed manager of the research department of the Westinghouse Electric and Manufacturing Company to succeed Mr. C. E. Skinner, who is now assistant director of engineering.

Mr. C. H. Kidwell, formerly with the Semet-Solvay Company, Syracuse, N. Y., is now with Dr. Raymond F. Bacon, who has recently opened a consulting chemical engineering practice in New York City.

Dr. Aaron Arkin, professor of pathology and bacteriology in the West Virginia University School of Medicine, has been granted a year's leave of absence for study and research abroad. He will spend the year in Vienna, Berlin, Paris and London doing work in pathology and medicine.

A Belgian scientific expedition, led by Professor Massart, of Brussels University, will leave next month for Brazil, where biological, botanical and zoological research work will be carried out.

PROFESSOR A. E. WALLER, of the department of botany, Ohio State University, is spending four months in Europe continuing studies on economic botany.

AT the fifteenth annual meeting of the American and Canadian Section of the International Association of Medical Museums held recently in the Army Medical Museum, Washington, under the presidency of Professor James Ewing, of Cornell University, the following officers were elected for the ensuing year: *President,* Dr. Frank B. Mallory, Boston; *vice-presidents,* Drs. Howard T. Karsner, Cleveland, Harry Marshall, University, Va., and Robert A. Lambert, New Haven; *secretary-treasurer,* Dr. Maude E. Abbot, Montreal.

THE Harvard Medical Association held its triennial dinner on June 16. Dean Edsall spoke on the progress of the Medical School. Dr. Francis W. Peabody, professor of medicine, discussed his new work in the department of clinical investigation at the Boston City Hospital. Dr. Elliott P. Joslin spoke of the relations between the Medical School and its alumni.

THE Harvard Engineering Society held a dinner in Boston on June 14. Clifford M. Holland, '05, presided. The speakers included Dean Hughes, of the Engineering School, and W. W. Torrey, '19, secretary of the undergraduate section of the society. Howard E. Coffin spoke on "Our American air policies and national defence."

IN connection with the annual general meeting of the Eugenics Education Society a conference on "The inheritance of mental qualities, good and bad," was held at Burlington House, London, on July 4. Among the speakers were Dr. Tredgold, Dr. C. H. Bond, Dr. Bernard Hollander and Mr. R. A. Fisher.

PROFESSOR JAMES G. NEEDHAM, of Cornell University, will give a special lecture at the University of Utah Summer School, on "War, a biological phenomenon."

AN address was delivered on June 7 before the Medico-Chirurgical Society of Edinburgh, with Professor Sir Robert Philip in the chair, by Professor A. Calmette, of the Institut Pasteur of Paris, on "The protection of mankind against tuberculosis."

A COMMITTEE has been formed in France to erect by international subscription a monument in memory of Ives Delage, distinguished for his work in biology. It is proposed to place the monument at Roscoff, where Delage was in charge of the Marine Biological Station.

FRED C. WORKENTHIN, assistant professor of botany at Iowa State College, Ames, Iowa, died on June 13, at the age of thirty-two.

EDWARD HALL NICHOLS, clinical professor of surgery in the Medical School of Harvard University, has died at the age of fifty-eight years. Dr. Nichols was also director of the cancer laboratory of the Croft Research Fund, Boston.

WILLIAM MUNROE COURTIS died at his home in Detroit on June 19, aged eighty years. He was a well known consulting engineer in mining and had also made contributions to botany.

PROFESSOR FREDERIC PERCIVAL TUTHILL, chemist, for twenty years connected with the Brooklyn College of Pharmacy, died on July 2, aged fifty-four years.

BY the will of the late Prince Albert de Monaco, a million francs is bequeathed to the Paris Academy of Sciences.

A RESEARCH fellowship of $1,000 for the study of the chemistry of tubercle bacillus has been given to Yale University by the National Tuberculosis Association. The funds will be used to support research in the subject now being conducted by Professor Treat B. Johnson and his associate, Dr. E. B. Brown.

THE National Poultry Council of Great Britain has been informed by the ministry of agriculture that the revised scheme of operation for the educational and research work of a national poultry institute has now been approved by the development commissioners, and that the treasury will sanction the payment of the promised grant. The amount of the grant for capital expenditure is not to exceed £19,500, and is conditional on a further sum of £6,500 being provided by the industry, to complete the £26,000 which, it is estimated, will be required under this head. As the scheme is to be financed out of the fund provided under the Corn Production Acts, it is understood that the maintenance grant (estimated at £6,000 per annum) is limited to a term of five years, at the end of which time it will be subject to reconsideration by the treasury. The starting of this work depends now on the promptitude with which the contribution from the industry is raised.

A committee of representatives of British governmental departments and British scientific men has recently recommended a comprehensive scheme of dealing with inventions by government workers or by individuals aided or maintained from public funds. The committee recommends the organization of an interdepartmental patents board. Pending a decision in each case by this board, all rights in inventions made by government employees shall belong to the government. If the inventor can satisfy the board that he derived no assistance from the nature of his employment in making the invention, he shall be entitled to all rights therein. The question of whether the inventor is entitled to any reward in addition to the enjoyment of commercial rights shall be decided by the board. Where the rights in an invention capable of commercial exploitation belong to the government, the invention shall be exploited commercially for the benefit of the government. A system of awards and merits for the inventor is proposed, which should be passed upon by an awards committee, to be organized within the proposed patents board. These are not intended as substitutes for commercial profits, but as a recognition of merit and as an incentive to government workers.

A psychological test in addition to the regular examination will be required of all men entering Princeton University. A trial period of two years has been set for the test. During this time any man entering who fails to pass the test, but whose written examinations are satisfactory, will not be disqualified. If the faculty committee which has charge of the test reports favorably at the end of the trial period, the psychological test will be as essential thereafter as a written examination.

English literature leads in popularity as a subject for "concentration" among Harvard freshmen. Of the 634 freshmen who have filed with the committee on electives their choice of subjects for concentration during the rest of their college course, 175 have selected English. Economics comes second, with 119; history is third, with 66; Romance languages fourth, with 59, and chemistry fifth, with 46. The other subjects chosen and the number of freshmen who are to concentrate in each are as follows: Mathematics, 32; government, 26; history and literature, 25; biology, 24; physics, 14; classics, 13; fine arts, 11; geology, 6; psychology, 6; philosophy, 4; social ethics, 4; all others, 4.

As reported in *Nature,* an important contribution to the controversy over the Piltdown Skull has been made by Professors Elliot Smith and Hunter at a meetiug of the Anatomical Society, when they exhibited a reconstruction of the skull and its endocranial cast. The reconstruction has been made by a careful and minute examination and correlation of the anatomical points of the fragments of the skull. The result confirms generally the reconstructions made by Dr. Smith Woodward and Mr. Pycraft when first the skull was discovered, and agrees in showing the remarkable breadth of the skull and its low capacity, which is, in each case, placed below 1,300 cc. This later reconstruction, however, differs in one important particular. The occipital fragment assumes a more vertical position, with the effect that the skull is brought into closer relation with the skull of the anthropoids. As a result, the cranium falls into complete harmony with the chimpanzee-like jaw, and the paradox which has hitherto been a stumbling-block to the acceptance of the jaw as indubitably belonging to the fragments of the cranium now disappears.

The Association of Engineers whose members are former students of the Liége University, on the occasion of the seventy-fifth anniversary of its foundation, held in Liége, from June 11 to 16, an international scientific congress. There were seven sections, dealing, respectively, with mining, metallurgy, mechanics, electricity, chemical industries, civil engineering and geology, in each of which a number of papers were read and discussed.

UNIVERSITY AND EDUCATIONAL NOTES

BY the will of Mrs. Ann M. Swift the University of Chicago and Northwestern University received a total of $200,000, while the American University of Washington receives $25,000.

THE *Journal* of the American Medical Association states that the sum of $2,500,000 has been appropriated by the Dominican Order which controls the University of St. Thomas College of Medicine, Manila, for the erection of a new concrete building, in which will be housed all the colleges of the university, the laboratories, the dispensary, the libraries, the hall, the chapel and its offices, leaving the old building which the university now occupies in the Walled City. The site for this new building will be on the outskirts of Manila. Construction work will be started in a few months. A university hospital for the practice of the students of the college of medicine will be erected on the same site. Dr. José Luis de Castro is dean of the university.

DR. A. A. HAMERSCHLAG, who has been president of Carnegie Institute of Technology, Pittsburgh, since it was established in 1903, has resigned, effective on July 1. Dr. Thomas Stockham Baker, secretary for the past three years, and formerly director of the Jacob Tome Institute at Port Deposit, Md., has been appointed acting president. Dr. Hamerschlag plans to enter business, with offices in Pittsburgh and New York, as adviser and consultant to business organizations.

DR. GEORGE W. CORNER, associate professor of anatomy at the Johns Hopkins Medical School, has been appointed head of the department of anatomy in the new school of medicine and dentistry now being organized at the University of Rochester, N. Y.

THE appointment is announced of Dr. Edwin Bramwell to the Moncrieff-Arnott chair of clinical medicine at the University of Edinburgh, in succession to the late Professor Francis D. Boyd. Dr. Edwin Bramwell is a son of Dr. Byron Bramwell, the distinguished Edinburgh physician, and has made his reputation chiefly in the study of diseases of the nervous system.

AT the University of Cambridge Mr. F. C. Bartlett, St. John's College, has been appointed reader in experimental psychology and director of the Psychological Laboratory.

DISCUSSION AND CORRESPONDENCE

SOME SIMPLIFICATIONS OF MICROSCOPICAL TECHNIQUE

IN handling large classes in histology and allied biological subjects in which it is desirable to supplement loan series of slides by sections, given out for individual mounting, any means of shortening or economizing the work of preparation is usually welcome. During the past three or four years I have hit upon and practically tested out a number of such short cuts which have proven exceedingly valuable. Others have doubtless used the same or similar methods, but their worth may justify publication here.

Among these are first, the substitution of C. P. Acetone for the usual series of graded percentages of alcohols for the hydration and dehydration of sections when staining and mounting. Each student is provided with three slide bottles, labelled Nos. 1, 2, and 3, and containing C. P. Acetone in two and Absolute Acetone in the third. Through this series the mounted sections are passed to and from the stain, before clearing and mounting as usual. Acetone mixes readily with water and with alcohol, and the absolute acetone with xylene or other clearing agents. It is especially valuable in applying the various blood stains to sections, since it does not extract them, nor affect them in any appreciable manner. It may also be substituted for absolute alcohol as a solvent for celloidin when imbedding in the latter medium. Its high volatility and inflammable nature are dangers against which the student should be explicitly warned.

The second method is the staining of ribbons of sections without removing the paraffine in which the material was imbedded. The paraffine ribbons are cut into convenient lengths, floated upon warm distilled water in a suitable dish until flattened, cooled, and then transferred to the surface of the filtered stain in a flat dish, upon which they are left floating until stained. The correct time of staining can be readily determined by experiment.

From the stain they are transferred by means of a clean lifter or a glass slide to a dish of distilled water, rinsed, differentiated if necessary, suitably counterstained in the same manner, rinsed, and finally floated into place upon the surface of an albumenized slide, dried thoroughly, cleared and mounted.

The majority of our routine histological stains may be used in this way, but few, such as iron haematoxylin, presenting any difficulties. By this method a number of sections of the same tissue or organ may be stained by different methods to bring out special structural features, and then mounted side by side on the same slide for comparative study. For example, Haematoxylin and Eosin, Mallory's or Van Gieson's connective tissue stains, and Para-Carmine combined with Orcein or Weigert's Resorcin-Fuchsin may be used, and a section of each mounted together under the same cover glass. Even the most reluctant student may thus be brought to a comparative synthetic study of the structure of an organ.

In routine work large numbers of sections may be stained by an assistant in a short time, floated upon distilled water in large dishes, and issued to a class, ready for mounting, without the large expenditure of time, labor, reagents and glassware necessitated by the usual method of handling individually mounted sections. If preferred the sections may be issued directly to the students, and each can readily perform the staining for himself, using Syracuse watch glasses or similar dishes. The main points are that the removal of the paraffine from the section, and the consequent use of albumen or other fixative, xylene, absolute alcohol, and the customary series of three to five percentages of graded alcohols are all unnecessary, save in the case of serial sections of considerable extent, and in delicate cytological work. Finally it is not even necessary to remove the paraffine as a final step before mounting in balsam, if the section has been thoroughly dried, the surrounding paraffine in such a mount being entirely invisible, save with a very narrow diaphragm opening.

F. M. McFarland

Department of Anatomy,
Stanford University, California

PROFESSOR KEYSER ON RUSSELL'S "THE ANALYSIS OF MIND"

May a belated reader of Professor Keyser's notice, in Science, November 25, of Bertrand Russell's *Analysis of Mind* dissent from the implication that the book is written by a man specifically competent to deal with psychology? My dissent is not based on the obviously amateur quality of Russell's psychology, for an amateur may be a good observer and many of Russell's psychological passages have genuine significance. Nor do I care to stress the rather eclectic range of Russell's psychological reading. I am concerned rather with his totally non-psychological point of view. In this book, as in all his others, Mr. Russell obviously treats psychology as handmaid of metaphysics —a procedure quite as disastrous to scientific psychology when the metaphysics in question is neo-realism as when it is, say, Wolffian spiritualism. Russell himself declares that he is "interested in psychology not so much for its own sake as for the light that it may throw on the problem of knowledge";[1] and the fact which his reviewer correctly states, that the motive of the book is "primarily logical . . . that of reconciling two tendencies seemingly" inconsistent, "the tendency of the behaviorist to materialize mind and the tendency of modern physicists to spiritualize matter"—this fact alone rouses the suspicion of every scientifically-minded reader. For the competent psychologist writes not in the interest of logical or metaphysical reconciliations but rather with the primary intent to record and to order observed phenomena. The reviewer provides us with many other instances of the author's metaphysical manipulations. Russell's doctrine of desire, for example, as "a mere 'fiction' like force in dynamics," may be (in Keyser's phrase) "a diabolically ingenious analysis" but certainly is not a psychological conception. And assuredly Russell's agreement with the realists in the thesis that (with respect to sensations) the world is composed of a "neutral stuff" would not by anybody be regarded as a contribution to psychology.

I am not here concerned to criticize the argument, or the more plentiful assertions, on which the metaphysical conclusion of *The*

[1] *Analysis of Mind*, p. 15.

Analysis of Mind is grounded. Yet I can not forbear to call the interested reader's attention to the mortal wound which Russell himself inflicts upon his argument by his treatment, in Lecture XII, of belief. He has rested the whole realistic theory of consciousness as "neutral stuff" on the denial of the "personal" or "function" conception of consciousness.[2] Yet here he insists that "believing," a present occurrence "in the believer" is "an actual experienced feeling,"[3] a personal "attitude."[4] Professor Keyser, to be sure, might regard this as one of those "notably frequent public recantations of experience" which testify to Russell's "ceaseless re-examination of seeming certitudes and . . . to an unsurpassed intellectual candor." But I can not force myself to such a pitch of liberality. I am willing to grant Russell the privilege of changing opinion with every volume, of arguing in 1921 for the neutral monism which in 1914-1915 he so brilliantly refuted.[5] But liberality may be carried too far, and for my part I protest that nobody, be he Bertrand Russell himself, shall be at liberty in the course of a given argument to recant, publicly or privately, one of the premises of the argument itself.

Mary Whiton Calkins

Wellesley College

[2] *Op. cit.*, pp. 17 ff.

[3] *Op. cit.*, pp. 233 ff.

[4] *Op. cit.*, p. 243.

[5] Cf. *The Monist*, XXIV, XXV, *passim*.

METHODS OF GERMAN PUBLISHERS

In Germany the chief publishers of mathematical books and periodicals are Springer, Teubner, and Vereinigung wissenschaftlicher Verleger (a combination of the firms: Göschen, Guttentag, Reimer, Trühner and Veit). They have decided that for their mathematical publications of 1922 America shall, in general, be required to pay at least as much as \$2.40 per 100 marks of the price for Germany.

Of *Jahrbuch über die Fortschritte der Mathematik,* volume 45, part 3 (conclusion) has not been published; but part 1 (1920, 12 + 368 pages) and part 2 (1921, 6 + 526 pages) are sold in Germany for 73 and 190 marks respectively. The corresponding prices for America are \$4.65 and \$9.00! Such extortion ought appreciably to hasten the appearance of an American abstract journal, the establishment of which has been already approved by the National Research Council.

But again, *Journal für die reine und angewandte Mathematik* (Crelle), volume 151 (1920-21), is sold in Germany for 96 marks; the price to America is \$6.00!

The publisher of these two periodicals is Vereinigung wissenschaftlicher Verleger.

The above facts, obtained from the publishers themselves on May 26 and May 31, 1922, will probably suggest to mathematicians the immediate cancellation of all contemplated orders for the publications of Vereinigung wissenschaftlicher Verleger—at least.

R. C. Archibald

Newcastle-upon-Tyne,
June 12, 1922

RUSSIAN SCIENTIFIC LITERATURE

The officers of the Russian Entomo-Phytopathological Congress sent a request some months ago to American scientific societies and investigators to send to Russia literature on entomological and phytopathological matters.

In connection with this request the Russians promised to send Russian scientific literature in exchange. Certain difficulties, however, have been found to exist, principal among which is a regulation by the Soviet government made about two months ago which prohibits the sending out of literature from Russia without a special permit. This permit seems very difficult to get. The Russian scientific men, therefore, who have received American scientific literature in response to their request, feel much embarrassed by their inability to respond by sending Russian literature here, and I have promised to make known, in this way, the facts which have prevented their promised sending of Russian literature to those Americans who have kindly sent scientific papers to them.

Vernon Kellogg

QUOTATIONS

PHYSIOLOGICAL EFFECTS AT HIGH ALTITUDES

In the Friday evening discourse delivered at the Royal Institution last week Mr. Joseph

Barcroft, F.R.S., reader in physiology at the University of Cambridge, provided some details of the recent expedition to Peru, to study physiological effects at high altitudes, supplementing the account he gave to the Chelsea Clinical Society as reported in our columns on April 22 (p. 648). The observations were carried out in the mining town of Cerro de Pasco, which is situated in the Andes, at a height of about 14,000 feet. Mr. Barcroft noted in passing the curious fact that at 12,000 feet there were cows which gave milk, and at 13,000 feet cows which gave little or no milk; this was not a question of fodder, because fodder was brought to the animals, and still they gave no milk. At 15,000 feet there were neither cows nor milk. Another point of interest was that fleas disappeared at 11,000 feet, though the louse accompanied man to a higher region. The Andes were chosen for this expedition for two reasons. The less important was that, unlike the heights on Teneriffe, to which the lecturer had previously gone as a member of an expedition, water was obtainable, by means of a water tower on the railway, right up to the level at which the work was done, and water, of course, was the first essential of the laboratory. The second reason was that in this case, instead of a mountain solitude, there was a community which had been acclimatized for generations to life at these levels. The people in this region were interesting ethnologically: they might loosely be called Indians, and their civilization, such as it was, probably dated back to before the days of the Incas. Many of them lived in chimneyless and windowless houses; they had a purely communal system of government, and some of their customs would hardly appeal to more civilized races. When a native was very ill, for instance, the date of his funeral was fixed without reference to his convenience, and an official saw to it that he was ready to keep the appointment! It was remarkable what loads the people were able to carry at these altitudes. A boy of about 13 would carry from the interior of a mine a burden of 40 pounds, ascending a staircase with it from a point 250 feet below, while a full-grown man would carry a hundred pounds of metal! yet the European was out of breath if he carried his coat up a slight incline. Even the native, however, only accomplishes the work with great panting and with many intervals for rest. X-ray photographs of the chests of some of the natives showed that the ribs started almost horizontally and went round the chest like the hoops of a barrel. According to tables of chest measurements in relation to the length of the spine, the natives in this region should have a chest measurement of less than 80 cm, whereas their usual chest measurement was 90 cm. The native who was 5 feet 2 inches in height had a chest which should belong to a man of 5 feet 11 inches. Mr. Barcroft dealt also with blood changes. The immediate effect of the ascent was greatly to increase the number of red blood corpuscles, and although this excess was somewhat reduced later, the blood of members of the expedition showed throughout a larger proportion of young blood cells than normal. Comparative X-ray photographs showed also that the heart tended distinctly to become smaller. Mr. Barcroft closed by appealing for the establishment of some institute and laboratory which should continue permanently the study of the physiological effects at high altitudes.—*British Medical Journal.*

SCIENTIFIC BOOKS

BOOKS ON NATURAL AND UNNATURAL HISTORY

How and Why Stories: JOHN C. BRANNER. Henry Holt & Co., New York.

Interesting Neighbors: OLIVER P. JENKINS. P. Blakiston's Son & Co., Philadelphia.

The Earth and Its Life: A. WADDINGHAM SEERS. World Book Company, Yonkers-on-Hudson, New York.

I find on my desk three little books of natural and unnatural history, as different as possible, one from another, but each wholly admirable of its kind. Branner's *How and Why Stories* represent the efforts of wise old negroes on his father's plantation in East Tennessee to account for the ways of common animals as seen against a Biblical background. The various tales are as racy and quite as remarkable as the Georgia adventures of Brer Rabbit as related by Joel Chandler Harris. In them, much as in *Paradise Lost,* Ole Nick takes the part of hero though he stands in the foreground only when mischief is to be accomplished as when he paints some of the Good Lawd's sheep and men black while the Creator was busy in the dining room after a hard day's work. So "dey come out culled all 'cep'n de pams o' dey han's an' the bottoms o' dey feet, an' de bran' new sun done make dey hair kinky 'cause it was so hot. But after all, honey, dey's all white on de insides, des lak othah folks, an' dey chilln dey's all des de same way."

The reason "why the snake has no feet" will interest students of evolution. It appears that Ole Nick was snooping around the wall outside the Garden of Eden, finally boring a hole through, thereby wearing "about an inch off de end of his ole tail." Through this hole he coaxed the snake, then a lizard, to thrust his nose, which Ole Nick seized "an' he pull so ha'd dat he scraped all fo' o' de snake's laigs clean off, an' he pull an' stretch his body out so long dat when he was all thu' de hole he look jes' like a piece of rope."

The moral attached to each tale is unique. In this case "dey don't no good come o' listening to de debble. He's allus ready to promise you mo'n he can do, and to tell you things he don't know nothing about."

As to the origin of this species of folk-lore, Dr. Branner says that it can not be traced to Africa. "It is too clearly under the influence of Biblical history to have had such an origin."

In a few trenchant words, Dr. Branner disposes of the idea that negroes were happier in slavery. It is true that on emancipation "they were inveigled away from their former homes and friends and finally left to the winds and waves of fate like so much flotsam and jetsam of the war." Returning at one time to his old home at Dandridge, he called on a beloved and trusted former slave, "Aunt Ellen." He found her "in a state of poverty and wretchedness that went to his heart." After discussing her condition, he asked her: "Don't you think you were better off as a slave?"

And this is what Aunt Ellen replied:

"De Lawd bless yo' soul, chile, dat's a fac'; hit's jes lak you ben a sayin'. I knows I had mo' to eat an' mo' to wear, an' a better house to live in, an' all o' dem things, an' you all was mighty good to me; an' I didn' have none o' dese here doctah's bills to pay. But Law', honey, atter all, dah's de feelin's!"

"From that day to this I have had no more to say in favor of human slavery."

The book is admirably illustrated, the serious pictures by William S. Atkinson, the zoological artist of Stanford, and the cartoons—not less excellent—by Richard K. Culver, both former students of Dr. Branner.

In *Interesting Neighbors* Professor Jenkins has given a model of what "Nature Studies" for children should be. Taking familiar animals, mostly insects, and various wild flowers, he leads the reader along to the observation and interpretation of phenomena that ought to be familiar. Anywhere and everywhere he finds unexpected adaptations and relations of cause and effect, for every fact in Nature has somewhere a cause behind it.

The "Magic House" is the oak-gall, which sacrifices a leaf to make a safe home for the babies of the gall-fly, thus secure from depredations of the flycatcher, the tree frog and predatory insects. Many other insects are treated in similar fashion, their life histories accurately described and in such fashion that children of any age will be interested, and those not case-hardened will be eager to verify. And to induce them to do this is the purpose of this charming book, which will not suffer in comparison with the works of Fabre. Atkinson's illustrations are admirable.

The Earth and Its Life is a compact record of the story of Evolution from the lowest Protozoan up to civilized man. It is written in simple and interesting fashion and so far as the limits of space permit, the conclusions are fairly represented. Little effort is made, however, to define the factors in organic evolution, the processes in operation day by day, the knowledge of which gave reality to what before Lyell and Darwin was merely a philosophical conception. The last seven of the eighteen chapters are devoted to the evolution of man, a matter of increasing scientific interest as the caves and gravels of the earth are becoming more and more fully explored.

David Starr Jordan

Philippine Birds for Boys and Girls: Richard C. McGregor and Elizabeth Marshall, Bureau of Printing, Manila.

Just as I finished the last line above, there came to my desk another charming book of nature study written for the children of the Philippines.

Mr. McGregor (by the way, a former student of Jenkins, Branner and myself) has been for years the ornithologist of the Bureau of Science in the islands and is author of a valuable "Manual of Philippine Birds." In this small book he gives simple, intelligible life histories, mostly accompanied by colored plates, of thirty of the most striking birds of the region. Among the most notable is the edible-nest swift (*Collocealia germani*) with its singular habit of locking the female in its nest of glue during incubation. When one nest is taken for "bird's nest soup," it cheerfully builds another, but, when in a hurry, it mixes sticks and moss with the glue. Most powerful of the birds of the islands is the monkey-eating eagle (*Pithecophaga jefferyi*), the chief enemy of the monkeys of the Philippine forests. "Handsome and cruel, it is large and strong and fearless. No other country in all the world has a monkey-eating eagle. It is our eagle. His picture would make a good symbol for a flag or a school banner. It would stand for strength, industry, courage."

For such a purpose it might serve even better than our own bald eagle, "the piratical parasite on the osprey, otherwise known as the emblem of the republic" (Elliott Coues).

David Starr Jordan

SPECIAL ARTICLES

THE CONTROL AND CURE OF PARATHYROID TETANY IN NORMAL AND PREGNANT ANIMALS

Normal Animals.—In our first communication on this subject[1] we stated that we could keep completely parathyroidectomized "dogs alive indefinitely (at least two months) even when fed daily on a diet consisting chiefly of meat" by means of the intravenous injection of Ringer's solution. We have confirmed and extended this work as follows:

1. If this treatment is maintained for about forty days no further injections are necessary, especially if

2. The animals are given only a moderate amount of meat and care is taken that

3. The animals do not become constipated.

After *about* forty days the animals can be put on their usual diet containing great quantities of meat without inducing tetany. In one animal we could induce the severest form of tetany on the one hundred and twenty-first day (February 22, 1922) after parathyroidectomy by feeding an excessively large amount of meat mixed with barium sulphate as a constipating agent. In fact, if this animal became constipated spontaneously on its usual meat diet more or less severe parathyroid tetany attacks would occur.

The freedom from all signs of tetany on a normal meat diet after treating parathyroidectomized animals for about forty days might be due

a. To the hypertrophy under treatment of accessory parathyroid tissue;

b. To the compensatory activity of some other organ or organs;

c. To the increased tolerance of the poison or toxins responsible for the tetany.

d. To the return to functional activity of a deranged gasterointestinal tract as part of a general paresis of the sympathetic nervous system. We have some evidence on the latter possibility.

At any rate, it is clear that the cause of the tetany is an exogenous poison or poisons derived chiefly if not entirely from the proteins (more especially the meat) of the food.

Pregnant Animals.—Parathyroid tetany is notoriously severe and fatal in pregnant animals. Eight of Carlson's[2] fifteen dogs died in "acute tetany within twelve to twenty-four hours after parathyroidectomy." The average duration of life of ten pregnant animals operated on by Werelius[3] was 1.98 days.

We used to date three pregnant animals: One early after conception; two just before

[1] Luckhardt and Rosenbloom: *Proc. Soc. Exp. Biol. and Med.*, Vol. XIX, No. 3, 1921, p. 129.

[2] Carlson: *Proc. Soc. Exp. Biol. and Med.*, 1913, Vol. X, pp. 183-184.

[3] Werelius: *Surg., Gynec. and Obstetrics,* February, 1913, pp. 141-144.

term. The first of the series died on the fourteenth day after parathyroidectomy probably from a hemothorax. Three hundred and seventy-five cc of almost pure blood were found in the thoracic cavity of this animal at autopsy.

Of the remaining two pregnant animals one went into labor four days after parathyroidectomy and gave birth to seven young. This animal showed slight tetany symptoms twenty-four hours after operation and again violent tetany at the time of labor. Three days later the consumption of an unusually large meal of meat precipitated a tetanic convulsion involving the diaphragm. Artificial respiration had to be given. The tetany was soon controlled by enemata and intravenous injections of Ringer's solution. The animal was kept throughout the puerperium on a moderate meat and bone diet. Artificial feeding of the young was resorted to in part. The latter contracted distemper, the last two dying from the disease on the twenty-sixth and twenty-eighth days after birth. The mother is alive at the time of writing (ninety-eighth day after parathyroidectomy). She has received no injections since the fifty-first day.

The other pregnant animal went into labor on the day of the parathyroidectomy and within twenty-four hours gave birth to nine young. Her tetany attacks were unusually severe and difficult to control. Several of her young died. Others were given away. *Unaided she raised four of her young to the stage of weaning.* The last intravenous injection was given on the fifty-second day after parathyroidectomy. She is alive at the time of writing and in splendid physical condition (eighty-seven days after operation).

Our chief conclusions are as follows:

1. By means of the intravenous injection of Ringer's solution completely parathyroidectomized animals can not only be kept alive for a prolonged period of time but if this treatment is maintained for *about* forty days they are to all purposes cured of their tetany.

2. On the basis of further work we find that normal Ringer's solution is better than Ca free Ringer's solution in controlling parathyroid tetany.

3. The source of the poison responsible for the tetany is of exogenous origin (particularly meat of the diet). One can precipitate an almost fatal attack of tetany thirty-three days after parathyroidectomy in two hours by feeding an animal one half pound of meat, especially if the latter is not fresh.

4. In addition to the intravenous injections of Ringer's solution it is important to avoid constipation by feeding bones and giving soap suds enemata.

5. Even pregnant dogs can be kept alive. Instead of dying in tetany within seventy-two hours after parathyroidectomy they can pass through pregnancy, labor, and raise their young. The control and cure of pregnant and lactating bitches is, however, much more difficult than in normal, non-pregnant animals.

6. None of the adult animals which have survived as long as seven months have shown any signs indicative of myxedema although both lobes of the thyroid gland were removed at the time of the parathyroidectomy. They are in excellent physical condition. The administration by mouth of dessicated thyroid gland in three gram doses every other day for more than one month did not have the slightest effect on their general condition and behavior.

7. The young animals born of and raised by parathyroidectomized mothers never showed any symptoms even suggestive of tetany.

Arno B. Luckhardt
Philip J. Rosenbloom
Hull Physiological Laboratory,
The University of Chicago

INFLUENCE OF H-ION ON GROWTH OF AZOTOBACTER[1]

While studying the influence of the reaction of the soil solution upon the Azotobacter flora of soils,[2] it seemed desirable to ascertain the influence of the reaction of culture media upon pure cultures of these organisms. Several strains of Azotobacter were isolated from different soils and grown in dextrose media of different hydrogen-ion concentrations. The maximum hydrogen-ion concentration permitting growth was found to be p_H 5.9-6.0 for all

[1] Contribution No. 49, Department of Bacteriology, Kansas Agricultural Experiment Station.

[2] P. L. Gainey: Science, N. S. Vol. 48, pp. 139-140.

strains studied. This is appreciably lower than that reported (p_H 6.6-6.8) for two strains by Fred,[3] but agrees very closely with the senior writer's findings regarding the maximum hydrogen-ion concentration tolerated by these organisms in soils (p_H 5.9-6.0).[4]

As the hydrogen-ion concentration of the medium decreased, growth increased until p_H 6.1 to 6.4 was reached. Here growth appeared to be quite as vigorous as at lower concentrations.

No fixation of nitrogen took place in a hydrogen-ion concentration greater than p_H 5.9, while fixation in concentrations of p_H 6.3 to 6.5 was as great as in lower concentrations. The optimum reaction for the fixation of nitrogen appeared to be very closely associated with the optimum reaction for growth.

The total quantity of acid produced by the various cultures was insignificant. The culture medium employed required only about 0.05 cc N/1 acid per 100 cc to produce a change of 0.1 p_H in reaction. Even with this low buffer index only slight changes in the hydrogen-ion concentration of the medium were produced by the growth of any strain of the organism. This would indicate the production of inappreciable quantities of either acid or basic metabolic by-products by these organisms.

P. L. GAINEY
H. W. BATCHELOR
KANSAS AGRICULTURAL
EXPERIMENT STATION

PRELIMINARY NOTES ON VAUXITE AND PARAVAUXITE

AMONG the mineral specimens collected on the Vaux-Academy Andean expedition of 1921 are two that have proved to be new. As the crystallographic work on these will take some time, the following brief notes are therefore presented:

VAUXITE

Color: Sky-blue to Venetian-blue (Ridgway); streak white. Luster vitreous. Transparent. Form: Aggregates of small crystals tabular parallel to b (010). Hardness 3.5. Specific gravity = 2.45.

Composition: 4 FeO. 2 Al_2O_3. 3 P_2O_5. 24 H_2O + 3 H_2O.

Crystal system: Triclinic.

Optical properties: Optically +; $\alpha = 1.551$; $\beta = 1.555$; $\gamma = 1.562$; all $\pm$ .003; $\gamma - \alpha =$ .001; $2V = 32°$; Bx_{ac} emerges on sections parallel to b (010). Dispersion considerable $\rho > \upsilon$. Strongly pleochroic, colorless to blue.

Occurrence: On wavellite from the tin mines of Llallagua, Bolivia.

Name: In honor of the well-known amateur mineralogist, Mr. George Vaux, Jr., of Bryn Mawr, Pennsylvania.

PARAVAUXITE

Colorless; streak white. Luster vitreous to pearly. Transparent. Form: Small prismatic crystals. Hardness 3. Specific gravity: 2:30.

Composition: FeO. Al_2O_3. P_2O_5. $6H_2O$ + $5H_2O$.

Crystal form: Triclinic. Cleavage, perfect parallel to b (010).

Optical properties: Optically+; $\alpha = 1.554$; $\beta = 1.558$; $\gamma = 1.573$; all $\pm$ .003; $\gamma - \alpha =$ .019; 2V (calculated) 35°. Sections parallel to b (010) show the emergence of an optic axis.

Occurrence: On wavellite from Llallagua, Bolivia.

SAMUEL G. GORDON
ACADEMY OF NATURAL
SCIENCES OF PHILADELPHIA,
APRIL 15, 1922

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

SECTION OF CHEMICAL EDUCATION

Edgar F. Smith, *chairman*
Neil E. Gordon, *secretary*

First year college chemistry: WILLIAM MCPHERSON.

A first course in general chemistry: WILHELM SEGERBLOM. A brief comparison is made of fourteen of the more modern texts in chemistry suitable for secondary schools. The results of a recent text-book survey made by the New England Association of Chemistry Teachers are given. The usual custom of starting beginners in chem-

[3] E. B. Fred: *Jour. Agr. Res.*, Vol. 14, pp. 317-336.

[4] P. L. Gainey: *Jour. Agr. Res.*, Vol. 14, pp. 265-271.

istry on gases and gas laws is criticized. The belief that the ordinary student can get more tangible results by starting with more tangible substances is put forth. A scheme of experimentation, which was tried out at Exeter some years ago, and which starts the student on some common metals and leads up through a series of ninety experiments to a little chemical investigation of an unknown substance without the use of a conception of atoms, molecules and symbols, is described. The scheme was satisfactory from the point of view of teaching chemistry but had its limitations for those who must primarily prepare students for the college entrance examinations. A possible revision of the College Entrance Examination Board syllabus is suggested.

First year chemistry for women: MINNIE B. FISHER. Women students who take chemistry as a cultural subject, or as a prerequisite to home economics courses, should be taught in separate groups. They lack background for scientific work, will devote little time to pure science and need very careful laboratory direction and supervision. Conference periods should be arranged to clear up difficult points. The utmost accuracy in observation and recording of facts should be insisted on. Greatest cultural value is to instill into students greater respect for truth. Greater proportion of time should be devoted to study of chemical history, theory and non-metallic elements.

Metric system: EUGENE C. BINGHAM. Metric education has been too largely neglected in the elementary schools, so we need not only to instruct our students in its use, but also in the desirability of an extension of the use of the metric system. Particularly we should give an object lesson to students by buying apparatus and chemicals and selling it in metric quantities.

Methods for presenting first year chemistry: F. P. VENABLE.

The project method of teaching chemistry: NEIL E. GORDON. A project method has been worked out in the first year chemistry where the laboratory work and the text work have been very closely correlated. What the student can find out and has time to find out is not presented in the text. Blank spaces are left for inserting this material by the student, and hence the book is not complete until the student has done his part. The method has been found very efficient in training the student's power to think, ability to reason and arousing his curiosity.

Studying chemical engineering by the unit-operation method: DR. W. K. LEWIS and PROFESSOR R. T. HASLAM. A brief description of the School of Chemical Engineering Practice of the Massachusetts Institute of Technology and the methods employed in teaching chemical engineering by means of experimental work on full-scale operating equipment is given. The field of chemical engineering is divided into "unit-operations," the more important of which are flow of fluids, flow of heat, evaporation, distillation, drying, filtration, combustion, extraction, electrolysis, etc., and these unit-operations are studied quantitatively, particular attention being paid to the efficiency of the operation, how this efficiency can be improved or the losses decreased, and how the equipment can be changed to get increased production. The students in this school design, carry out and work up the results of these investigations by themselves under suitable guidance from members of the institute faculty resident at the plant, who devote their time wholly to work in the practice school. A description of the quantitative tests carried out in the study of these unit-operations is given, showing the wide scope and the fundamental character of these plant investigations.

Standardization of courses in quantitative analysis for students in chemical engineering: JOHN L. DANIEL. A study of the courses given to chemical engineering students in sixty-nine institutions shows that the time given to quantitative analysis laboratory varies from 72 hours as a minimum to 714 as a maximum. The time given to recitation work in quantitative varies from none to 270 hours. There is no suggestion of any agreement among these schools as to the proper time to give to quantitative. Teachers of this subject should confer with a view to standardizing the course so that sufficient time would be given to it to accomplish its aim and purposes and to avoid devoting an excessive amount of time to it as this crowds desirable courses out of the curriculum.

Discussion of committee's report on chemical engineering education: R. H. MCKEE.

Content of chemistry courses: L. J. DESHA. With a fixed limit to the time available for instruction in chemistry and an ever-widening science, the problem of what to omit becomes fundamental. Courses have grown by simple addition of the newer developments to the traditional content, without sufficient attention to consolidation. As a result, the student's knowledge consists chiefly of isolated facts but poorly knit together by laws and theories. Reorganization should start with a clear-cut decision as to just what we are going to try to teach in the four years available, the careful selection of the subject matter best suited to this end and the equally careful omission of extraneous facts.

Importance and time given for courses in economics and industrial management in chemical engineering training: C. S. Williamson, Jr.

Distribution of time between "pure" and "applied" science: Graham Edgar.

Recent progress at Columbia University: Marston Taylor Bogert. Certain new advanced courses in chemistry are now available for those interested. Statistics are given relating to the present student body in the department of chemistry.

Some laboratory helpers: J. N. Swan. The planning of a chemical building is a fine piece of research work. Many problems present themselves for solution. Attention is here called to just two items as representing different fundamental ideas to be kept in mind in planning for two different things in the same laboratory. In the matter of locks for desks in the freshman laboratory the fundamental idea is to save time. Getting into a desk is wholly a matter of routine; hence a time saver is worth while. Therefore compare the time involved with different locks and, as a secondary matter, expense and trouble to the institution. In the matter of reagent bottles it has got into the minds of some that time saving is the fundamental principle. Not so, they are teachers. The time of students spent in looking at reagent bottles is well spent; therefore the bottles should be where they can be seen. The fundamental principle is to have excellent reagent bottles where they hold the attention of the student. A comparison is then made of varieties of locks and of reagent bottles.

A chart of the synthetic intermediates: Chas. W. Cuno. A chart of the various commercial intermediates prepared from the distillates of coal tar, their type syntheses, the relation of these intermediates to one another, and their relationship to the common dyes of commerce. Three objects are in view: (1) to give the student in organic chemistry a bird's-eye view of this immense field; (2) to aid the manufacturer and commercial chemist in understanding and covering his field; (3) to show the research chemist possible gaps in present syntheses.

Training for agricultural chemistry: W. F. Hand.

Unified chemistry courses: Jack P. Montgomery.

Standard tests in science, especially chemistry: H. A. Webb. Standard tests have become adopted as a definite method in educational practice. A standard test may be defined as a method of measuring quantitatively a pupil's intelligence or his achievements in a certain branch of study. Various workers in the field of science as early as 1917 began to publish proposed standard tests in different scientific branches. The different types of tests and methods suggested up to the present time were illustrated. It is proposed by some that a type of quick, rapidly taken test be substituted for the conventional two or three hour examination which is so frequently used. The results obtained with such tests were discussed, and the advantages and disadvantages set forth. The use of standard tests in science has not been widely adopted, for none of them are standardized in the ordinarily accepted sense of the word, the whole matter being in a very experimental stage.

Science or athletics? E. G. Mahin. The steady increase in extra-curricular activities in our colleges is believed to be largely responsible for the much discussed decline in our standards of scientific education. It is believed also that the abnormal development of commercialized intercollegiate athletics is the greatest obstacle to restriction of such activities to sane and reasonable limits. In this paper it is argued that our standards can not be materially improved until the colleges divorce themselves from commercialized athletics, and that this necessarily involves elimination of the high salaried professional coach and correction of the disproportion now existing in expenditures for athletics and for educational purposes.

Section of History of Chemistry

C. A. Browne, *chairman*
Lyman C. Newell, *Secretary*

Dr. Thomas Cooper—A pioneer American chemist: Edgar F. Smith.

The chemical and scientific achievements of Father Athanasius Kircher, S. J.: George A. Coyle.

A book and a battery (Section of Sir Humphry Davy's battery and a volume of the complete works of Davy): J. N. Swan.

An early type of chemical slide rule: John A. Gunton. An improved scale of chemical equivalents, dating from 1828, is described. It was designed by Beck and Henry of Albany as an improvement on a scale invented by Wollaston in 1814 and differs from the original in having a greater number of elements listed and also in the fact that hydrogen is taken as the radix or unit. Altogether 36 elements and 144 compounds are listed on which computations may be based. The calculation is carried out by means of sliding portion, as in the ordinary slide rule, the slider being subdivided into divisions representing the logarithmic ratios of the numbers from 8 to 330. The "equivalent weights" as given and the nomenclature are interesting from the historical standpoint.

Reminiscences of Italian chemists: WILLIAM MCPHERSON.

A few sources of information upon early chemistry and chemical industries in America: C. A. BROWNE.

Some facts relating to early chemists and chemical industries in Alabama: B. B. ROSS.

Some early southern chemists and their work: EUGENE A. SMITH.

Not much time was taken in the discussion of the papers, as the program was long without discussion. There were more than one hundred present during at least part of the time the section was in session, which was probably the largest attendance of any section at the meeting.

Quite a number of autograph letters, pamphlets, pictures and books were shown and some pieces of apparatus.

DIVISION OF ORGANIC CHEMISTRY

H. T. Clarke, *chairman*

Frank C. Whitmore, *secretary*

The preparation of methylmercuric acetate and methylmercuric hydroxide: M. C. SNEED and J. LOUIS MAYNARD. During the course of an investigation of the thermal decomposition of mercurous acetate in an atmosphere of nitrogen, the formation of a small quantity of an organic derivative of mercury was noted. This product was assumed to be methyl mercuric acetate, despite the fact that its properties did not agree with those described by Otto. Doubt was cast on the purity of his salt prepared by the action of acetic acid on mercury dimethyl at 120°. Jones and Werner have shown that, at higher temperatures, a more complicated reaction takes place with no evidence of the formation of the desired salt. The true methylmercuric acetate has been prepared by four reactions, each of a different type, none of which admits the possibility of the decomposition of the desired organomercuric salt. These methods were: (1) Action of mercuric acetate with mercury dimethyl; (2) Action of methylmercuric iodide and silver acetate; (3) Neutralization of methylmercuric hydroxide with acetic acid; (4) Action of methylmercuric hydroxide with ethyl acetate. The same organomercuric salt was formed in each of the above reactions. It was identical with the mercury derivative produced in the decomposition of mercurous acetate. The hitherto unprepared methylmercuric hydroxide required in methods 3 and 4 was obtained as a white crystalline solid by the action of moist silver oxide on methylmercuric iodide.

An electrolytic method for the preparation of mercury dimethyl: HENRY C. HOWARD, JR., and J. LOUIS MAYNARD. Although mercury dimethyl has been obtained by Kraus by the electrolysis of aqueous solutions of methylmercuric salts, the low conductivity of such solutions renders the process unsuitable as a means of preparation of the dialykyl. However, it has been found that the addition of pyridine in approximately equimolecular quantities increases the conductivity to such an extent that electrolysis becomes a satisfactory method of preparation. In the course of this investigation the conductivities of solutions of methylmercuric hydroxide and several of its salts were determined. It is interesting to note that these measurements show methyl mercuric hydroxide to be an extremely weak base. This is contrary to the statements in the literature.

The asymmetry of diazodiethylglutamate: WILLIAM A. NOYES and H. M. CHILES. While Noyes and Marvel did not succeed in obtaining optically active diazo esters in which the asymmetry was due to the carbon atom to which the diazo group is attached, Levene and Mikesha have reported the preparation of such a compound from *l*-diethyl aspartate. We have obtained an active diazo ester, $EtO_2C\text{-}CH_2\text{-}CH_2\text{-}CN_2\text{-}CO_2Et$, from *d*-diethyl glutamate by the Curtius method. The carefully purified ester is a yellow oil which boils 92-93° under a pressure of 0.1 mm. Other optically active substances which might have been present were carefully removed and the composition was established by analysis. The specific rotation at 20° for the D line is +1.68°. The specific rotation in a 10 per cent. ether solution is +4.03°. The diazo ester, in solution in ether, gives the *d*-hydroxy ester on shaking with NH_2SO_4. Saponification of the hydroxy ester gives the sodium salt of a hydroxy acid which is also dextrorotatory. It is difficult to reconcile the optical activity of this diazo compound with the Lewis-Langmuir theory of the combination of atoms in "non-polar" compounds.

Further observations on the nitration of halogenated phenols: L. Chas. Raiford and Liang Yi Ho. Previous work by Raiford and Heyl has shown that the method of nitration of brominated phenols first used by Zincke is suitable for the bromine and iodine compounds, but that the nitro radical fails to replace chlorine; and that, further, both dibrominated and tribrominated derivatives of ortho and meta cresols may be expected to give isomeric nitro derivatives. The small yield (10-12 per cent.) of the para siomeride, 3-bromo-5-nitro-o-cresol, obtained when dibromo-o-cresol was nitrated in this way raised the question as to whether the position taken by the nitro radical depends more upon the relative position of the halogen atom or upon its character. To get data on this point, 3-chloro-5-bromo-o-cresol and its isomer, 3-bromo-5-chloro-o-cresol, were nitrated. In each case the bromine was displaced, giving the isomeric compounds, 3-chloro-5-nitro-o-cresol and 3-nitro-5-chloro-o-cresol.

New organic selenium compounds: Marston Taylor Bogert and Y. G. Chen. By the action of hydrogen selenide upon acyl anthranilic nitriles, selenoquinazolones have been prepared and studied. Derivatives of 2-phenyl benzselenazole also have been investigated and show some interesting properties.

The synthesis of a thiazole analog of cinchophen (atphan): Marston Taylor Bogert and E. Abrahamson. 2-phenyl benzothiazole is nitrated, giving the 6-nitro derivative, which is reduced to the amine, and the latter is then changed to the corresponding carboxyl compound through the diazo reaction. Various derivatives and collateral compounds were prepared. The position of the nitro group was proved by decomposition of the amine and by its conversion to the benzobis thiazole.

Hydrocyanic acid: an ammono carbonous acid and an ammono formaldehyde: Edward C. Franklin. From a purely formal point of view HNC represents hydrocyanic acid as an ammono carbonous acid, while the nitrile formula represents it simultaneously as an ammono formaldehyde and as formic ammonid. Sodium ammono carbonite may be nitridized to an ammono carbonate by a considerable number of methods, as, for example, by the action of sodium ammono nitrate and of cyanogen as represented by the equations, $NaNC + NaN_3 = NCNNa_2 + N_2$ and $NaNC + C_2N_2 = NaN(CN)_2 + C$. As an ammono aldehyde, hydrocyanic acid undergoes polymerization and condensation, forms addition compounds with bisulfites, ammonia, water and alcohol, reacts with hydroxylamine, hydrazine and phenylhydrazine, and is reducible to an ammono alcohol.

A study of the optimum condition for the formation of the Grignard reagent: Henry Gilman and Chas. H. Meyers. Two satisfactory methods for the estimation of the Grignard reagent are being used. One involves titration with standard acid and the other the measurement of gas evolved when the reagent is decomposed by water. The study concerns those ordinary factors affecting the yield: rate of addition of RX, concentration of reagents, kind of magnesium, cooling during formation, refluxing after formation, stirring, kind of air protection (calcium chloride, soda lime, etc.), catalysts, etc. This preliminary report is on ethyl magnesium iodide.

The reaction between thionyl aniline and the Grignard reagent: Henry Gilman and Harry L. Morris. In connection with a series of studies on the mode of reaction of the Grignard reagent with compounds having more than one reactive grouping, thionyl aniline ($C_6H_5N{=}S{=}O$) has been treated with several RMgX compounds. Phenyl magnesium bromide gives a good yield of the anilide of benezen sulfinic acid. Excess of the Grignard reagent gives the same compound. Up to the present no success has attended attempts to determine the mechanism of the reaction—the —MgX may have added either to the nitrogen or to the oxygen.

Arsenated heterocyclic compounds prepared from 3, 4-diaminophenyl arsonic acid (amino arsanilic acid): W. Lee Lewis and R. S. Bly. The great reactivity of the ortho-diamines with a great variety of substances yielding quinoxalines, azimides, piafthioles, imidazoles, etc., suggested the easily available amino arsanilic acid as a fruitful starting point for new organic arsenicals. 3,4-diaminophenyl arsonic acid is made by nitrating oxalyl p-arsanilic acid and reducing the nitro compound with ferrous chloride and ammonia. Thus far this compound has been condensed with benzil, oxalic acid, pyruvic acid, maltosone yielding the following: 2,3-diphenyl-quinoxaline-6-arsonic acid, 2, 3-diketoquinoxaline-6-arsonic acid, 2-methyl-3-hydroxy-quinoxaline-6-arsonic acid, and 3-(glucosido-erythrityl)-quinoxaline-6-arsonic acid.

Derivatives of the beta-chloro-vinyl arsines: W. Lee Lewis and H. W. Stiegler. The chloro-vinyl arsines were prepared by the action of acetylene upon arsenic chloride in the presence of aluminum chloride and were separated by fractionation under reduced pressure. The following derivatives were prepared: Beta-chloro-vinyl arsenious oxide, beta-chloro-vinyl arsonic acid, beta-chloro-vinyl di-iodo arsine, beta-chloro-vinyl bibromo arsine, hydrated bis-beta-chloro-vinyl arsenic acid, bis-beta-chloro-vinyl arsenious sulfide and bis-beta-chloro-vinyl arsenious oxide.

Chemical and crystallographic notes on the acid phthalates: Francis D. Dodge. The use of potassium acid phthalate as ultimate standard in alkalimetry was suggested by the writer in 1915. This salt and the corresponding salts of sodium, ammonium, lithium and magnesium have since been more carefully examined. Acid salts of the formula, $2MHC_8H_4O_4 \cdot C_8H_6O_4$ ($M = K, NH$), were also observed. The acid phthalates crystallize remarkably well, and invited further study. The potassium, sodium, ammonium and lithium salts have been measured. The potassium and ammonium salts are isomorphous, and also show an interesting isomorphism with the corresponding salts of ortho-sulfo-benzoic acid. The rubidium and cæsium salts were also prepared, and appear to belong to the same isomorphous group. In optical properties, the crystals of the potassium and lithium acid phthalates proved interesting, as they exhibit crossed axial plane dispersion toward the violet end of the spectrum. The same variety of dispersion is also very well shown by the mixed crystals of potassium and rubidium acid phthalates.

The occurrence of formic acid in essential oils: Francis D. Dodge. A crystalline sediment which had been deposited in a zinc lined container of oil of geranium was found to be zinc formate, and its occurrence was explained by the presence of formic acid in the oil. This acid, in combination with the alcoholic compounds as esters, is apparently a normal constituent of the oil, the amount of ester, calculated as geraniol formate, ranging from 9 to 13 per cent. A method was devised for the determination of the acid in oils, and a number of the latter were examined. The relatively large amount of formic ester found in oil of geranium seems to be characteristic, and the determination may be of service in the technical valuation of the oil.

Catalytic reduction of the C=N complex: DeWitt Neighbors, S. M. Clark, J. E. Miller, A. L. Foster and J. R. Bailey. Lochte and Bailey have recently applied the catalytic method employing colloidal platinum to the reduction of dimethylketazine, $Me_2C=N-N=CMe_2$. This reaction has been successfully applied to the reduction of acetone semicarbazone to i-propylsemicarbazide, of menthone semicarbazone to menthylsemicarbazide, of camphor semicarbone to bornylsemicarbazide, and of acetaldehydephenylhydrazone to phenyl hydrazoethyl. The investigation of i-propylsemicarbazide has been completed. Among the salts prepared are the hydrochloride and the oxalate. Other derivatives made are the nitroso and benzoyl compounds. The latter with caustic soda yields the corresponding i-propylphenylhydroxytriazole. With 80 per cent. H_2SO_4 i-propylsemicarbazide hydrolyzes to i-propylhydrazine, previously obtained by Lochte in the reduction of acetone hydrazone. Oxidation of the semicarbazide with permanganate in either acid or alkaline solution gives 2-carbonamidoazopropane, $NH_2-CO-N=N-CHMe_2$, along with acetone semicarbazone. The azo compound readily undergoes rearrangement to the hydrazone.

The preparation of mono- and parabromacetaldehyde and their application to synthetic work in cellulose chemistry: Harold Hibbert and Harold S. Hill. These substances have been prepared in a state of purity and have been applied to the synthesis of a variety of substances closely related to the polysaccharides.

The electrolytic reduction of crotonaldehyde: Harold Hibbert and Roland R. Read. Using a lead cathode, the principal product is an unsaturated cyclic aldehyde, apparently 4-aldehydo-2, 3-dimethyl-2, 3-dihydro-R-pentene (cyclopentadiene). The authors discuss the mechanism of this reduction and see in it valuable evidence for Nef's vinyl alcohol theory of the aldol condensation.

Preparation and properties of 1-mercaptobenzothiazole and its derivatives: L. B. Sebrell and C. E. Boord. The preparation of this substance from thiocarbanilide and sulfur, from aniline, carbon disulfide and sulfur, and from both the zinc and ammonium salts of phenyldithiocarbamic acid and sulfur were carefully studied and compared as to yield, purity of product, etc. This work was extended to the methyl derivatives of 1-mercaptobenzothiazole, heretofore unknown, and their preparation and properties described.

Absorption spectra of phenylazophenol and its derivatives in the visible region: C. S. Adams and C. E. Boord. The absorption spectra of azobenzene, phenylazophenol, and the substitution products of phenylazophenol were studied in both alcoholic and alkaline solutions. The shift in the absorption band due to position isomerism, variation in the dye concentration, changes in the solvent, changes in the nature and concentration of the alkalies used were carefully noted and the results recorded as extinction curves. The work includes the methyl, chloro, bromo, iodo, nitro and hydroxy derivatives.

The condensation of primary aromatic arsines with aldehydes: C. S. PALMER and ROGER ADAMS. It has been found that primary aromatic arsines react with aldehydes in three ways, depending on the condition. These may be illustrated by the equations: (1) $RAsH_2 + 2H\text{-}CH =$ $RAs(CHOHR)_2$; (2) $2RAsH_2 + 4R\text{-}CHO =$

$$RAs\begin{matrix} \diagup O\text{-}CH\text{-}R \diagdown \\ \diagdown R\text{-}CH\text{-}O \diagup \end{matrix}As\text{-}R + 2R\text{-}CH_2OH;$$

(3) $2RAsH_2 +$ $2R\text{-}CHO = R\text{-}As{=}As\text{-}R + 2R\text{-}CH_2OH$. The first reaction proceeds by treating the arsine with the aldehyde at room temperature with a little concentrated hydrochloric acid as a catalyst. The products are high-boiling oils, or in the aromatic series, solids. They are stable to water, alkalies, and cold dilute acids; they oxidize readily to give the aryl arsonic acids and aldehyde; they react with many other reagents as though they consisted of a mixture of the aldehyde and the arsine; they form addition products with chloroplatinic acid. The second reaction proceeds by treating the arsines and aldehydes with anhydrous hydrogen chloride, or by treating the compounds obtained by reaction (1) with hydrogen chloride, acetyl chloride, or acetic anhydride. Alcohol is evolved and 1, 4, 3, 6-dioxdiarsines are produced having the structure given above in equation (2). These products do not form when aromatic aldehydes are used. The third reaction proceeds by heating the arsine with the aldehyde at a high temperature with or without hydrochloric acid or at a low temperature without hydrochloric acid.

Organomercury compounds formed from salicylaldehyde and its nitro derivatives: EDMUND BURRUS MIDDLETON with FRANK C. WHITMORE. Calicylaldehyde, since it is not readily oxidized and contains a phenolic hydroxyl, can be mercurated with mercuric acetate. The principal product is 3, 5-diacetoxymercuri-salicylaldehyde. Using an excess of the aldehyde in water solution gives a mono-acetoxymercuri-salicylaldehyde, although the chief product is still the dimercurated compound. 3-nitro- and 5-nitro-salicylaldehyde react with mercuric acetate in alcohol to give mono-mercurated products. The sodium salts of these compounds are highly colored and soluble. Oxidation changes the mercurated aldehydes to the corresponding acids. The mercurated aldehydes have been condensed with the following amines: aniline, p-toluidine, anthranilic acid and p-aminobenzoic acid. The mercurated salicylaldehydes are decomposed by aqueous inorganic iodides giving inorganic mercury compounds, alkali and the unmercurated aldehydes.

Organomercury compounds formed from benzenesulfonic and benzylsulfonic acids: FRANK C. WHITMORE and LOUIS EHRENFELD. Benzenesulfonic acid in aqueous solution dissolves mercuric oxide readily. Evaporation of the resulting solution does not give the expected mercuric salt. All the mercury is then attached to carbon, the product apparently being a mixture of at least two organic mercury compounds. Benzylsulfonic acid dissolves mercuric oxide and changes to an organic mercury compound even on gentle warming. The product contains only one substance. The position of the mercury is to be determined. The remarkable ease of mercuration of these sulfonic acids is without parallel among aromatic compounds which contain no "activating group" such as —OH or —NH_2. Preliminary report.

Mass action in the preparation of compounds of urea with acids and salts: JACK P. MONTGOMERY.

Mononitro derivatives of the benzoic acid esters of the trihalogen tertiary butyl alcohols. T. B. ALDRICH and JULIA E. BLANNER. Through the interaction of o-, m-, and p-nitrobenzoyl chlorides and trichloro tertiary butyl alcohol and tribromo tertiary butyl alcohol, the six possible esters have been prepared. Nitration of the benzoic ester of trichloro tertiary butyl alcohol gives a nitro ester which is identical with the product obtained from m-nitrobenzoyl chloride. The nitro esters crystallize from alcohol in the form of colorless plates or needles. They are insoluble in water, but readily soluble in organic solvents; are not readily saponified; are practically odorless and tasteless; and can be reduced to amino compounds. They are not as active physiologically as the alcohols from which they are prepared. Possibly this is due to their insolubility.

Some reaction products of malonic ester and cyclohexane derivatives: E. C. KENDALL and A. E. OSTERBERG. Cyclohexane ethoxyglycol was prepared from ortho-chloro-cyclohexanol and sodium ethylate in alcohol. This substance heated with malonic ester replaces one or both ethyl groups according to conditions. The disubstituted product heated with malonic ester gives the monosubstituted compound. Ortho-amino-cyclohexanol reacts with malonic ester with either one or both groups. The amino group is first substituted. The methylene hydrogen atoms of the malonic residue in this compound are easily replaced by chlorine. Sodium ethylate and alcohol react with this to form "dichloracetyl of ortho-amino-cyclohexanol." The reaction product between amino-cyclohexanol and malonic ester in which both groups react with the ester at a high temperature reacts in such a manner that two molecules combine with an acetal linkage.

The alkylation of aniline: A. B. BROWN and E. EMMET REID. Mixtures of aniline vapor with methyl, ethyl, propyl and butyl alcohols have been passed over special silica gel at from 300 to 450°. This substance is an efficient catalyst for this reaction, though its activity falls off with time. In all cases the product is chiefly the monoalkyl derivative. The optimum temperature is from 365 to 395°. At the start 43 to 51 per cent. of alkyl anilines are produced with one equivalent of the alcohol and 68 to 70 per cent. with two equivalents, except in the case of butyl alcohol, where an excess is of little advantage.

The amination of alcohols: A. B. BROWN and E. EMMET REID. An extensive study has been made of the conversion of methyl, ethyl, propyl and butyl alcohols into the corresponding amines by passing their vapors mixed with ammonia over various catalysts at different temperatures up to 500°. The optimum temperatures and percentages of the primary, secondary and tertiary amines formed have been determined for the different catalysts. The best catalyst so far found is a specially prepared silica gel.

The alkylation of benzene: T. M. BERRY and E. EMMET REID. Continuing the work of Milligan and Reid, a more thorough study has been made of the alkylation of benzene by ethylene and propylene in the presence of aluminum chloride. The proportion of the alkylated benzenes in the two layers has been specifically investigated. It has been found that the higher alkylated benzenes, except the hexa-, are concentrated in the lower layer, which also contains almost all of the aluminum chloride. The absorption of propylene is relatively slow but continues till the tetra- product, at least, is formed.

Ditolyl ketene: HENRY GILMAN and CHESTER E. ADAMS. Several unsuccessful attempts have been made by others to synthesize this ketene. Azitolil, prepared by the oxidation of monohydrazi tolil, loses nitrogen when heated in benzene at 75 to 80° C., rearranging to the desired ketene. In addition to its general interest as a new type it is being used in connection with another study.

The effect of an "iso" grouping on the melting and boiling points of organic compounds belonging to various classes: F B. FLICK, H. M. CRAWFORD, R. HOYLE and H. GILMAN. In connection with some work on the structure of tetra-tolyl ethylene, a substance with an apparently "abnormal" melting point, a regularity in the boiling points of ethylenic hydrocarbons having an "iso" group was observed. The study extended to other classes of compounds having an "iso" grouping revealed certain regularities, some of which might have been forecasted.

Physiological action and chemical constitution: the replacement of the benzoyl by related acyl groups: HENRY GILMAN and RUSSELL M. PICKENS. A number of organic acids, aromatic and aliphatic, are related in different ways to benzoic acid. The physiological behavior (the present study concerns local anesthetics) of derivatives of these acids is being compared. The diethylaminoethyl and the benzyl esters of pyromucic, furyl acrylic and alpha-thienoic acids are described.

Arsenated benzanilide and its derivatives: W. LEE LEWIS and C. S. HAMILTON. Dichloro-p-arsinobenzoyl chloride was prepared according to the method of Lewis and Cheetham and condensed with various amines. With aniline there resulted p-arsonobenzanilide which, on reduction, gave p-arseno-benzanilide. Similarly there were made p-arsono-benzanthranilide and -anisidide and the arseno derivative of the latter. Further derivatives prepared are the following: p-arsonobenzoyl-p-phenetidide, its arseno derivative, diiodo-p-arsino-benzoyl-p-phenetidide, p-arseno-benzoyl-p-xylidide, p-arseno-benzoyl-alpha-naphthylamide, and p-arsonoso-benzoyl-arsanilide.

Arsenated benzophenone and its derivatives: W. LEE LEWIS and H. C. CHEETHAM. A previous paper by the authors dealt with the condensation of di-chloro-p-arsinobenzoyl chloride with aromatic hydrocarbons and phenyl ethers in the presence of anhydrous aluminum chloride. In the present paper the work has been extended to include the preparation of the following: acetophenone-p-arsonic acid, o-carboxyphenyl arsonic acid, dichloro-o-arsinobenzoyl chloride, 4-methylbenzophenone-2′-arsonic acid, 4-ethoxy-benzophenone-2′-arsonic acid, 4, 4′-dibenzoyl-arsenobenzene, 4-methoxy-benzophenone-2′-arsonic acid, 4-methoxy-benzophenone-2′-arsenous acid, 4-ethoxybenzophenone-2′-dibromo-arsine, 4-methoxy-benzophenone-2′-dichloro-arsine, 4-methoxy-benzophenone-2′-diiodo-arsine, 4-ethoxy-benzophenone-2′-diiodo-arsine, 4-methoxy-benzophenone-4′-dibromo-arsine, 4-methoxy-benzophenone-4′-diiodo-arsine, and 4-methoxy-benzophenone-4′-arsinic (acid)-acetic acid.

Application of the chloroethers for the preparation of some new derivatives of diethyl malonate and barbituric acid: Arthur J. Hill and DeWitt T. Keach. The present investigations are preliminary to an extended study of the hypnotic effects produced by the introduction of various ether rests in the 5 position in barbituric acid (the methylene grouping). To this end chloromethyl ethyl ether and chloromethyl methyl ether have been combined with the sodium salts of diethyl malonate and ethyl diethyl malonate, suspended in anhydrous ether. The following esters have been thereby obtained: Di (ethoxymethyl) diethyl malonate, ethyl-ethoxymethyl diethyl malonate, and ethyl-methoxymethyl diethyl malonate. These derivatives of malonic ester interact smoothly with urea in the presence of alcoholic sodium ethylate, giving respectively: 5, 5-di (ethoxymethyl) barbituric acid, 5, 5-ethyl-ethoxymethyl barbituric acid, and 5, 5-ethyl-methoxymethyl barbituric acid.

DIVISION OF RUBBER CHEMISTRY

C. W. Bedford, *chairman*

Arnold H. Smith, *secretary*

The internal mixer as a factory unit: R. P. Dinsmore. The study of the internal type of rubber mixer in factory production has revealed two defects. The ratio of cooling surface to volume of stock is so much less in such a mixer than on a mill and the working is so much more rapid that the temperature of the batch rises rapidly, and in most tire stocks it is impractical to add sulphur before the batch is taken out of the mixer. Also, these mixers require considerable batching-out equipment in order to sheet out the finished stock thin enough so that it will cool in a reasonably short time. The time for batching-out does not vary greatly, and it is difficult to balance mixing equipment with batching-out equipment. The advantages to be gained from the internal mixer are lower mixing costs, greater freedom from the dust nuisance and lighter work for the operator.

The thermal properties of various pigments and of rubber: Ira Williams. The thermal conductivity and diffusivity of rubber is determined by two separate methods. A method for the determination of the conductivity of pigments is given and the values have been determined for the most common pigments used in rubber compounding. A method is shown by which the thermal conductivity and diffusivity of any rubber compound may be calculated from an analysis of the stock.

Physical properties of rubber compounded with light magnesium carbonate: H. W. Greider. The physical properties of rubber compounded with light magnesium carbonate have been studied, including tensile strength, elongation, hardness, resilient energy capacity and permanent set. This material was shown to behave in rubber as a reinforcing or toughening pigment, the maximum effect being given by nine volumes of the filler to 100 volumes of rubber. The principal disadvantage of magnesium carbonate in rubber was found to be the high permanent set imparted to the vulcanized product, attributable to the definite crystalline character of the particles. The reinforcing effect of magnesium carbonate at nine volumes per hundred of rubber was compared with equal proportions of other reinforcing pigments, including zinc oxide, gas black, fine china clay and colloidal barium sulfate. Gas black was shown to be the only filler showing a reinforcing effect greater than that given by light magnesium carbonate.

The relation between chemical and physical state-of-cure of rubber vulcanized in the presence of certain organic accelerators: Norman A. Shepard and Stanley Krall. Hexamethylenetetramine, aldehyde ammonia, p-nitrosodimethylaniline and thiocarbanilide, respectively, have been introduced in such quantities into a mixing consisting of 48 parts of first latex crêpe, 48 parts of zinc oxide and 3 parts of sulfur, that equivalent *physical* states of cure (as gauged by the stress-strain relations) were obtained in each case when vulcanized for 60 minutes at 287° F. The coefficients of vulcanization of these cures show that there is no uniform relationship between the *physical* and *chemical* states of cure in these stocks, even though the time and temperature of curing are constant. The equivalent quantities used in this work indicate that, in the type of stock here examined, one part of hexamethylenetetramine is equivalent in accelerating power to one and one half parts of aldehyde ammonia, three parts of thiocarbanilide and one half part of p-nitrosodimethylaniline, respectively.

Physical testing graphs: W. B. Wiegand.

Rubber Division methods for rubber analysis: Report of committee and discussion.

Organic accelerators. Symposium. Specification standards and testing, including both chemical and physical tests in compounds.

Charles S. Parsons,
Secretary.

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CONTENTS

CONSERVATION OF THE WATERS OF THE COLORADO RIVER FROM THE STANDPOINT OF THE RECLAMATION SERVICE[1]

The Colorado River Basin includes the largest river system lying entirely within the arid region. Its average annual discharge is nearly 18,000,000 acre-feet and it drains 244,000 square miles of territory, nearly all in the United States, less than one per cent. of the area and an insignificant part of the water coming from Mexico. The basin lies in seven different states of the Union and all of them can and should receive benefit from the use of its waters. The trunk stream was navigated for many years from the gulf northward a distance of over 400 miles and before the advent of railroads this navigation was important. It has recently been largely abandoned but the stream is technically and actually navigable. Most of the course of the main stream is in the United States, but for a distance of about 20 miles it forms the boundary between Mexico and Arizona and for about 80 miles flows through Mexican territory. It is therefor an international stream, an interstate stream, and a navigable stream. The waters of the stream not heretofore appropriated to private use are the property of the United States government and the lands necessary for its proper development and use are mainly public lands. Its problems and their administration are therefore distinctly national.

Like most of the streams of the world the discharge of the Colorado River varies greatly in volume. Its low water discharge frequently falls below 5,000 cubic feet per second, and its flood sometimes peaks above 200,000 cubic feet per second. Numerous small valleys are

[1] Presented at the joint meeting of the American Association for the Advancement of Science and the Pacific Division, Salt Lake City, June 23, 1922.

irrigated from the tributaries of the Colorado River and their aggregate use of its waters is very important. The largest valley which the Colorado irrigates is the Imperial Valley in southern California. Smaller diversions from the river are in the Palo Verde Valley of California and the Yuma Valley of Arizona. These valleys can of course receive only the waters left after the diversion in the basin above and in years of low water the entire available flow of the river is utilized in the lower valleys. A much larger quantity is needed to fully develop these valleys and this can not be secured without the storage of the flood flow at some point above. Hence arises the problem of the conservation of the waters of the Colorado River.

This problem has been under investigation by the Reclamation Service ever since the year of its organization, 1902. In this it has had the cooperation of the Geological Survey in the measurement of streams and of the Agricultural Department in the examination of soils. The investigation has been carried on in all parts of its vast basin, many dam sites have been explored with diamond drill, and the results have been condensed in various reports, the latest and most comprehensive of which has been recently published as Senate Document No. 142 entitled "Problems of Imperial Valley and vicinity."

The topography of the Colorado River Basin is admirably adapted to the conservation of its waters and their use for power. Several good reservoir sites have been found at advantageous locations. The main stream below its junction with Green River has a total fall of nearly 4,000 feet to sea level, fully three fourths of which are physically capable of being developed for power, and the greater portion of the waters of the basin can be made available for use in this stretch. The main trunk of Green River above the junction falls over 2,000 feet and the upper fork or Grand River has a fall of nearly 4,000 feet. The average potential power in the basin at present is over 8,000,000 horse power. Some of this is unavailable for development for various reasons and some of the water will ultimately be consumed in irrigation, so that the ultimate available is about 6,000,000 horse power, of which more than two thirds is on the main stream, mostly within the state of Arizona or on its boundaries.

During the past twenty years many engineering examinations of the main stream of the Colorado River have been made by power interests, with a view to the estimation of its power possibilities, and though these were uniformly reported as great, the engineers have until recently agreed in the conclusion that there was no available market; but the markets have been growing and the feasibility of transmitting large blocks of power has also been improving. It is believed that the time has at last arrived when the development of power on the lower Colorado River has become feasible at such points as are most accessible and nearest to adequate markets.

The use of the waters of the Colorado for irrigation presents problems of considerable difficulty. Most of the river is in canyons where no valleys are adjacent and its use in irrigation is impossible. In the lower reaches the river has formed some alluvial valleys which are in part being irrigated by the natural flow of the stream, but which for full development require a much larger flow of water than is available in the late summer and fall. The present irrigated area can be more than trebled if the water supply is conserved and the complete regulation of the river will furnish a supply greater than the available valley areas. Their reclamation, however, presents great engineering difficulties and imposes upon those lands heavy charges for construction which would be difficult if not impossible for settlers to pay if the entire burden of the conservation and diversion had to be borne by those settlers. Fortunately, however, the conservation for power purposes will so nearly fit with the requirements for irrigation that the utility of the storage sites for the development of power may be utilized as an asset to defray the expenses of regulating the river and thus through the power asset render feasible irrigation enterprises that would not otherwise be feasible.

One of the greatest, and by far the most pressing problems on the Colorado, is the control of the mighty floods that are sometimes furnished by its drainage basin and which annually threaten to overwhelm and destroy the valleys in its lower reaches. Problems of this kind are presented on every large river flowing through alluvial valleys, but the case of the Colorado is unique and the flood problem is far more important and imminent than usually is the case. This situation is due to the peculiar topographic conditions of the valleys which the river serves.

The Gulf of California formerly extended northwestward to a point a few miles above the town of Indio, about 144 miles from the present head of the gulf. The Colorado River, emptying into the gulf a short distance south of the present international boundary, carried its heavy load of silt into the gulf for centuries, gradually building up a great delta cone entirely across the gulf and cutting off its northern end, which remains as a great depression from which most of the water has been evaporated, leaving in its bottom the Salton Sea of 300 square miles, with its surface about 250 feet below sea level.

The river flowing over its delta cone steadily deposits silt in its channel and by over flow on its immediate banks, so that it gradually builds up its channel and its banks and forms a ridge growing higher and higher until the stream becomes so unstable that it breaks its banks in the highwater period and follows some other course. In this manner the stream has in past centuries swung back and forth over its delta, until this exists as a broad, flat ridge between the gulf and the Salton Sea, about 30 feet above sea level, and on the summit of this the river flows at present, the water finding its way to the southward into the gulf.

The direct distance from Andrade on the Colorado River, where it reaches Mexico, to the head of the gulf is about 75 miles, and the distance to the margin of Salton Sea is but little more. As that latter is about 250 feet lower than the gulf, the strong tendency to flow in that direction needs no demonstration. This, coupled with the inevitable necessity for such an alluvial stream to leave its channel at intervals, constitutes the menace of the lands lying about Salton Sea, called the Imperial Valley. As there is no escape of water from Salton Sea except by evaporation, the river flowing into this sea would, unless diverted, gradually fill it to sea level or above and submerge the cultivated land and the towns of Imperial Valley, nearly all of which are below sea level. Any flood waters that overflow the bank to the north must therefore without fail be restrained and not allowed to flow northward into Salton Sea. This is now prevented by a large levee, north of Volcano Lake, extending eastward and connecting with high land near Andrade. This levee is in Mexico and its maintenance is complicated thereby.

In 1905 the river scoured out the channel of the Imperial Canal and turned its entire volume into the Salton Basin, eroding a deep gorge and raising the level of Salton Sea. It submerged the salt works and forced the removal of the main line of the Southern Pacific Railroad. At great difficulty and expense, after several unsuccessful attempts, the river was returned to its old channel in February, 1907. The control of the river would be greatly facilitated if the floods were reduced in volume by storage. Investigations have been made concerning the feasibility of storing the floods and reducing their volume to an amount easily controlled.

The regulation of the Colorado River has been examined and discussed a great deal. Some engineers have expressed opinions that the storage of the waters of the Colorado should be accomplished entirely in the upper basin and on the tributaries of the river because in those regions good storage sites can be found which will intercept the major portion of the water supply and will receive those waters very largely free from sediment and nearly clear, whereas the erosion rapidly in progress throughout the canyon region gradually loads the river with sediment so that the water reaching the reservoir sites below the canyon is heavily laden with sediment. Where the river leaves the canyon region it is estimated that it carries on an average about 80,000 acre-feet of sediment annually.

There are, however, many and serious objections to this plan. Reservoirs above the canyon region, while in the long run intercepting the major portion of the waters, leave unregulated the sudden floods to which the lower and more arid portion is subject. The Gila Basin alone, while comprising less than one fourth of the area of the basin, sometimes furnishes floods which at their maximum may equal or even exceed those of the main stream above its mouth with nearly four times the drainage area and about fifteen times the mean annual discharge. Complete regulation therefore requires the control of the waters of the Gila as well as those of the Colorado, and the same is true of any other large portion of the basin. If we confine storage to the streams above the Arizona line we can intercept over 80 per cent. of the mean annual flow, but we leave unregulated about 150,000 square miles of drainage area or three fifths of the basin. This area while arid and unreliable as to water supply, is, like the Gila Basin, subject to torrential rains and would in the aggregate leave a flood menace that would have to be met in some other way if the lands are to be protected.

It is obvious that the nearer the reservoir can be built to the lands in the lower valley the more complete will be its flood regulation, and it also happens that the lowest reservoir site of adequate capacity, which is at Boulder Canyon, lies at a point within transmission distance of the Pacific Coast and thus renders available for its construction the vast power asset which is not available to any adequate reservoir site existing above this point. Fortunately it is possible here to build a dam as high as may be required and to furnish thereby not only complete regulation of the river flow but a surplus capacity which will store the sediment for centuries to come without impairing the head on the power plants to be served therefrom. In the distant future it will become necessary to furnish additional storage by building reservoirs above, but this requirement will be more than a century away and in that time certain regulation of the river is likely to be accomplished by reservoirs on its tributaries and the problem can be easily and practically met when it arises.

Investigations have demonstrated the feasibility of building a dam of sufficient height to form a reservoir in Boulder Canyon of more than 30,000,000 acre-feet capacity, which is more than actually required to accomplish the proposed solution of the conservation problems that are now imminent. The feasibility and perfection of this accomplishment and the economy with which it will conserve the waters of the Colorado River for their best uses, are in strong contrast to the results that would be obtained by reservoirs in the upper basin. Good sites for storage and the development of power exist on the Green, the Grand and the Yampa, all of which have been carefully surveyed by the Reclamation Service, and their possibility established. These reservoirs could be built one at a time as needed and individually would cost much less than a large reservoir on the lower river, but if their construction were undertaken to meet the present needs of the lower valleys, they would necessarily be operated in accordance with those needs and this would destroy their usefulness for power development and irrigation in the upper basin where they are needed and for which purposes there are no substitutes. To attempt such a solution would therefore interpose obstacles of a legal and financial nature to the proper development of the upper states and virtually destroy a large part of the potential resources of those states because most of the projects would become infeasible if loaded with the additional burdens of the extinguishing rights which such a program would establish. The preservation of the resources of the upper states and the elimination of serious obstacles to their development is the strongest argument in favor of storage on the lower river and the preservation of the reservoir sites in the upper basin for local use. It is thus seen that the conservation and proper use of the waters of the Colorado Basin are in some sense one great problem which must be considered as a whole, otherwise there is danger of virtual destruction of natural resources by throwing obstacles in the way of the development which at best is in many cases difficult and expensive.

The recognition of this relation has led to common action on the part of the seven states affected and of the Congress of the United States, which has provided for a commission to consider the equitable division of the waters of the Colorado River. On this commission the United States is represented by its chairman, Honorable Herbert Hoover, secretary of commerce, whose ability and fidelity to public duty are recognized in every household of the land. It is hoped that under his leadership an agreement can be reached among the states which can be ratified by the United States and which will provide for the full use of the waters of the Colorado River without imposing unbearable burdens on any part of the basin nor destroy any of its resources.

In order to make a large storage reservoir in the lower basin financially feasible, it will be necessary to charge the major portion of the cost of the storage dam to power. The development of power and irrigation are closely related in that the amount of power which it is practicable to develop depends largely upon the extent of the development of the irrigable lands in the entire drainage basin. The extremely arid and semi-tropic character of the lands in the lower Colorado Basin makes it necessary to irrigate throughout the year and irrigation requirements therefore conform more nearly to the requirements for power than do those in northern latitudes. The capacity of the reservoir provided for power purposes will depend wholly on the relation of its cost to the value of additional power obtainable therewith.

As the point of complete utilization of the streams is approached, the excess water will occur in such widely separated periods as to require a disproportionate amount of storage for its utilization. It has been assumed that all the water must primarily be conserved for irrigation use. By utilizing the minimum head on the turbines as determined by silt storage in the entire Colorado River Basin, 600,000 firm horsepower of electric energy can be developed at Boulder Canyon and 700,000 horsepower is feasible with the same reservoir in connection with the full development of the irrigable lands in the upper basin and about 1,500,000 acres in the lower basin which it is practicable to develop in the near future. In either case there will be a large amount of secondary power which will be of considerable value. Installation of a power plant to develop a large amount of power may be desirable for the reason that although the development of the upper basin will doubtless proceed steadily it will be a long time before the full development is reached. The immense amount of power to be generated and the variable head under which the turbines will be required to work will make the Boulder Canyon plant one of the most remarkable ever built. Under present plans the power house would be located on the downstream toe of the dam in the event a gravity dam is built, or along the canyon wall below the dam if an arch dam is constructed.

Among the more important reservoir sites in the upper basin which have been carefully investigated by the Reclamation Service are the following: the Flaming Gorge on the Green River, where a dam 327 feet high would create a reservoir with storage capacity of 4,000,000 acre feet; the Juniper on the Yampa River, where a dam 268 feet high would create a reservoir of 1,500,000 acre feet capacity; the Dewey located on the Grand River with a dam 275 feet high, which would create a reservoir of 2,270,000 acre feet capacity. The foundations of these sites have been tested with diamond drill and the foundations are known to be satisfactory.

The choice of a reservoir site on the lower Colorado River depends upon numerous factors of which a few may here be enumerated:

First, for flood control the reservoir should be as near the area to be protected as possible.

Second, for irrigation with ultimate supply but little in excess of demands, control must be had as near the ultimate diversion as possible for the prevention of waste due to inability to coordinate demand and supply.

Third, the generation of power, incidental to irrigation operations, should be carried on as near as possible to its market.

Fourth, the site should be as close to established railroads as possible to cut down construction costs.

Fifth, with due allowance for costs the reservoir should be as deep as possible in order to expose the minimum possible area for evaporation losses and prevent waste of water thereby.

Sixth, lowest possible cost giving due weight to other considerations.

From all data available to date, the Black or Boulder Canyon sites, only 18½ miles apart by river, seem to fill the above requirements more nearly than any other site or sites which have been found.

The proper size of the reservoir is a matter not yet fully determined, the factors entering into this feature being irrigation storage, flood detention storage, silt storage and power development.

The maximum capacity so far considered is 31,400,000 acre feet, including 5,000,000 acre feet of silt storage, 11,400,000 acre feet for irrigation storage, 10,000,000 acre feet for power development and 5,000,000 acre feet for flood control. Other capacities considered have varied from 8,000,000 acre feet up to the maximum. Recent estimates include a reservoir, with dam located in Black Canyon to store 23,500,000 acre feet, which would leave a 200 foot head available for the development of power between this reservoir and the so-called Diamond Springs power project.

If built for flood control purposes alone, a reservoir with capacities of 5,000,000 and 8,000,000 acre feet is estimated to be sufficient to hold discharges at Yuma due to upstream floods down to 75,000 and 50,000 second feet respectively except in rare instances. In connection with a reservoir for irrigation purposes, the addition of 5,000,000 acre feet storage for flood control alone is expected to provide the desired reduction in floods.

In order to visualize the size of the reservoir to be impounded it may be said that in case of the largest reservoir considered, the lake when full will have a surface of 240 square miles and will be about 90 miles long, with a 40 mile arm extending up the Virgin River. If all the water in the reservoir were to be discharged through a conduit 10 feet in diameter at the rate of 10 feet per second it would require six years to empty the reservoir provided no water entered it during that time and neglecting evaporation losses.

A great many preliminary designs and estimates have been prepared of various types of dam for both Boulder and Black Canyons in connection with various plans for the development of power. The conclusion reached is that a dam of the gravity type, built on a curved plan, is the most conservative in design and best suited to a dam of such unprecedented height.

The dam in Boulder Canyon proposed for the largest reservoir considered would be 600 feet high above the present low water surface in the river and 750 feet from the lowest point in the foundation to the highest point on the dam. This would be more than twice the height of Arrowrock Dam, which is 348½ feet high and which, at present, is the highest dam in the world. The length on top would be approximately 1,250 feet and at the bottom the dam would be nearly as long up and down stream as it is high. The amount of concrete required to build the dam and appurtenant structures with a reasonable allowance for contingencies is roughly estimated at 4,700,000 cubic yards. This would be four times the concrete contained in Arrowrock and Elephant Butte dams combined, and if used to build a column 100 feet in diameter, the height of the column would be three miles and would weigh 9½ million tons.

The preliminary estimate of the cost of this dam is about $58,500,000. About 700,000 firm horsepower could be generated with a power plant costing $28,000,000 and the transmission line will cost about $20,500,000 more, or a total of about $107,000,000.

In connection with the dam, it is proposed to provide outlet capacity for the discharge of 25,000 second feet of water for irrigation use and a spillway capacity of 200,000 second feet with water surface in the reservoir 10 feet below the top of the dam. Under conditions of extreme floods the latter will be increased to 300,000 second feet at the time the water surface in the reservoir reaches the top of the dam. As a part of the spillway it is proposed to provide an opening at the bottom of the flood storage with no provision for closure. By this means water would start discharging as soon as the reservoir is full to the top of the irrigation storage and would continue to discharge as long as there is any water in the space provided for flood detention. This permanent opening would prevent encroachment upon that portion of the reservoir provided for flood detention and will be so designed as not to allow water to pass in excess of the capacity of the levee system in the lower basin.

Excellent dam sites exist in both canyons and after examining them in February, 1921, Dr. F. L. Ransome of the United States Geological Survey pronounced them as geologically feasible for the construction of a high dam.

Probably the most difficult task to be encountered in the construction of a dam on the Colorado River is the turning of the river during construction of the foundation and considerable thought has been given to this feature. A study of the hydrograph of the Colorado at Yuma over the period 1902 to 1921 shows that, if the discharge at Boulder Canyon is assumed to approximate that at Yuma with the exception of the flash peaks thrown into the river from the Gila, a diversion works of 50,000 second feet capacity would have been overtopped every year of the twenty and that the average time of submergence would have been about 11 per cent. of the total, the maximum being about 84 days in 1920 and the minimum 2 days in 1904.

Diversion works of 75,000 second feet capacity would not have been overtopped during nine of the twenty years. The average time of submergence would have been 5 per cent. of the total, the maximum being about 50 days in 1907 and 1909.

Seven of the twenty years of record show peaks of from 115,000 to 190,000 second feet at times occurring in two successive years. In 1920 the peak was 190,000 second feet, while in 1921 it reached 185,700 feet, and the present year promises to be one of high discharge.

With so great an amount of work to be done in excavating and laying concrete below water surface in so short a season it is essential that diversion works of ample capacity be provided to avoid being flooded out, thus losing much valuable time. It is therefore considered necessary to provide for diverting the river during years of ordinary high water and it is proposed to design the works with a capacity of 150,000 second feet. The years 1920 and 1921 are the only ones of record when the discharge exceeded 150,000 second feet at Yuma and it is thought that the expenditure necessary to increase the capacity of the diversion works above 150,000 second feet is unwarranted. Diversion would be by means of cofferdams and tunnels through the rock abutments of the main dam.

In order that the diversion problem may be properly attacked and in order that methods to be used in construction of the dam may be properly worked out, diamond drilling operations to ascertain foundation conditions at the possible dam sites were commenced in September, 1920, and are still under way. To date three sites have been investigated in a preliminary way and considerable detail information has been obtained at one of them. A total of 88 holes have been put down including approximately 3,500 feet of wash borings and 2,100 feet of diamond drilling. The results of the investigations at Boulder Canyon indicate that bed rock will be found at depths not to exceed 140 feet below low water surface. At Black Canyon, bed rock in the deepest hole drilled to date was found at a depth of 62 feet below low water surface. However, the investigations have not been carried far enough for it to be said that this is the maximum depth to bed rock at the Black Canyon site.

The following recommendations by Director Davis conclude his report as provided for in the Kincaid Act:

1. It is recommended that through suitable legislation the United States undertake the construction with government funds of a highline canal from Laguna dam to the Imperial Valley, to be reimbursed by the lands benefited.

2. It is recommended that the public lands that can be reclaimed by such works be reserved for settlement by ex-service men under conditions securing actual settlement and cultivation.

3. It is recommended that through suitable legislation the United States undertake the construction with government funds of a reservoir at or near Boulder Canyon on the lower Colorado

River, to be reimbursed by the revenues from leasing the power privileges incident thereto.

4. It is recommended that any state interested in this development shall have the right at its election to contribute an equitable part of the cost of the construction of the reservoir and receive for its contribution a proportionate share of power at cost to be determined by the secretary of the interior.

5. It is recommended that the secretary of the interior be empowered after full hearing of all concerned to allot the various applicants their due proportion of the power privileges and to allocate the cost and benefits of a highline canal.

6. It is recommended that every development hereafter authorized be required in both construction and operation to give priority of right and use:

First, to river regulation and flood control.

Second, to use of storage water for irrigation.

Third, to development of power.

These recommendations have been embodied in a House bill by Representative Swing of California, introduced April 25, 1922. This bill provides for an advance of $70,000,000 to the reclamation fund to be used for the construction of the Boulder Canyon dam and the Imperial Valley system to be repaid to the general treasury in accordance with the Reclamation Act of 1902.

F. E. Weymouth

U. S. Reclamation Service

THE ELECTOR PLAN FOR THE ADMINISTRATION OF RESEARCH FUNDS[1]

One of the most effective uses of wealth for the good of mankind lies in the wise encouragement of the search for truth through sustained scientific investigation.

A history of the methods followed through the last two hundred years reveals an astonishing record of unwise provisions in wills and bequests and shows that only in the last few years have economic and legal authorities devoted systematic efforts to the organization of permanent trust funds given for benevolent purposes.

During the last few years, the Community Trust movement has developed a valuable type of organization. The result of this plan has been most gratifying. To cite a single example, in the first six years of its existence, the Cleveland Foundation accumulated a fund of more than one hundred million dollars.

The specific interests of research in science have not yet enjoyed any such encouragement or facilitation through the organization of general public interest. With but slight exceptions, donors are left to hit or miss methods of organization and without appropriate encouragement or aid.

It would therefore seem timely to present an outline of a method of organization which shall be safe and permanent, flexible and adjustable to changing conditions, simple and economic of operation, and inviting as a means of disposing of wealth in the service of science and the establishment of a monument to commemorate some cherished object or ideal.

The plan should be devised to meet the changing conditions of the times, conceding to each succeeding generation the largest measure of ability to administer its own affairs, and should afford the opportunity for the maintenance of some broad, scientific project in which the donor is interested, while, at the same time, granting great flexibility in the meeting of unforeseen future contingencies. It should avoid specifically those methods of organization which history has shown to be undesirable, particularly as to methods of perpetuating the governing board, the designation of objects to be served, and the safeguarding of the capital. It should utilize legal and economic principles which in recent investigations have been pronounced sound.

The approval and promulgation of some plan by recognized scientific bodies should give a new significance and opportunity to the ownership of wealth and should furnish an incentive for generosity in the disposal of a fortune,

[1] The present note is a skeletal outline of a preliminary report prepared by the writer as chairman of the Committee on the Stabilizing of Scientific Funds. The committee is continued for further work on this problem and welcomes discussion and criticism of the plan from those who are interested in the allocation of funds in trust from wills, bequests, or grants for the encouragement of scientific investigation and service.

because it perpetuates it under a proper guarantee and makes it a permanent instrument in the service of science for the good of mankind.

To meet these needs, a type of organization to be known as the Elector Plan is proposed.

I. The Plan

1. A board of trustees entrusted with the administration of a fund shall be elected at stated periods by a committee of electors.

2. There shall be five electors appointed annually, two to be chosen by the board itself and three by some stable institution or institutions designated in the charter.

3. The board of trustees shall be composed of five members or some multiple of five, such as ten or fifteen. Election shall be for five years, and a member shall not be eligible for re-election until after a lapse of one year. Rotation established, one fifth of the board shall be elected each year. Irregular vacancies shall also be filled at the annual election. The chairman of the board of trustees shall be designated annually by the board itself. Either the original board or the original electors may be named in the charter by the donor.

4. The powers and duties of the board of trustees shall be prescribed in the charter, and must include the following provisions: (1) Full power to carry out the provisions of the charter in regard to the organization and supervision of projects and the expenditure of funds; (2) power to adapt the provisions of the charter as to object of funds, to meet changing conditions and needs in the spirit of the original intent of the donor; (3) power to change custodianship of funds, on good evidence for need of change, to guarantee safety and profitable investment. The charter shall also prescribe how any of the institutions which designate electors may be replaced in case of loss of fitness for the service.

5. The funds shall be placed in the custody of a trust company or companies having a capital and surplus of not less than ten million dollars, empowered to make investments and pay out the income with the consent of the board of trustees.

6. The charter shall provide for an annual auditing and public accounting of the expenditures.

II. Advantages of the Plan

It provides that the board of trustees shall be elected by persons a majority of whom are approved representatives of the science or sciences named, fully conversant with the situation in the age in which they are acting, free from self-interest in the election, and by virtue of their position charged with responsibility for rendering this type of service.

It harmonizes a progressive flexibility and growth in adaptation to purpose as determined by a progressively evolving science with stability and good faith in permanent serviceableness.

It prevents the unwise restriction of funds by donors, the diversion or dissipation of funds by self-perpetuating boards, the loss of value in funds as a result of changing conditions and interests in the service of science, and uninformed and whimsical procedure in the allocation of funds for research.

It serves the purpose of encouraging donors in generous and confident giving of funds for research, creates an interest in this type of permanent and far-sighted service as a personal monument or memorial, and points to the opportunity and wisdom of consulting representative scientific bodies on technical matters in the allocation of funds for research.

III. Stabilizing Organization

The National Research Council, a working organization of the National Academy of Sciences, would seem to commend itself as a suitable body for this type of responsibility in that it is permanent, progressively adaptable, representative of the sciences, composed of persons highly qualified for scientific guardianship, and takes a genuine interest in rendering service of this kind with forethought. The National Research Council should therefore hold itself ready to designate one, two or three of the electors in accordance with the wish of the donor as expressed in the charter.

Other agencies, such as other scientific foundations, national societies, state or federal officials, universities, museums, community trusts, or other organizations representing a particular interest involved, may be found suitable for acting in a coordinate capacity with the National Research Council. Among the qualifications of an organization adapted for such coordinate responsibility with the National Research Council in designating electors, these are essential: That it shall represent the interest involved, shall be permanent, shall be progressively adaptable to the evolution of its function, shall be so organized as to perform this function with a genuine interest and forethought, and shall command a position of recognized dignity and integrity.

C. E. Seashore

Division of Anthropology and Psychology, National Research Council

ALFRED GOLDSBOROUGH MAYOR

American men of science have lost a highly esteemed colleague and friend in the untimely death, at his laboratory at Tortugas, Florida, on June 24, of Alfred Goldsborough Mayor. For about three years past he has been making a heroic struggle against a tubercular infection, followed during the last winter by a severe attack of influenza, while he was at Tucson, Arizona; but the end came sooner than either he or his intimate associates anticipated.

Mayor was born at Frederick, Maryland, April 16, 1868. His early life was spent at Maplewood, New Jersey, where his family lived while his distinguished father was professor of physics at Stevens Institute of Technology. His easy aptitude for learning in general doubtless led him to pursue a course of study in that institute, and he was awarded the degree of mechanical engineer there in 1889. Later on he turned his attention to zoology and pursued studies at Harvard University leading to the degree of doctor of science in 1897. For some years he was intimately associated with Professor Alexander Agassiz as a trusted assistant in the development of the museum of comparative zoology at Harvard and in the other fertile enterprises of Agassiz. From 1900 to 1904 he was curator of the natural sciences of the museum of the Brooklyn Institute. Since 1904 he has been director of the department of marine biology of the Carnegie Institution of Washington, and the more important results of his investigations, and of the investigations of his numerous associates made at the Tortugas laboratory and during his expeditions elsewhere are to be found in the publications of the institution of the past two decades.

A just estimate of the scientific work of Mayor must be left to more competent hands. It is more fitting in a brief notice to call attention to the characteristics he manifested as a man among men. He possessed and practiced in high degree four cardinal virtues of which the world at large is now in great need, namely, the virtues of integrity, industry, reciprocity and moral courage. Although of a distinctly artistic and poetic temperament, he had unusual capacity to see and to understand realities. Few among our contemporaries have understood so well as he the arithmetical limitations, for example, of the Carnegie Institution of Washington. Few men approach the problems of life with the degree of insight and foresight he brought to bear upon them. It is commonly held that men of science are incompetent in fiscal affairs; but this is only an obscure way of stating the fact that men as a rule are inefficient in business. Mayor was a marked exception to the rule. Whatever he undertook was well considered and well executed, and it was never essential to even suggest the aid of a public auditor to interpret his accounts. His versatility was equal to almost any emergency. He was equally at home in the navigation of a ship, in the construction of a laboratory, in the delineation of the delicate tissues of a jelly-fish, and in his associations with the natives of the South Sea Islands. He accepted the situation, whatever it was, and without complaint sought only to improve its conditions. Never aggressive but always persuasive, he was one of the most unselfish of men. In the conduct of his laboratory and of his expeditions, his personal interests were the last to be considered. He afforded a continuous example of the joy in life that comes from getting something worth while well done. He made it easy for, and a source of the highest pleasure to, his associates who worked with him. His normal span was cut short by insidious disease, but he left an impressive and inspiring record in the fields of altruistic endeavor.

R. S. Woodward

SCIENTIFIC EVENTS

MAGNESITE IN SOUTHERN NEVADA

A massive deposit of magnesite of unusual character that has recently been brought to the attention of the United States Geological Survey promises to yield a large and readily available supply of this material. The deposit lies in Clark County, Nevada, in the valley of Muddy River, one of the tributaries of Virgin River, a few miles above the town of St. Thomas. The material has been known for some time as kaolin, and successful experiments for utilizing it as a porcelain clay are reported to have been made, though they have not yet resulted in the exploitation of the deposit. The recognized outcrops have been located as mining claims, and some preliminary exploration and development work has been done. A side track on the St. Thomas branch of the Los Angeles and Salt Lake Railroad, about three miles northeast of the northernmost group of claims, offers a readily available railroad connection, and the station has been named Kaolin from this deposit.

The so-called kaolin is stated by the Geological Survey to be in fact a magnesite and was deposited in a highly magnesian sedimentary bed, a part of a regularly stratified series of sedimentary beds exposed by stream channels that cut across a low ridge at the upper edge of Muddy Valley. The deposit forms a chalky-looking bluff, dazzlingly white in the bright sunlight. The material is porcelain-white, fine grained and massive, is remarkably free from foreign material, and has the structureless appearance and conchoidal fracture that are generally characteristic of magnesite. It is not so hard as the more typical magnesite, and it crumbles more rapidly on exposure to the weather.

The deposit is included between tilted beds of conglomerate and sandstone below and shale above. The lower contact is sharply defined, but the magnesite grades up into the overlying beds. The purer part of the deposit consists of beds aggregating at least 200 feet in thickness. Within the section of purer material there are a few bands of sandy matter, but these are minor in amount and apparently almost negligible, as they could undoubtedly be avoided in mining. The whole section lies in the form of a "hogback"—that is, the softer beds lap up against a uniform slope of the sandstone and conglomerate that has a northeasterly dip of 30° to 50°.

The region in which the deposit lies is in large part covered with alluvial wash, which conceals most of the bedrock formations, so that the section including the magnesite is exposed at only a few places where streams have cut down through the overlying deposits. The regularity of the exposed section and the continuity of the harder beds, which project through the surface wash, justify the assumption that the magnesite is practically continuous between exposures and for considerable distances beyond. Its length at the surface seems to be a mile at least.

THE BRITISH CHEMICAL INDUSTRY

Sir Joseph Larmor, professor of mathematical physics at Cambridge and member of parliament, writes to the London *Times* as follows:

I have no claim to expert technical knowledge on chemical matters, but with others I have been wondering what is involved in the announcement in the House of Commons that the British Dyes Association are entering into negotiation with the German Color Industry Combine.

I well remember the remonstrances of scientific chemists when this national venture was placed under the direction of business men and members of the House of Commons early in the war; but it was reasonable at that time that the energies of the government that was conducting the war should not be distracted on smaller matters.

The welcome letter of Sir William Pope suggests further questions, to which answers must now be available and possibly instructive. Has the American dye industry, also started during the war, been as hopelessly unfortunate as our own? Have the attempts to develop the fixation of atmospheric nitrogen in this country, on methods which supplied the paramount needs of Germany during the war, met with better success? If the industry of fine chemicals is to be worked by British companies supported by the government, under German direction and instruction, what is to become of the armies of young men who, at the universities, have been undergoing long and expensive training in chemistry, in order to take advantage of the openings that public policy seemed to offer?

We were informed on the highest authority that British effort, in the universities and in technical works, overtook and far out-distanced that long start that German military chemists possessed as regards noxious gases and other agents of chemical warfare. Has that superiority now disappeared, and why? One may even ask, judging from public pronouncements, is the same the case with our war-time superiority in aircraft and the relative scientific problems? Or is it that these things are now back under official control, with copious production of Blue-books?

A dozen years ago my duties threw me in the way of observing some of the great German university chemists who developed into chemical engineers on the grand scale and founded the German industry. While struck by their quiet capacity and apparent friendliness, it did not appear for a moment that they rated themselves higher than their British colleagues who had never had the same opportunities.

AGRICULTURE AND WIRELESS TELEPHONY IN FRANCE

AN editorial article in the London *Times* says:

WHILE England has been considering France has acted and has arranged to bring wireless telephony to the assistance of agriculture. A generous extension of the telephone system to rural districts has long been urged on our own General Post Office. It would help to redress the isolation of the country and it would confer the special benefit of prompt knowledge of approaching meteorological changes. Farmers and gardeners, who are at the mercy of vagaries of the weather, could do much to arrange their work or even to protect their crops were they in possession of weather bulletins such as are posted at harbors for the benefit of fishermen and mariners. But the cost of telephone cables has retarded the progress of extensions, and would, indeed, prohibit even the ultimate completion of a sufficient network. According to a message from our Paris correspondent, printed in our columns last Wednesday, France has overcome the difficulties of cost and distance by a prompt application of wireless telephony. The ministers of air and of agriculture, acting in concert, have arranged that the National Meteorological Office shall "broadcast" a weather bulletin twice daily. Every commune will have a receiving station in the parish school or police station, where the messages will be received and posted. It is proposed, further, that the peasants shall be warned of any sudden storm by ringing the village bell. Such an organization is well suited to rural France, where, for the most part, the owners are the actual cultivators and live in villages from which they sally forth to their fields. It would require modification in this country, where the isolated farm rather than the village is the center which would have to be reached. But messages issued by the Meteorological Office, now under the Air Ministry, could be received at suitably chosen towns, from which they would be redistributed not only to villages, but to farms in possession of the cheap wireless receivers already at the disposal of the general community.

THE MOUNT EVEREST EXPEDITION

AT a recent meeting of the Royal Geographical Society Sir Francis Younghusband, the president, made the following announcement in regard to the Mount Everest Expedition:

As this is the last meeting of the session and consequently the last occasion on which I shall have the honor of addressing you as your president, perhaps you will allow me to summarize the results of the Mount Everest Expedition, so far as we at present know them. The climbers were on June 6 to have made a final effort to reach the summit—or rather the real attempt, for the previous efforts were more in the nature of reconnaissances. But we know that the monsoon broke on June 3 and we fear that this will have definitely frustrated any further effort.

But the expedition has, in spite of terrific weather, already accomplished much. As you know, they have reached 26,800 feet without oxygen and 27,300 feet with its aid. And in accomplishing these great feats they have gained much experience for future use. They have ascertained that the mountain itself at the highest points reached is, in Mallory's words, "not difficult," and Finch and Bruce were able to proceed along the north face without ropes. Mallory was convinced, too, that with favorable weather the porters could have carried a camp to 26,000 feet and so brought the climbers within reach of the summit. And Finch's experience was that by a moderate use of oxygen in camp both sleep and hunger were induced. So that, even if the final climbers did not carry oxygen on them, they might start from their high camp refreshed by its use.

The experience gained this year also shows that skilled mountaineers are able to take those un-skilled in high mountain craft to the highest altitudes. Geoffrey Bruce had never climbed a snow and ice mountain before. Yet under Finch's skilled leadership he was able to attain a height of 27,300 feet. And the Sherpa porters, though they were practically untrained to snow and ice work, were able, under General Bruce's stimulating influence—and we must gratefully acknowledge that it was he who originated and carried out the idea of forming a corps of these men—to carry loads up to 25,500 feet, some of them making the journey four times and so earning the unstinted praise of the best mountaineers.

So by careful organization and combination of effort, by using experience to guide inexperieuce, and by the display of indomitable pluck on the part of the highest climbers, the expedition has at a bound brought the record up from 24,600 feet to 27,300 feet, and thus left only 1,700 feet to be climbed before the crowning summit is reached.

The standard of human achievement has thereby been sensibly raised. And many another climber, many another traveler, and many another struggler upward in every walk of life and in every country will be braced and heartened in remembering what Finch and Mallory, Somervell, Norton and Bruce have this year accomplished on Mount Everest. And this, to my mind, is incomparably the most valuable result of the expedition—and a result which makes their efforts in the highest degree worth while.

In conclusion may I quote from an article on mountaineering I have just read? "Mountaineering proper is not necessarily rashness, but is entirely a question of prudence and of courage, of strength and steadiness, and of a feeling for nature and her most hidden beauties, which are often awe-inspiring, but for that reason the more sublime and to a contemplative spirit the more suggestive." These words were written thirty-three years ago by an Italian Alpine climber, a certain Father Ratti. That mountaineer has now become Pope Pius XI and his words exactly express the sentiment which has animated all those connected with the Mount Everest Expedition, whether in its initiation or in its execution—and which will continue to animate them till the final goal is reached.

The *Public Ledger,* in a cable dispatch, announces that the expedition to climb Mount Everest has been abandoned as a result of an avalanche in which seven porters were killed. Three members of the expedition, C. L. Mallory, T. H. Somervell and C. A. Crawford, had narrow escapes. The dispatch said the final attempt to scale Mount Everest had been made on June 7.

ENGINEERS AND AN AMERICAN UNIVERSITY IN EUROPE

Establishment in Central Europe of a great American university and library is urged by Dr. B. Stepanek, minister to the United States from Czechoslovakia, who, to advance international peace, calls upon the engineers of this and other countries for united participation in world affairs. Dr. Stepanek makes an appeal for the formation of a world federation of engineers, and for an international engineering conference to deal constructively with the problems of civilization.

Dr. Stepanek's views, made public by the American Society of Mechanical Engineers, which, through its official journal, stresses the need of engineering solidarity among the leading nations, are regarded by engineers as a significant diplomatic utterance supporting the efforts now being made in America, Great Britain, France and Italy to bring about closer relations among engineers.

Award of the John Fritz medal to Senator Guglielmo Marconi has aroused fresh interest in the idea of a world union of engineers. Marconi's expressed hope of promoting peace through science coincides, it was said, with action to devise a working plan of international cooperation between the engineers of America and Italy.

John W. Lieb, vice-president of the New York Edison Company, has reported, after a trip to Italy, that Italian engineers are ready to form such an alliance. Herbert Hoover, Professor Comfort A. Adams, of Harvard University, Eugene Schneider, of Paris, and Sir Robert A. Hadfield, of London, are others who favored advancement of world peace through the united action of men of science. Actively backing the project also are the presidents of the American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Institute of Electrical Engineers and the Federated American Engineering Societies.

Alfred D. Flinn, secretary of the Engineering Foundation, and chairman of the Engineering Division of the National Research Council, endorses Dr. Stepanek's suggestions "that at an early date there should be an international conference of engineers, rather than of politicians and of statesmen, bound by tradition and self-seeking nationalism—a conference of constructively-minded men who could take fresh views of the world's condition, deal scientifically with fundamental causes, and suggest impartial, far-sighted plans for continuing progress."

In appealing for the establishment of an American university in Central Europe, Minister Stepanek said that it would constitute a center from which could be given out the best products of American culture, a source of correct information about America and American ideas. Through a world alliance of engineers, the minister said, a constructive type of mind could be brought more effectively into the service of the nations.

SCIENTIFIC NOTES AND NEWS

Jacobus Cornelius Kapteyn, professor of astronomy and theoretical mechanics at the University of Groningen since 1888, has died at the age of seventy-one years.

William Wislicenus, director of the chemical laboratory of the University of Tübingen, died on May 8, at the age of sixty-one years.

Dr. Edwin E. Slosson, editor of *Science Service,* received the honorary degree of LL.D. at the recent commencement of the University of Kentucky.

Dr. W. S. Thayer, formerly professor of medicine in the Johns Hopkins Medical School, has been elected an overseer of Harvard University.

Dr. Otto Klotz has been elected an honorary overseas member of the Norman Lockyer Observatory in England.

M. Henri Lesbegue has been elected a member of the Paris Academy of Sciences in the section of mathematics to succeed the late M. C. Jourdan. M. Lesbegues has recently been elected professor at the Collège de France.

At the meeting of the Royal Society of Edinburgh on June 19, the Keith Prize (1919-1921) was presented to Professor R. A. Sampson for his astronomical researches, and the Neill Prize (1919-1921) to Sir Edward Sharpey Schafer, for his contributions to our knowledge of physiology.

At a special meeting of the directing board of the National University of Mexico, it was voted to grant an honorary diploma to Dr. S. Ramòn y Cajal. The Mexican Academy of Medicine has appointed him an honorary member.

The second year's work of the American School in France for Prehistoric Studies began the first week in July at La Quina, Charente, under the directorship of Dr. Charles Peabody. The retiring director, Professor George Grant MacCurdy, will visit Switzerland, Austria, Czechoslovakia, Germany, Belgium and England before returning to Yale University in September.

Dr. John L. Stenquist, who has been assistant to the director of reference and research in the Department of Education of New York City, has been appointed director of the new Bureau of Educational Measurements, Statistics and Research for the city of Baltimore, where he will assume his duties about September 1.

Dr. Edward A. Spitzka has been appointed district medical officer, Second District, U. S. Veterans' Bureau. The Second District embraces the state of New York, New Jersey and Connecticut.

Hugh M. Henton, formerly instructor in metallurgy at Case School of Applied Science, has opened an office as consulting engineer in Cleveland.

Professor Herbert H. Whetzel, who has been head of the department of plant pathology since its organization in the State College of Agriculture at Cornell University, has been relieved from the leadership at his own urgent solicitation in order that he may devote his time exclusively to teaching and research.

Professor Joel Stebbins, of the University of Illinois, who, as was reported early in the spring, has been appointed professor of astronomy and director of the Washburn Observatory at the University of Wisconsin, succeeding Professor G. C. Comstock, retired, took up his new work July 1. Professor Comstock has been director of the observatory since 1889 and has reached the age of retirement. He has been on the faculty since 1887, and was dean of the Graduate School from 1906 to 1920.

Professor Tracy E. Hazen, of Barnard College, Columbia University, sailed from New York on June 21 for Buenaventura, Columbia. Early in July he expects to join the expedition of Dr. Francis W. Pennell and Mr. Ellsworth Killip for botanical exploration of the Cordillera Central of the Andes, returning to New York in September.

Professor J. A. Detlefsen, of the University of Illinois, will take a year's leave of absence during which he will devote himself to the study of the inheritance of disturbances of orientation.

Professor June E. Downey, head of the department of psychology of the University of Wyoming, has been granted leave of absence for the next academic year and will spend the year in study and travel, part of the time abroad. Miss Louisa C. Wagoner will serve as chairman of the department during Professor Downey's absence and will be assisted by Donald A. Laird of the University of Iowa.

During the week of July 24 to 28, Professor H. S. Jennings, of the Johns Hopkins University, will give before the summer session of the Colorado State Normal School at Gunnison, Colorado, a series of five lectures on "Adventures in research on development and evolution."

The following popular lectures in physics are being given this summer at the University of Illinois:

June 22, Production of sound by the application of heat: Professor C. T. Knipp.

June 29, Relativity: Discussion of phenomena: Associate Professor J. Kunz.

July 6, Recording of sound on photographic films and its application to talking motion pictures: Professor J. Tykociner.

July 13, Wireless telegraph: H. A. Brown.

July 20, Fatigue of metals: Professor H. F. Moore.

July 27, Theories of magnetism: Assistant Professor E. H. Williams.

August 3, The tones from bells: Professor F. R. Watson.

The second lecture of the series on physics in industry, arranged by the London Institute of Physics, was given on July 4 in the hall of the Institution of Electrical Engineers, by Sir J. Alfred Ewing, whose subject was "The physicist in engineering practice, with special reference to applications of thermodynamics."

On June 7 a lecture was given by Professor A. F. Holleman, of Amsterdam, at the Imperial College of Science and Technology, under the auspices of the University of London, entitled "Recent researches on substitution in the benzene nucleus."

The fifth international Neo-Malthusian and Birth Control Conference was held in London on July 11-14, under the presidency of Dr. C. V. Drysdale. Many delegates from abroad were present and the discussions were arranged to take place in several sections. A visit to Dorking was arranged to the birthplace of the Reverend T. R. Malthus.

We learn from *Nature* that the formal opening of the newly established Metallografiska Institutet of Stockholm has recently taken place. The new institute is under the direction of Dr. Carl Benedicks, whose work on the physical chemistry of metals is well known. An inaugural address was delivered by Professor Arrhenius, who referred to the international character of scientific research, as shown by the presence of foreign representatives at the ceremony, and by the review of the history of metallography contained in the address of Dr. Benedicks.

The Italian Royal Committee for Scientific Marine Investigations has assumed charge of the Zoological Station at Rovigno, Istria, which was formerly under German administration, and the station is now in active work, under Professor Raffaele Issel as director.

The Honorary Advisory Council for Scientific and Industrial Research of Canada has made a grant to the department of chemistry of Macdonald College for an investigation of soil acidity. The various methods proposed for the measurement of soil acidity will be compared, surveys in Quebec will be carried on, and the relation of acidity to crop growth will be studied with a view to deciding whether full or partial correction of acidity should be attempted in soils devoted to specific crops or crop rotations.

The Public Health Institute of Chicago has undertaken to finance the cooperative research between the University of Wisconsin Medical School and the Chemical Department of Northwestern University, which in the past has been supported by appropriations from the United States Interdepartmental Social Hygiene Board. This research which has been devoted to attempts to improve the treatment of syphilis of the central nervous system has been directed by Dr. W. Lee Lewis and Dr. Frank C. Whitmore, of Northwestern University, and Dr. A. S. Loevenhart and Dr. W. F. Lorenz, of the University of Wisconsin. The Public Health Institute has appropriated $21,600 to both universities for the coming year.

A party from the department of zoology of the Louisiana State University at Baton Rouge spent several days during the latter part of June in an exploring and collecting trip in the waters of the gulf east and south of the Mississippi River delta. Through the courtesy of the Honorable M. L. Alexander, state commissioner of conservation, the party had the use of the yacht of the commission, the *Alexandria,* and her crew. The course followed was from New Orleans through Lakes Pontchartrain and Borgne and Mississippi Sound to the Chandeleur Islands; and a number of the islands *en route,* including several of the federal game preserves, were visited and explored. It is hoped that this may be the first of a series of annual trips for the purpose of studying at first hand not only the bird life but the rich coelenterate, arthropod, molluscan and fish fauna of this fertile region. The members of the party were Mr. Robert Glenk, curator of the Louisiana State Museum at New Orleans, who initiated the trip; Mr. Percy Viosca, Jr., the biologist of the Fisheries Division of the Conservation Commission; Dr. E. H. Behre, Miss A. M. Fuller, W. H. Browning, J. R. Fowler and Miss Jessie Chambers, all of the department of zoology of the State University.

The Paris correspondent of the *Journal of Industrial and Engineering Chemistry* writes that the French Senate is now considering a first draft of a law organizing an "Office national des recherches scientifiques, industrielles et agricoles." This organization is modeled on the National Research Council of the United States. This plan is said to have been fought from the first by the chamber, which sees in it a duplication of the laboratories of the teaching establishments of the state. It has been decided that the part of the new office would be one of coordination of the different laboratories, not only of the state but also of private industry. There have been established in France some laboratories analogous to the Mellon Institute, and these organizations would cooperate in the work of this office.

On the occasion of the annual inspection by the General Board of the British National Physical Laboratory on June 29, as we learn from the London *Times,* some eight hundred guests were invited to Teddington, where they had the opportunity of seeing some of the work that is being done. All the various departments were open to view, and the attention of the visitors was drawn to many exhibits with features of special interest. In the aerodynamics department one of the wind channels was engaged in measuring the distribution of pressure over the wings of a model aeroplane, and in another the discontinuous flow of air was rendered visible by a smoke cloud. In the new extension that has been added to the engineering department machines were at work for testing the efficiency of spur gears and of the transmission gears and driving chains of motor-cars. In another new building devoted to the testing of concrete a steel colmun cased in concrete, which had failed in the testing machine under a load of fifty-five tons, was to be seen side by side with an exactly similar column not so cased, which had not been able to sustain more than four tons. Close to this building is a new underground range in which a small projectile is made by an arrangement of electrical contacts to photograph itself at regular intervals during its flight to the target.

THE British commissioners of 1851 announce the following appointments to senior studentships for 1922:

J. Sybrandt Buck, B.Sc. (Liverpool), research student in chemistry, of the University of Liverpool.

Geoffrey T. R. Hill, B.Sc. (London), research student in aeronautics, of the University of London, University College, late experimental engineer and pilot to Handley Page, Limited.

Albert Edward Ingham, B.A. (Cambridge), research student in mathematics, of the University of Cambridge.

John Edward Jones, M.Sc. (Victoria), lecturer in mathematics, of the University of Manchester.

Cecil Edgar Tilley, B.Sc. (Adelaide and Sydney), research student in geology, of the University of Cambridge.

The senior studentships are intended to give a few selected students of exceptional promise and proved capacity for original work the opportunity of devoting their whole time for a period of not less than two years to the prosecution of scientific research. The studentships are of the value of £400 per annum (with additional allowances. The awards are made by selection from among candidates under thirty years of age who are recommended to the commissioners through the executive authorities of institutions invited to make recommendations. The student is required to devote himself to research in some branch of pure or applied science.

UNIVERSITY AND EDUCATIONAL NOTES

DR. LEON L. SOLOMON, New Orleans, has announced that he will give the University of Louisville the sum of $500 annually, for use in the medical research laboratory of the university. This fund will be known as the Solomon Fund.

THE resignation of J. C. Jones, president of the University of Missouri, has been accepted by the curators of the institution, effective at the close of the college year. Dr. Jones has been a member of the faculty for thirty-eight years and desired to be relieved of the responsibility, as he is now sixty-six years old.

PROFESSOR MILO S. KETCHUM, professor of civil engineering at the University of Pennsylvania, has been appointed dean of the engineering school of the University of Illinois and director of its extension work.

PROFESSOR EARL B. MILLARD, professor of materials of engineering, and Professor Harrison W. Hayward, associate professor of theoretical chemistry, have been appointed assistant directors of the division of industrial cooperation and research of the Massachusetts Institute of Technology.

DR. E. S. CONKLIN, head of the department of psychology of the University of Oregon, has been made acting dean of the Graduate School for the session of 1922-1923, in the absence of Dean George Rebec, who will devote the year to travel and study in Europe.

PROFESSOR EDWARD C. STONE, of the department of chemistry of Trinity College, Hartford, Conn., who has been on leave of absence during the past year, has resigned, and Dr. Charles B. Hurd, of Colby College, Waterville, Me., has been appointed his successor.

MR. H. J. WARING, dean of the faculty of medicine of the University of London, has been elected vice-chancellor of the university for 1922-1923, in succession to Sir Sydney Russell-Wells.

DR. HUGO OBERMAIER has been appointed to the new professorship of prehistoric archeology at the University of Madrid.

DISCUSSION AND CORRESPONDENCE

WHICH IS THE HIGHEST WATER FALL IN THE WORLD?

TO THE EDITOR OF SCIENCE: Mr. Hardy's recent note concerning the reputed height of the Kaieteur Falls in British Guiana raises the moot question as to which really is the highest water fall on earth.

My physiographic studies in the Yosemite region of California, which is *par excellence* the land of water falls have led me to collect data on water falls in different part of the world for purposes of comparison. My information still is far from complete—as necessarily it must be in view of the scattered nature of the references to water falls in the literature, and in view of our still imperfect knowledge of the mountainous portions of several continents—nevertheless I venture to offer here a few facts and figures that may be of interest in this connection. If more accurate data are available, it is hoped that this note will be instrumental in inducing others to bring them forth.

The Kaieteur Falls, which are reported to be 804 feet high, are probably the highest of their particular class—the class of broad, voluminous cataracts to which the Niagara Falls, the Victoria Falls and several others belong. The Wooloomumbi, on a branch of Macleay River, Australia, is about 900 feet high, but its volume is so much smaller that it scarcely belongs in this class.

The highest water falls in the world are of the slender "bridal veil" type. Among them the Yosemite Falls appear to stand foremost. The entire chain of falls and cascades which the waters of Yosemite Creek make in their descent from the upland to the floor of the Yosemite Valley is 2,565 feet high. The individual measurements are: upper fall, 1,430 feet; intermediate cascade, 815 feet; lower fall, 320 feet.

However, it may be questioned whether it is fair, in making comparisons with other water falls, to consider the two Yosemite Falls and their connecting cascades as forming together a single unit. Those who would champion the claim to first place of some other noble water fall—and there is no little pride, national, state and local, involved in this matter—might perhaps properly object to such procedure. For the cascades between the upper and lower Yosemite Falls, however beautiful they may be, consist only of small drops, chutes and rapids, and their descent of 815 feet is distributed over a horizontal distance of about 2,000 feet. There are elsewhere many other cascades of a similar kind that are not generally considered worthy of being classed as water falls.

It is to be noted, however, that, even if the point be conceded and the cascades be ruled out, the upper Yosemite Fall, taken by itself, still remains far in the lead as the highest single, unbroken leap of water in the world. This leap measures 1,360 feet in height.

There is, so far as I can ascertain, only one water fall that exceeds the upper Yosemite in height—the Sutherland Fall, in New Zealand. It measures 1,904 feet in height but it is broken about midway by projecting ledges and makes no clear leap of more than 900 feet. The falls of Gavarnie, in the Pyrenees, are, according to some authorities, 1,385 feet high, but they consist of braided streamlets that slide down the seams of an irregularly sculptured cliff and do not fall clear through any notable height.

It seems to me that it would be a matter of no little satisfaction to American geographers —and, indeed, to all American citizens who take pride in the great natural features of their country—if the question of the highest water fall could be definitely settled, and I, therefore, wish to express the hope that others who may have reliable data on this subject will consent to make them known. Personally, I should feel greatly indebted for any information they may be willing to supply.

F. E. Matthes

U. S. Geological Survey,
Washington, D. C.

A CABINET FOR COLORED PAPERS

Facilities for storing the stock of large sheets of colored papers in the psychological laboratory usually fall considerably short of the technical requirements. This is true of all papers that have been surfaced on one side for use in chromatic or achromatic comparisons and more specifically for working out color equations. Such papers should be readily accessible for selection, should therefore be arranged in relatively short series, and should be properly classified and indexed. To these ends it is customary to store the papers in a vertical cabinet built up of some two dozen shallow drawers of suitable dimensions.

On account of the unequal treatment of the two surfaces these papers have a tendency to curl upward. In almost any arrangement of drawers this will lead to tearing, rolling up and final destruction of some of the material in the cabinet. It is a particularly common occurrence in cabinets built to accommodate papers with the short side toward the front and constructed without partitions between the drawers. What psychologist has not experienced some form of emotion when he has envisaged the pile of trash and supertrash accumulated behind the drawers at the periodical laboratory housecleaning festivity! The affective experience of the conscientious director of the laboratory is further embellished by the knowledge that this trash is expensive to replace and wasteful of energy and time spent in reorganizing the contents of the cabinet.

In an earlier attempt to prevent mutilation of papers in this wise a cardboard of medium weight was placed in each drawer on top of the papers. Instructions printed in bold characters advised students and others to replace it before closing the drawer. But since failure to heed the advice did not entail consequences similar to the infraction of a natural law, treatment of the situation by suggestion was unsuccessful. The next step was to tack a piece of cardboard over the back of the drawer and reaching forward about eight or ten inches. While this device proved to be a great help, it did not prevent catching and rolling back at the front of the drawer when it was pulled out.

The best solution of the difficulty seems to lie in a very simple arrangement which if embodied in the original construction of a cabinet ought to be less expensive than a case of drawers, but it can also be installed where drawers are already in use. In the simpler plan the drawers are slides that fit into grooves at the side of the cabinet and are made with strips 1½ inches high at the front and a trifle lower at the back, but affording ample room for the standard-sized sheets. On each slide a heavy cardboard cover is hinged at the back with heavy binder's cloth over the top of the strip and is cut large enough to fall just within the front strip or face of the slide. A leather "pull" or flap by means of which the cover can be readily lifted is fastened to it near the front. The apparent inconvenience of having to pull the drawer almost entirely out before the cover can be sufficiently lifted to extract the papers is more of an advantage than a hindrance in view of the well-known fact that most of the untidiness of cabinets is due to the careless extraction and introduction of papers with drawers insufficiently opened. Papers that lie beneath are thereby frequently pulled or pushed back and crumpled up. If the cabinet were constructed so that the grooves at the sides extended six inches or more, or in other words if the sides of the cabinet were built six or more inches wider than the depth of the slides, the slides could be held in place while the covers were lifted and the papers handled, provided that the remaining slides were always systematically returned to their full extent.

A neat and carefully arranged "color cabinet" is always an asset to the well-appointed laboratory and there seems to be no reason why we should not begin at this point to inculcate the ideals of order and system in the minds of our young scientists and at the same time to increase the efficiency of the laboratory according to those standards for which the newer generation is so valiantly fighting!

Christian A. Ruckmick
Wellesley College

THE HUMAN YOLK SAC

Some time ago there came under my observation two specimens of early human twins, both of which showed a direct developmental relation to single yolk sacs. For record I published a brief note[1] announcing the discovery of this important condition and emphasizing the single-ovum origin which it implies; in addition were appended several deductions or speculations of secondary importance. In a recent issue[2] of this journal Professor F. T. Lewis has raised certain objections which demand consideration that the intent of my former condensed account be not misunderstood.

The second specimen described in that publication had a single yolk sac and yolk stalk connected to one embryo of the twin pair; the other embryo lacked both stalk and sac. Professor Lewis believes this indicates the early obliteration of one of the originally paired stalks. My interpretation was that an early unequal division of the embryonic mass had left

[1] *Anatomical Record*, Vol. 23, pp. 245-251.

[2] Science, Vol. 55, p. 478.

one member essentially without a sac, as such. This conclusion was based on the following facts:

1. There is no external evidence of a second yolk sac or stalk although the most careful search was made for them.

2. The umbilical cord lacks a yolk-stalk component, as proved microscopically by serial sections.

3. The single yolk sac shows no indication of a second stump, nor are its vessels suggestively arranged as if at any previous time in relation to a second stalk.

4. Although the yolk stalk normally becomes separated from the *gut* in embryos slightly younger, its connection with the *yolk sac* is retained until later. (On this point Professor Lewis's criticism unintentionally carries the erroneous implication that it is even remarkable that the other stalk had retained its connection with the sac until this period—and hence the early disappearance of one is entirely obvious!).

5. The yolk stalk, with its vessels and investing tissue, usually is recognizable until a considerably later period than the six weeks' embryo in question; Minot records that it persists beyond the fourth month but seems to have disappeared by the sixth; Lönnberg states that portions of its vessels may be found rarely at birth; and in any case they are easily demonstrable in embryos five or more times the size of my specimen.

Evaluating these several points I was led to favor an early primary separation, rather than a late secondary one with the coincidence of precocious disjunction of a stalk and its simultaneously precocious disappearence. After thorough reconsideration I still incline to the same opinion though recognizing fully the possibility of the alternative interpretation which I myself had considered but too summarily dismissed without mention. But whichever interpretation is correct, the real objective of the communication is equally supported, for both refer to a single-ovum origin.

In the further discussion of this specimen several deductions were drawn as to the physiological import of absence of the yolk sac. No implication of morphological development, except mention of the ingrowth of bloodvessels, was meant, and I supposed the context made this clear; if not, several statements must have seemed as revolutionary to others as they did to Professor Lewis. When, therefore, I spoke of the yolk sac as "not essential to the growth of an embryo or the proper differentiation of its parts," I was merely referring to the "growth" (that is, increase in size) of an embryo and its organs, and the coincident "differentiation" (or orderly progress) of its developing parts. The sole aim was to draw attention to the physiological insignificance of the yolk sac as related to growth. This is attested by the remainder of the same sentence: "indeed, the embryo in question is slightly larger than its twin . . . ," and again further on: "In the earliest human embryos known, when it might be of real use, it (the yolk sac) is a simple entodermal sac containing masses of coagulum; growth to a conspicuous size is attained relatively late, long after adequate nutritional relations with the mother have been thoroughly established." Little did I suspect that any one would infer an intended reference to initial morphological development in its strict sense. Of course, the gut and allantois had to form from entoderm somewhere, and the yolk sac, broadly speaking, is the undoubted source, yet it is entirely conceivable that essentially all the yolk sac, as a significant *sac,* might be dispensed with and still the gut would arise from entoderm which for the most part normally forms its roof. With this in mind I wrote that the fission "was presumably such that one received all, or essentially all, the cells destined to form a yolk sac," etc. Again, that I recognized the possibility of a rudimentary or abortive sac is seen in a later sentence: "That tiny vascular anlages of yolk-sac ancestry actually existed . . . is of course conceivable."

In short, my aim was remote from the heresy of denying the gut an entodermal, yolk-sac origin; on the contrary it was to re-emphasize from the functional side precisely what Professor Lewis has designated as a platitude: "But it is universally recognized that the yolk sac does its work in early stages, and . . . usually persists as a functionless rudiment until birth . . ." When, therefore, the foregoing complete explanation was furnished Professor Lewis he generously replied: "The chief interest in anatomical publications is in the observations they record; and as to the interpretation of the unusual specimens which you described so clearly, we seem to be in entire agreement."

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SCIENTIFIC BOOKS

Reptiles of the World. By RAYMOND DITMARS. New York, The Macmillan Company, 1922. pp. xi plus 373; 90 plates, 1 colored.

This book is a reprint of the first edition (1910), the only change being in the arrangement of plates. I believe now, as I did in 1911 (SCIENCE, N. S., XXXIV, pp. 54-55), that it is an excellent popular account of a group that has been neglected by writers on natural history, that it is rather well proportioned, and that it contains much of interest to professional zoologists and herpetologists.

I made a few rather unimportant criticisms in the review of the first edition, viz., a few typographical errors, absence of plate references, too few headings, the amount of space devoted to the habits of captive specimens, and an antiquated nomenclature. Unfortunately, since the text is an exact reprint, these criticisms still apply, and it must now be added that the book is decidedly out-of-date. Twelve years see many additions to our knowledge of even those groups which receive relatively little attention, of which the Reptilia is one: more forms are known, more information upon habits and distribution is available, and the accepted nomenclature is different than in 1910. Much of the new information might well find a place even in a popular book.

It is not because I am interested in systematic herpetology that I protest against the retention in works of this kind of an obsolete nomenclature. Admittedly it is not important in itself to the amateur naturalist whether the racers are called *Bascanion, Zamenis* or *Coluber*, and it may be granted that the use of the latest accepted names would often confuse the amateur naturalist or beginning student who has become familiar with the forms under other names. However, it must also be admitted that the retention of old names in recent popular natural histories and text-books makes it equally difficult for the student to read the modern literature on particular groups. In 1910 there was some excuse for retaining an out-of-date nomenclature, since there was not at that time a recent check-list of the North American reptiles; but the present edition would be much more valuable if the nomenclature were based upon the excellent check-list of Stejneger and Barbour, with the names used in the earlier edition given as synonyms.

In one respect the book is decidedly improved. The total number of pages, including plates, has been reduced from 463 to 419 by printing the plates on both sides of the page. The first edition was too bulky, and the present one would be improved by the use of a thinner text paper.

As I pointed out in 1911, there is a distinct need for a general book upon the natural history of reptiles. This one goes a long way towards meeting this need; but it is sincerely to be hoped that before another printing the old plates will be discarded and the subject matter brought up to date.

ALEXANDER G. RUTHVEN

SPECIAL ARTICLES

THE MEASUREMENT OF EXTREMELY SMALL CAPACITIES AND INDUCTANCES

HYSLOP and Carman[1] have recently described an undamped wave method of measuring small changes of capacity such as are obtained by introducing liquids as the dielectrics in the capacity of an oscillating circuit. Thomas[2] has applied this same beat-note oscillating circuit method to the measurement of the capacity of transmission line insulators.

The authors described[3] a method of using the hot-cathode Braun tube as the detector of

[1] *Phys. Rev.*, XV, p. 243, 1920.

[2] *Electrical Journal*, XVIII, p. 349, 1921.

[3] *Phys. Rev.*, XVIII, p. 331.

frequency change, indicating that the method is sufficiently sensitive to afford a means of detecting such small changes of capacity as are caused by introducing a gas as the dielectric instead of vacuum.

The method is particularly applicable to the determination of the dielectric constants of gases as it will be seen from the following that only the difference between the constant and unity is measured.

Since the authors started the above investigation L. M. Hull of the Bureau of Standards has described[4] the use of the hot-cathode Braun tube to determine frequency ratios.

Two oscillating circuits are made to deflect a cathode beam in two directions at right angles to each other. The combined deflections produce one of the well-known Lissajous' figures. If the two circuits are of exactly the same frequency, say 500,000 cycles, the resulting figure will in general be an ellipse. A change of capacity sufficient to cause a frequency change of 5 cycles per second will cause the ellipse to revolve 5 times per second. The change of frequency, if small, may thus be counted directly. The frequency of the master circuit must be kept constant during the time of observation. This can be done.

Let C_1 be a portion of the capacity in the one oscillating circuit and let it be so arranged that the dielectric may be either vacuum or a gas of dielectric constant K.

Then

$$F = \frac{1}{2\pi\sqrt{L(C + C_1)}}$$

where F is the frequency and C is the capacity of the remainder of the circuit, distributed capacity included. If the introduction of a gas in the condenser C_1 causes a change f in the frequency due to additional capacity ΔC, we shall have

$$F - f = \frac{1}{2\pi\sqrt{L(C + C_1 + \Delta C)}}$$

Eliminating L and solving for ΔC

$$\Delta C = \frac{f(2F - f)(C + C_1)}{(F - f)^2}$$

[4] *Proc. Inst. Radio Engr.*, 9, p. 130.

Neglecting f as small compared with F

$$\Delta C = \frac{2f(C + C_1)}{F}$$

Since

$$\Delta C = C_1(K - 1)$$

$$K - 1 = \frac{2f(C + C_1)}{C_1 F}$$

It is readily seen that the largest error is in the determination of the initial capacities. The preceding equation also indicates that only the excess of the dielectric constant over unity is measured. Should it be found possible to surround the entire capacity with the gas the above equation reduces to

$$K - 1 = \frac{2f}{F}$$

and the method would then be one of quite remarkable accuracy.

If the capacity be kept constant and the inductance varied, the first two equations may be written

$$F = \frac{1}{2\pi\sqrt{LC}}$$

$$F - f = \frac{}{2\pi\sqrt{(L + \Delta L)C}}$$

where C is the entire capacity of the circuit.

Eliminating C we have

$$\Delta L = \frac{2fL}{F}$$

If the master circuit can be kept constant for 60 seconds, and such has already been accomplished, a change of inductance of the order of 1 part in 10^8 can be detected.

The ability to detect so small a change in an inductance makes it now possible to use the inductance as the basis of an ether-drift experiment similar to that of Trouton and Noble.[5] Even though the experiment be doomed to null effect it is nevertheless necessary that it be carried out.

The above method may also be applied to the determination of the magnetic permeabilities of gases.

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[5] *Proc. Roy. Soc.*, 72 (1903), p. 132.

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

SECTION OF CELLULOSE CHEMISTRY

Harold Hibbert, *chairman*

G. J. Esselen, Jr., *secretary*

Report of the Standard Cellulose Committee.

Report of the Analytical Methods Committee.

Report of the Viscosity Measurement Committee.

The effect of concentrated hydrochloric acid on different celluloses: E. C. Sherrard and A. W. Froehlke. A preliminary report on an investigation to differentiate celluloses from various species of woods by observing the action of concentrated hydrochloric acid by means of the polariscope. Characteristic curves are given showing changes in specific rotation. Cotton and spruce cellulose give similar curves, although it has been shown that mannose is present in spruce cellulose and absent in cotton. For such a comparison a standard cellulose is required.

The effect of salts upon the acid hydrolysis of wood: E. C. Sherrard and W. H. Gauger. In a search for a material to act as a catalyst in the hydrolysis of wood a number of salts and acids have been tried. The effect of these added materials upon sugar and alcohol yields, as well as the effect produced by varying some of the conditions under which the hydrolysis was carried out, are given in the report.

Sugar formation in a sulfite digester: E. C. Sherrard and C. F. Suhm. This paper contains charts showing the rate of formation of sugar during the conversion of white spruce into sulfite pulp by the Mitscherlich and Ritter-Kellner processes. Time and steam pressure appear to exert the greatest influence on sugar formation.

Ethyl alcohol from western larch: E. C. Sherrard. This report describes the preparation of ethyl alcohol from the difficultly fermentable galactose obtained from western larch. Yields of sugar and alcohol are given for the hydrolysis of the water-soluble portion, the residue remaining after water extraction and the original larch wood. It is pointed out that western larch is the best source of ethyl alcohol of any wood yet studied.

Some of the products obtained in the hydrolysis of white spruce wood with dilute sulphuric acid under steam pressure: E. C. Sherrard and G. W. Blanco. A study of products formed in the hydrolysis of wood and wood cellulose has furnished valuable information concerning this reaction and the composition of these two substances. Approximately 20 per cent. of the wood cellulose is hydrolyzed with the formation of mannose, glucose, galactose, xylose and arabinose. Mannose and glucose represent nearly two thirds of these sugars. Spruce cellulose prepared by the Cross and Bevan method yields mannose, glucose and pentoses on hydrolysis with dilute hydrochloric acid. This indicates a marked difference in the chemical constitution of wood cellulose and of cotton cellulose. The latter does not yield mannose or pentose sugars on hydrolysis.

The distribution of methoxyl in the products of wood distillation: L. F. Hawley and S. S. Aiyar. At the last meeting of the society it was reported that the methoxyl had been determined in the charcoal, settled tar, dissolved tar, pyroligneous acid and gas, from the distillation of maple wood both treated and untreated with sodium carbonate. This work has been continued to include oak and one softwood and also one other catalyzer, phosphoric acid. In the case of oak and the softwood the increase in methyl alcohol due to sodium carbonate is not balanced by the decrease of methoxyl in the charcoal and the dissolved tar alone (as was the case with maple) but also by a decrease in the methane in the gas. The increase in methyl alcohol due to phosphoric acid was accompanied by decreases in the methoxyl of all the other products.

The chemistry of wood. V: G. J. Ritter and L. C. Fleck. This article records the analysis of eight more species of wood in continuation of similar previous work. No very striking variations in composition were noted. In a study of the distribution of the pentosans it was found that both alpha and beta cellulose contained pentosans, the alpha cellulose containing the higher proportion. The distribution of the methoxyl groups was also studied, and it was found that in general the lignin of softwood contained a greater proportion of the total methoxyl of the wood than the lignin from hardwoods.

The chemistry of wood. IV. The analysis of western white pine and eucalyptus: S. A. Mahood and D. E. Cable. This paper represents a continuation of the investigation of the chemistry of wood carried on by the U. S. Forest Products Laboratory. In addition to those constants determined by Schorger methods are given in this paper for the determination of alpha, beta and gamma cellulose and of lignin. The values obtained for western white pine are in the main similar to those obtained for other conifers, while the values for eucalyptus do not vary greatly from the values previously obtained on broad-leafed trees. Since, according to the values obtained in this series, the woods fall into two groups of fairly uniform composition, depending upon whether they are from broad-leafed trees or from conifers, the suggestions are made that a more detailed study of the splitting products, particularly the cellulose and lignin, of the woods of these two groups be made.

Some observations on the determination of cellulose in woods. II: S. A. Mahood. In a previous communication the author showed that the yields of cellulose from woods obtained by Schorger's modification of the Cross and Bevan method of cellulose determination are higher than those obtained by Seiber and Walter's modification. It was suggested that this difference might be due (1) to a difference in concentration of the chlorine in contact with the sample or (2) to a difference in temperature at which the chlorinations are made. The present paper covers an investigation of these two points. It has been found that the yield of cellulose obtained by the Seiber and Walter method of chlorination can be made to accord with that obtained by the Schorger method by diluting the chlorine used with an equal volume of air. There appears to be no difference in the percentage of cellulose obtained by the Seiber and Walter method when chlorination takes place at zero and at room temperature. The Willard crucible has been found to be more suitable than the Gooch crucible with the fiber pad, as proposed by Seiber and Walter, for making chlorinations of cellulosic materials. The results show that the lower yield of cellulose obtained by the Seiber and Walter method of chlorination is due only to too concentrated a stream of chlorine and not to too high a chlorination temperature.

Preparation of a "standard cellulose": W. O. Mitscherling.

Synthesis of derivatives relating to polysaccharides: Harold Hibbert and Harold S. Hill. Bromacetaldehyde has been condensed with mannitol, glycerin, glycerin brom-hydrin and various glycols. The bromine atom in the resulting cylic derivatives may be replaced by hydroxyl by boiling with dilute alkali. In the case of glycerin a bicylic derivative is apparently formed at the same time. The condensation products are being subjected to a careful examination in view of their relationship to the anhydro-sugars and polysaccharides.

Synthesis and properties of cylic acetal derivatives: Harold Hibbert and John A. Timm. Partition experiments carried out on the condensation of a mixture of one mol. each of a 1:2 and a 1:3 glycol with one mol. of an aldehyde show that in the various cases investigated a much higher yield is obtained of the six- than of the five-membered ring compound. Also, the stability of the latter towards dilute acids is much less than that of the former. Similar experiments are being carried out using a mixture of one mol. each of two aldehydes with one mol. of a glycol. The nature of the products resulting from the condensation of various aldehydes (1 mol.) with glycerol (1 mol.) is also under investigation as well as the part played by the catalyst in bringing about such condensations.

Constitution of sedoheptose anhydride and its relation to cellulose: Harold Hibbert. The constitution of this anhydro-sugar first prepared by Hudson and LaForge is probably represented by a 5:7 dilactonyl-configuration for the following reasons: It is stable towards mineral acids so that the absence of an ethylene linking may be assumed. The product is a mono-molecular, stable, crystalline derivative showing no tendency towards polymerization, in this respect differing from the intra-molecular condensation product of a $\gamma\Delta$ di-hydroxy aldehydo-derivative, the outstanding feature of which, as found by the writer, is its rapid ease of conversion into a polymorphic form. The evidence for this view could be found in the oxidation of sedoheptose anhydride to the acid, from which, by elimination of carbon dioxide, levoglucosan should be formed. Experiments with this object in view are in progress. The properties of $\gamma\Delta$ dihydroxy-aldehyde derivatives are being examined, the first under review, viz., 2:keto-5:6 dihydroxyhexane, being found to yield a highly polymerized product when submitted to the intra-molecular condensing action of a small amount of a mineral acid.

Symposium. The action of alkali and acid on cellulose, wood and waste cellulosic material with special reference to the production of cheap cattle foods.

Joint symposium with division of organic chemistry on recent work on the constitution of starch and cellulose.

SECTION OF PETROLEUM CHEMISTRY

T. G. Delbridge, *chairman*

W. A. Gruse, *secretary*

Volume changes in petroleum products: A. P. Bjerregaard. This paper will deal with some peculiarities exhibited by petroleum oils under changes of atmospheric temperature conditions when the oil is in tank cars. A set of expansion coefficients that fit the observed phenomena will be included.

The surface tension of petroleum: C. K. Francis and H. T. Bennett. The surface tension of petroleum from different sections of the United States and of the products derived from the various crudes was determined in order to ascertain whether a relation existed between the surface tension and any other physical properties of the oils. The surface tension of petroleum varies almost directly with the specific gravity, but is influenced by the asphaltic content. The presence of high boiling fractions and high viscosity products tends to raise the surface tension of the lighter petroleum products, such as gasoline and naphtha. The small quantity of sulfur compounds, amorphous and crystalline wax, fatty acids and related substances commonly found in petroleum products do not appear to appreciably influence the surface tension. The surface tension at 85° F. of the substances examined varies as follows:

Crude	28.8		31.2
Gasoline	24.4		25.8
Naphtha	26.3		29.2
Kerosene	30.7		31.2
Gas oil		33.1	
Lubricating oil	36.0		37.5
Wax distillate	33.6		36.2

The change in viscosity of oils with the temperature: Winslow H. Herschel. It is often necessary to estimate the viscosity of an oil at one temperature from an observation made at another. While it is not convenient to do this by equations, because no two petroleum oils are alike, and the relation between viscosity and temperature is complex, a graphical method has been developed which it is believed is accurate enough for commercial purposes. The method depends upon the observed fact that the graphs of a logarithmic viscosity-temperature diagram will, under certain conditions, meet at a point.

Some notes on the determination of the absolute viscosity of petroleum oils: W. H. Fulweiler and C. W. Jordan. In connection with the determination of absolute viscosity, of certain samples of petroleum products, it was noted that the viscosities decreased when the sample had been left in the viscosimeter for 24 hours. In other samples, the viscosity increased on standing. Some data is given showing the effect on viscosity of various samples of petroleum, vegetable and animal oils. Some suggestions are made as to the cause of this phenomenon.

Detonation characteristics of blends of aromatic and paraffin hydrocarbons: Thomas Midgley, Jr., and T. A. Boyd. The compressions to which aromatic hydrocarbons can be subjected in internal-combustion engines without detonation are very high as compared to the initial compressions that can be employed when paraffin hydrocarbons are used as fuel. Accurate measurements have been made through a wide range of relative composition of the tendency of blends of these hydrocarbons to detonate in engines. Values are given for the limiting compression ratio at which the various blends will give combustion that is free from detonation. The new instrumentation used for the accurate measurement of the degree of detonation occurring during the combustion of the fuel mixture in the engine is described.

The catalytic oxidation of insulating oils: C. J. Rodman. Many oils used in electrical apparatus for insulating purposes tend to slowly form "deposits" known to the trade as oil sludge. Experiments have been carried out in both open and closed systems to substantiate the view that numerous substances may act continuously in small quantities to materially assist in the formation of the undesirable sludge. Such substances found somewhere in the transformer or circuit breaker construction are: copper, brass, lead, iron, tin, organic resins, oxidized asphaltic "varnishes" and some loading materials such as magnesia, calcia and a small proportion of certain driers found in the protective paints. Properly protected materials of electrical apparatus construction are discussed as well as the desirability of protecting the oil from oxygen contact.

Corrosion of petroleum refining equipment: R. R. Matthews and P. A. Crosby. The authors have shown in earlier papers that in refining Mid-Continent petroleum in a so-called pipe still hydrochloric acid was formed, due to hydrolysis of the magnesium chloride in the brine associated with the petroleum. Ammonia has been used in the fractionating system to reduce the corrosion caused by the acid. The cost has beeen small and results gratifying. This paper shows that hydrochloric acid is also produced when Mid-Continent crude is refined in shall stills arranged in series for continuous operation. The action was especially noted in stills where the oil temperatures were 175° C. to 250° C., and where bottom steam was used. The acid corrosion was also noted in a heat exchanger where the outgoing crude oil was not over 110° C. Evidently the acid formation was small there, however, as the exchanger was in use one and one half years before a tube was corroded badly enough to give away.

Recent developments in the methods for the extraction of gasoline from natural gas: Fred E. Hosmer and F. M. Seibert. The commercial importance of the natural gas gasoline industry is reviewed. The chemistry of natural gas is briefly discussed. Two new methods of gasoline extraction are described. The first is known as the low pressure evaporation method, in which the crude product is utilized to furnish refrigeration for cooling the gas after being subjected to pressure. The second method is known as the crude oil absorption method. This method consists in subjecting the gas to about fifty pounds pressure, at ordinary temperatures, and absorbing the gasoline in crude oil, carrying the saturation to about 25 per cent.

Petroleum education: Edwin De Barr and Fred W. Padgett. A survey of petroleum education from the standpoint of pedagogy and practical application throughout the course of several years. The paper is outlined as follows: I, Relation of the various branches of engineering to the petroleum industry; II, Theoretical discussion of petroleum education; III, Petroleum education at the University of Oklahoma; IV, The future of petroleum education. The writers realize that the subject of petroleum education, especially from the standpoint of chemistry, is in a formative stage and it is hoped that the present paper will stimulate discussion and that outlines of courses in other institutions will be presented.

Sulfur compounds and the oxidation of petroleum oils: C. E. Waters. In general, mineral lubricating oils which contain large percentages of sulfur compounds are more easily oxidized than those in which there is less sulfur. This is true whether the oils are heated to 250° C., as in the oxidation method for determining the "carbonization values" of oils, or when the oils are exposed to sunlight. The precipitates formed on diluting the oxidized oils with petroleum ether contain higher percentages of sulfur than the original oils. The residues left behind on cracking and partially distilling off oils, as in the Conradson carbon residue test, tend to retain the sulfur in the oil. The bearing of these facts upon the formation of sludge in transformer and turbine oils and of carbon in internal combustion engines is pointed out.

DIVISION OF WATER, SEWAGE AND SANITATION

A. M. Buswell, *chairman*

W. W. Skinner, *secretary*

The effect of temperature on the rate of reaction in water softening by the lime-soda ash method: Edward Bartow, M. E. Flentje and W. U. Gallaher.

Observations on the mechanism of iron removal: A. M. Buswell.

Specific gravity of mineral waters by calculation: J. W. Sale.

Bottled mineral waters of unusual composition: W. W. Skinner, C. H. Badger and J. W. Sale. The composition of the domestic and foreign bottled mineral waters examined in the water and beverage laboratory of the Bureau of Chemistry during the last fifteen years is discussed with particular reference to the presence of unusual constituents or of ordinary constituents present in unusual amounts. The majority of these waters belong to one or another of the three following types: First, those in which the dissolved mineral constituents consist chiefly of dissolved limestone or of dolomitic limestone; second, of sodium bicarbonate and sodium chloride; third, of either or both sodium sulfate and magnesium sulfate. Usually a determination of the acid radicals, namely, nitrate, chloride, sulfate, carbonate and bicarbonate, and of the basic radicals, iron, aluminum, calcium and magnesium, together with a calculation of the sodium by difference, will furnish sufficient knowledge as to the composition of a water, provided qualitative tests are made for the more unusual constituents. Ordinarily, constituents other than those mentioned and silica are present only in traces. There have been some exceptions to the above, and instead of traces only substantial amounts of certain constituents enumerated below were found. The following maximum amounts of constituents expressed in milligrams per liter are reported: nitrate, 5700.; nitrite, 10.; hydrogen sulfide, 496.; bromide, 1510.; iodide, 30.; fluoride, 0.4; phosphate, 32950.; borate, 2000.; saline ammonia, 69.; lithium, artificial water, 288.; natural water, 32.; strontium, 200.; barium, 18.; manganese, 50.; and arsenic, 15. The composition of the so-called iron and alum waters is discussed briefly.

Two instances in which acute troubles were explained by means of the p_H *determination:* W. F. Monfort.

Hydrogen ion concentration and coagulation: W. D. Hatfield. For the majority of water works laboratories Gillespie's method for determination of p_H values, without buffer solutions, is most applicable. The amount of alum required for coagulation of a water is dependent on the buffer value of the water or the methyl orange alkalinity. Turbidity has very little effect. Coagulation begins at a p_H of 7.6-7.8 and the flock settles readily until a p_H of 6.6 is reached. The Highland Park filtration plant operated most efficiently at a p_H of 7.3 but most economically at 7.5-7.6.

Formulation of equilibria in the coagulating basin: A. M. BUSWELL.

Report of committee on standard methods of analysis: A. M. BUSWELL.

CHARLES L. PARSONS,
Secretary

THE KENTUCKY ACADEMY OF SCIENCE

THE ninth annual meeting of the Kentucky Academy of Science convened in the physics lecture room of the University of Kentucky on May 20, with President G. D. Smith in the chair.

Twenty-three new members were elected. Officers elected are: Lucien Beckner, Winchester, *president;* John A. Gunton, Transylvania College, Lexington, *vice-president;* A. M. Peter, University of Kentucky, Lexington, *secretary,* and W. S. Anderson, University of Kentucky, Lexington, *Treasurer.* A. M. Peter holds over as representative in the council of the American Association for the Advancement of Science.

The following are abstracts of the communications:

The Boleti of Kentucky: G. D. SMITH, Eastern Kentucky State Normal School (President's address). Colored lantern slides and stereoscopic photographs of 37 species of boleti observed in the vicinity of Richmond were presented and explained.

Factors affecting the germination of the sclerotia of Claviceps (Ergot of rye): FRANK T. MCFARLAND, University of Kentucky. Most mycologists are fairly well acquainted with the method of germination of sclerotia of Claviceps, but there still remain several factors which are poorly understood. During the past two years, the writer has been engaged in a study of the sclerotia of ergot from various countries. In the course of these investigations it has been found that sclerotia more than one year old failed to germinate. Sclerotia sown out of doors, on the surface of the soil, without any covering showed good germination of the sclerotia with many well-formed stromata but the stalks usually are short. Some mycologists seem to have the idea that these sclerotia may have the power to retain their germination ability for more than one year. It is quite unlikely that any sclerotia under out-of-door conditions should remain dormant during the first spring after their maturity and germinate the second season. Sclerotia of Claviceps must go through a period of rest. The shortest period of rest so far found is about eight weeks. During this time when the sclerotia are at rest, they must be kept stratified in moist sand. Removal of the cuticle of sclerotia with a scalpel does not prevent the germination, but the stromata are nearly always deformed, and all seem to rise from a stromatic cushion. Treating the sclerotia with a 5 per cent. and a 30 per cent. NaCl salt solution, and then completely removing all traces of the salt and stratifying the sclerotia in the usual manner did not injure their germination power.

The rôle of manganese in plants: J. S. MCHARGUE, Kentucky Agricultural Experiment Station. The purpose of this investigation was to determine if manganese has any definite function to perform in plant economy. The method of attack has been the preparation of plant nutrient compounds and quartz sand, free from manganese, and the growing of plants in different portions of nutrient solutions or sand cultures from which manganese was withheld and in another equal number of portions of these media to which manganese was added. All the plants were grown until those that received manganese showed signs of fructification and a few to maturity. The plants from which manganese was withheld made a normal growth for about six weeks only. Thereafter they became chlorotic and the young leaves and buds died back and the plants made no further growth of any consequence, whereas the plants to which manganese was available grew in a normal way and fructified where the plants were grown to that state of maturity.

The author concludes that manganese is necessary in the plant economy and that, therefore, eleven elements are necessary for the normal growth of autotrophic plants, whereas it has been taught previously that only ten are necessary.

The hydroxy-anthraquinone derivatives in plants: JOHN ABERDEEN GUNTON, Transylvania College. A résumé was given of the various plants containing derivatives of this type as well as a description of the forms in which these occur. The cathartic principles of cascara, senna, rhubarb, aloes and buckthorn were shown to be irritant anthracene derivatives that exist in the plant in the form of glucosides to which the physiological action is presumably due. Plants containing these bodies are found widely distributed throughout the globe and present an interesting stage in the chemical evolution of plant life. Considerable remains yet to be done on this group from the analytical and synthetical standpoints.

Some seed-borne diseases of agricultural crops: W. D. Valleau, University of Kentucky. Further studies on the extent of seed infection of corn with *Fusarium moniliforme* confirm previous reports that it is practically universal. The organism is carried between the various seed-coat layers and may extend in as far as the aleurone layer. In very flinty corn the organism remains dormant a longer period after the seed is planted than in the poorly filled starchy kernels. A preliminary study of 8 lots of barley from 3 states, 12 lots of oats from 4 states, and 38 varieties of wheat from 5 states indicates that small grains are infected to a higher degree with pathogenic organisms than has generally been suspected. Morphological studies of lettuce seeds have demonstrated the presence of an organism in a high percentage of seeds which is believed to be the causal organism of lettuce root rot. The universal presence of root rot on clovers and the results of preliminary tests of seed infection suggest that the causal organism is constantly present in clover seed. Observations on crops affected by seed-borne root disease organisms, grown under different seasonal conditions, suggests that these organisms may play an important part in geographical and seasonal distribution of certain wild and crop plants.

A preliminary report on a study of various clovers as found on three soil experiment fields of Kentucky with special reference to root systems: E. N. Fergus and W. D. Valleau, University of Kentucky. An ecological and pathological study is being made of various clovers, particularly red clover, growing on three soil types of Kentucky, in order to determine the causes of clover failure. Actual counts showed that red and alsike clover stands were practically equal throughout the first year whether on productive or ''clover sick'' soils. Much diminution of stand occurs on most soils during the second summer, reaching 100 per cent. on the least productive soil. Root rot was present to some extent on all root systems examined. Those developed in least productive soils were badly diseased or dead at the end of the first season. All tap root systems examined were badly diseased or dead at the end of the second season. The persistence of a clover plant after death of the tap root system depends on its ability to produce new roots from the crown.

Extraction of crude oil by means of shafts and tunnels: Henry Meier, Centre College. This method of recovery of oil from beds has been successfully carried on in Alsace since 1917. Experience has shown that by means of wells and pumps not more than 20 per cent. as a maximum of the oil contained in a bed can be brought to the surface. The recovery by sinking a shaft and digging tunnels through oil-bearing sand enables the recovery by seepage and by treating the sand with hot water, of two and a half times as much oil as by means of wells. This method of recovery increases the value of a concession. It opens to countries whose oil-bearing regions seem to have reached the end of production, new and encouraging prospects.

Depletion of Kentucky crude oils: W. R. Jillson, State Geologist, Director of the Kentucky Geological Survey. Although petroleum was first produced on the South Fork of the Cumberland River in 1819, the industry in Kentucky may be said to have gained its feet in 1900, when 62,259 barrels were produced. Production increased steadily until it exceeded 1,200,000 barrels in 1905 and 1906, after which it steadily fell off to 407,081 barrels in 1915. From that time it increased rapidly to 9,226,473 barrels in 1919 and has continued near 9,000,000 barrels. The author thinks that a production of 150,000,000 barrels in the next 60 years is a conservative estimate.

Oil shales of Kentucky: C. S. Crouse, University of Kentucky. The oil consumption in the United States is outstripping the domestic production, creating an alarming situation. New sources of oil must be found. Oil shale will solve the problem so soon as the extraction of oil from this source is made commercially feasible. A research has been in progress at the University of Kentucky for three years with the development of a commercial retort as its object. The results are more than encouraging. Kentucky has 90,000,000,000 tons of shale immediately available for steam shovel methods of mining. This shale, conservatively figured, represents 40,000,000,000 barrels of crude oil. Kentucky shales show marked superiority over shales in other parts of the United States. Such being true Kentucky is the logical place for the genesis of the oil shale industry in this country.

Model showing structure of Gainesville oil pool, Allen County, Ky.: E. S. Perry, University of Kentucky. The author exhibited the model showing the stratification and explained its construction.

Table moving by so-called spirits: Glanville Terrell, University of Kentucky. An example of table-moving produced in daylight by a girl of fifteen and a boy of ten with no possibility of collusion, was described by the author, as having come under his observation. The author is convinced that the phenomenon was genuine but asserts his disbelief that it was a spiritual manifestation.

A Kentucky chemist of the old school: ALFRED M. PETER, University of Kentucky. J(ohn) Lawrence Smith, M.D. (1818-1883), a citizen of Louisville, Ky., from 1854 to 1883, is most esteemed by the chemist engaged in mineral analysis by reason of the unique and very practical method for the determination of alkalies in silicates of his devising. Indeed, the extensive study of the potassium content of Kentucky soils, by the experiment station, was made practicable by the application of this method. Dr. Smith's publications number some 150 titles, a large proportion of which appeared in the *American Journal of Science*. His work was mainly in mineral chemistry. His investigations on emery led to the development of the emery industry in the United States. He made a life study of meteorites, of which he had a very fine collection, now owned by Harvard University. Dr. Smith occupied a high position in the scientific world and was an active member of many learned societies both foreign and American, including the National Academy of Sciences. The Lawrence Smith medal of the National Academy, a gold medal worth $200, to be awarded for research upon meteorites, was established by Dr. Smith's widow, who used for the endowment the sum of $8,000 received from the sale of his collection of meteorites to Harvard University. The medal has been awarded only twice: to H. A. Newton, in 1888, and to Dr. Geo. P. Merrill, in 1922. Dr. Smith was a man of means, charitable, public spirited, always ready to contribute his scientific knowledge for public good, and was held in high esteem in the community.

Home economics as a science: MARGARET WHITTEMORE, University of Kentucky. Before considering home economics in relation to natural sciences it must be remembered that it has a vital connection also with social sciences and with the fine arts. For this reason, and also because it is distinctly an applied subject, its relation with the natural sciences should be chiefly that of producer and consumer. Home economics, however, should contribute to scientific knowledge by suggesting problems which need attention and by providing the situations for application and experimentation. The earnest attention now being given to home economics reveals several weaknesses. One is the fact that as a course of study it has been organized too much upon a logical in opposition to psychological basis. This seems still true of much of the teaching of the natural sciences, as shown by the requirement of inorganic before organic chemistry. Another cause of weakness is the failure to recognize the desirable limits of home economics and the frequent attempt to teach in the department the principles as well as the application of the arts and sciences involved.

The measurement of the mental changes after the removal of diseased tonsils and adenoids: GLADYS MARIE LOWE, University of Kentucky. A group of thirty-five school children operated upon for diseased tonsils and adenoids was compared with a group of twenty-five which did not undergo the operation. This study is unique in the use of a control group of children with diseased tonsils and adenoids but not operated upon. Three lines of evidence were used, namely, changes revealed by a scale of tests of mental alertness, by the teacher's estimate of certain traits, and by the actual scholarship records. The comparisons are made between data obtained just preceding the operation and those obtained one year after the diagnosis. The Stanford Revision of the Binet-Simon Scale for measuring mental alertness was used. The teacher's rating for each trait was obtained by estimating in which fifth of the class the pupils belonged. The traits estimated were: (1) companionship with fellows, (2) emotional self control, (3) initiative, (4) self expression (speech), (5) interest in school work, (6) attention and (7) scholarship. The results show that: (1) While the average scholarship of the operated group continued to be the same as that of all the classes represented, the average scholarship of the non-operated group fell one scholarship rank below the average of all the classes represented. (2) The operated group showed no more change in the mental age, or in "brightness" (I.Q.) than did the non-operated group. The differences compared with the error were so slight as to be negligible. (3) The teacher's estimates showed no significant change. (4) Pronounced improvement was found in three or four cases.

The importance of scientific investigation in marketing: O. B. JESNESS, University of Kentucky. Attention was called to the growing complexity of marketing methods and a comparison of present methods with the comparatively simple methods that sufficed a century ago was made in order to suggest some of the reasons why the marketing system of to-day necessarily is involved. Mention was made of the prevalence of loose thinking and talking on marketing questions.

Emphasis was placed on the importance of scientific investigations in marketing. Facts are the only safe basis for action and careful studies are needed in order to obtain essential facts. Agricultural experiment stations and departments have studied production problems for years but have taken up marketing activities only recently. Much work in this field is now being undertaken and the future should witness the accumulation of much helpful material.

Factors involved in the standardization of tobacco grades: Erle C. Vaughn, University of Kentucky. Standardization of tobacco grades is designed to avoid confusion, to stabilize prices, and to protect both producer and buyer. The factors involved are the conditions which must be considered in bringing about these results. The chief ones are: descriptive terms used, natural grades, manufacturers' grades, methods of buying and selling, interest of producer in grading, and the many variations which occur both in the product and in opinions and practices concerning it. These factors, their true value and their relation to each other must be carefully considered in establishing practicable standard grades of tobacco.

Factors which influence the cost of gain in feeding cattle: Wayland Rhoads, University of Kentucky. The foundation of the beef cattle industry is the production and sale of fat cattle for beef, so when cattle feeding is profitable, both the breeders of purebreds and the producer of feeder steers have a good market for their stock. Pasture is the basis of the cheapest gains while the winter feedlot is necessary to produce fat cattle at that time, in order to have an even supply of beef. The cost of putting gains on cattle varies with a number or a combination of things. They are the age of the cattle, the time of year the cattle are fed, whether on grass or on dry feed, the length of the feeding period, the feeds fed, conditions under which the cattle are fed such as barn room and water supply, the daily gain which the cattle make, the quality of the cattle, the way they were fed before going on feed, the condition of the cattle and last the individual feeder himself. The old saying is true that "the eye of the master fatteneth the cattle."

Geology of eggs: G. Davis Buckner and J. H. Martin, University of Kentucky. An experiment was discussed wherein two lots of ten White Leghorn hens each, all hatched the same day and coming from a common parent stock, were fed rations consisting of: No. 1, corn, buttermilk and limestone, and No. 2, corn and buttermilk. During the first six months of laying lot No. 1 consumed 11.1 pounds of limestone and produced 651 eggs while No. 2 laid 343 eggs. Among other things it was shown that the average dried eggshell was 4.7 grams in lot 1 and 3.5 grams in lot 2. This means that lot 1 produced 1,789 grams of dried eggshell more than did lot 2. The relation of egg production to geology may be inferred.

Testing for moisture in transformer oil: C. C. Kiplinger, Mt. Union College, Alliance, Ohio. Freshly cut sodium dropped into the oil to be tested is a convenient and sensitive means of detecting traces of moisture. Evolution of gas bubbles is produced by smaller quantities of moisture than can be detected by the usual test of rubbing the oil with eosin.

A simple apparatus for demonstrating heat of absorption: C. C. Kiplinger, Mt. Union College, Alliance, Ohio. A Bunsen ice calorimeter with a long horizontal capillary tube attached serves as an air thermometer which may be used to demonstrate thermal changes due to absorption of liquids by charcoal.

The present status of the cancer problem: (lecture) Dr. H. Gideon Wells, professor of pathology, University of Chicago. Many lantern slides, most of them from photomicrographs, were exhibited to show the nature of cancer, which may be described as the continued unnatural growth of cells. This growth cuts off the supply of nourishment for other cells and makes conditions more favorable for the growth of bacteria around the affected area. It seems to have been established that the disease is not caused by a specific parasite, nor has a specific causative agent been isolated. Improved methods in the use of radium and X-rays seem to give the best promise for the control of cancer, and great advances have been made in the last six years. Drugs are useless. A very important factor is education of the people to recognize superficial cancers and have them treated before they become serious. Cancer is not properly a contagious disease and is not necessarily inherited by humans, though it has been shown to follow the Mendelian law of inheritance in rats, and some animals are more susceptible to it than others. A study of statistics shows that cancer is not on the increase, the apparent increase being accounted for largely by more exact diagnoses; the actual number of deaths caused by cancer is decreasing because of improved methods of treatment.

Alfred M. Peter,
Secretary

May 27, 1922

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CONTENTS

THE HUMANIZING OF KNOWLEDGE[1]

I

Any most familiar object will suddenly turn strange when we look it in the face. As we repeat some common word or regard keenly the features of an intimate friend they are no longer what we took them to be. Were it not for our almost unlimited capacity for taking things for granted we should realize that we are encompassed with countless mysteries which might oppress our hearts beyond endurance did not custom and incuriosity veil the depths of our careless ignorance. That I am "I" to myself and "you" to all of you, who are each of you "I" to yourself is on contemplation a perturbing circumstance. That the vibrations of my vocal cords should stir ideas in you is no easy matter to explain, and no one has yet been able to tell us why we and the earth so inerrantly attract one another. But these can hardly be called mysteries to most of our fellow men, who are so inured to personality, speech and weight that they are for them scarcely observed commonplaces.

Those to whom a commonplace appears to be most extraordinary are very rare, but they are very precious, since they and they alone have made our minds. It is they who have through hundreds of thousands of years gradually enriched human thought and widened the gap that separates man from his animal congeners. Without them the mind as we know it would never have come into existence. They are the creators of human intelligence. The mass of mankind must perforce wait for some specially wide-eyed individual to point out to them what they have hitherto accepted as a matter of

[1] Address before the American Association for the Advancement of Science, meeting in conjunction with the Pacific Division in Salt Lake City, June 23-24.

routine or failed altogether to notice. These mind-makers are the questioners and seers. We classify them roughly as poets, religious leaders, moralists, story-tellers, philosophers, theologians, artists, scientists, inventors. They all are discoverers and pointers-out. What eludes the attention of others catches theirs. They form the noble band of wonderers. Commonly unnoticed things excite a strange and compelling curiosity in them, and each new question sets them on a new quest. They see where others are blind, they hear where others are deaf. They point out profundities, complexities, involutions, analogies, differences and dependencies where everything had seemed as plain as a pike staff.

In short, poets, philosophers, religious geniuses, artists and scientists are all rare variants of the human species, who emerge here and there through the ages. Sometimes they make a wide appeal to their fellow men; often they stir their resentment or horror; most frequently they suffer neglect and contempt. A discovery to which no one listens is obviously of little or no importance. It is a mere private gratification which concerns only the discoverer himself. So the great question arises as to what determines the *success* of a new idea; what establishes its currency and gives it a social significance by securing its victory over ignorance and indifference or over older rival and conflicting beliefs?

To be accepted by the multitude of non-discoverers an idea must obviously be *attractive* to them in some way or other. And what are the kinds of attractiveness which promote the wide dissemination and the firm and prolonged acceptance of beliefs? This is a difficult question, and I do not flatter myself that I can answer it very satisfactorily. I take it that the new idea must seem "good," and mayhap noble, beautiful and useful, and that it must fit in pretty well with existing notions; or at least must not threaten violently to dislocate the accepted scheme of things. If it is ugly, wicked, discouraging, humiliating or seriously disturbing to the received plan of life it is likely to be shown the door. Ideas like kisses go by favor. The *truth* of the new idea proposed for acceptance plays an altogether secondary rôle. We rank the Good, True and Beautiful together but it is shocking to observe how little does the success of a new observation depend upon its scientific or historical credentials. In almost all we hear, read, say and come to believe, truth, in the scientific sense of the term, is a matter of almost complete indifference. It is irrelevant and may seem an impudent intruder and marplot. We often naïvely use the word "feel" for "believe," and even the word "believe" means to cling to something dear and precious, and good in our sight—to accept what we like to accept. And the wonder grows that there ever appeared in this world of ours a group of men like those here assembled so eccentric as to regard truth as the paramount issue.

If we make an exception of certain homely matters of fact which have underlain the development and practice of the industrial arts, mankind has until very recently been nurtured in the main on beliefs that were not submitted to any rigorous test of scientific or historical criticism, and which for the most part would not have been able to withstand careful scrutiny. But it would be a grave mistake to assume that what from a modern scientific standpoint are myths, poetic fancies and gross misapprehensions have not played an all-essential part in the building up of the human mind. Man's beliefs had inevitably in the first instance to be what suited him and what he naturally and easily grasped and clung to. For it is not the precise truth of an idea, as we have seen, that leads to its wide acceptance but its appeal; its congeniality to a being of the nature and setting of man. There had to be a vast widening of the primitive imagination and vocabulary, and innumerable guesses about real and imaginary things before a phenomenon so strange as modern science could emerge. Logical definition and speculation can operate quite as well—indeed better on unreal presuppositions than on experimentally verifiable ones.

Among the wonderers and pointers-out the poet, who "fancy light from Fancy caught," whose "thought leapt out to wed with thought," has always been surest of a large audience. For songs, heroic tales and rhapsodies can be attuned to the heart's desire—they are magic carpets on which we can voyage whither we will. Their truth is the deepest truth, that of vague human longings. When we are told that Kubla Khan a stately pleasure dome decreed, "where Alph the sacred river ran, through caverns measureless to man, down to a sunless sea," we do not feel obliged to consult a list of Tartar rulers, or locate the sources of the river Alph, or consider the geological formation of limestone caverns. Few will be disturbed by the question of what particular species of wood louse secreted the honey dew, or the probable number of bacteria occurring per cubic centimeter in fresh milk of Paradise. When the scientific rumor reaches the poet that Nature is so careful of the type, so careless of the single life, he will find many who will share his impulse to kneel down upon "the great world's altar stairs that slope thro' darkness up to God." The truth of human fears, disappointments and aspirations is indeed the supreme truth, being made as we are, and is likely to remain so. All other truth no matter how true is in comparison dust and chaff, except for the few who owing to their highly exceptional temperament crave proofs and precision, at least in some narrow segment of life's circle.

Religion shares with poetry and romance the appeal to man's natural and deep longings and spontaneous inclinations. Indeed, among the many definitions of religion none is perhaps better than that of Santayana, to whom it seems to be poetry sometimes mistaking itself for science. Religion has concerned itself, at least during historic times, with those terrors, awes, obligations and aspirations which rest on a belief in supernatural beings, good and bad. It has to do with our vivid fears in a world of sad mischance; with the hopes, restraints and sacred duties which might in some way offset life's incalculable tragedies. The poetic elements in religion are accompanied by more or less definitely formulated beliefs about man's origin and nature and the workings of the things about him. These convictions are commonly of ancient and untraceable genesis, although they may finally be very logically and precisely stated by a Saint Thomas or a Calvin and form a part of a closely concatenated philosophical system. One may not, however, take the same liberties with religious beliefs as he may with the fancies of the poet. The adherents of a particular religious creed are not free to pick and choose, and reject what comes to seem improbable. The "truth" once delivered stands, for it depends largely on the form of its original delivery. It is the word of the Most High or of some prophet inspired by him. At least this has seemed inevitable to a great majority of Christians and their leaders since the founding of their faith. Religion therefore makes a double appeal, that of poetry and of divinely certified truth about all the great concerns of life. It meets questions about our origin, duty and possible fates, without any call for painful critical thinking, suspension of judgment and dubious, ever-to-be-revised, theories and hypotheses.

II

These preliminary reflections have been necessary in order to introduce the scientist to himself. He is quite as prone as others to take himself for granted and not realize what an altogether astonishing and even grotesque mystery he and his doings constitute. He, like the poets, philosophers, theologians and artists, belongs to the small and precious group of persistent wonderers. He is a questioner, a discoverer, a pointer-out. He like them gives meaning to things that would otherwise pass unnoticed. But there is something inhuman in his methods and aims. He craves a meticulous precision of observation, measurement and statement quite alien to the other teachers of men. He exhibits an almost shocking insensibility to the cherished motives of belief. He does not ask whether what he looks for is right or wrong, beautiful or ugly, useful or futile, comforting or distressing. He only asks whether what he finds is an instance of something really happening. He persistently carries his analysis as far as he can and scrupulously sets down just what he has seen and the inferences he may make or suspect. Moreover he interests himself in what appears to the overwhelming mass of mankind as stupid trifles which promise neither pleasure nor profit. What difference can it possibly make whether a caterpillar has four muscles or four thousand, as described by the indefatigable Lyonnet; whether the light from metallic arcs may contain wave lengths as short as a six hundred thousandth of a millimeter; whether the solutions of the violet salt of chromium sulphate are stable at room temperature; whether there are sixty or eighty thousand species of beetles. And in other fields, what does it profit a man to be able to point out the interpellations in the Book of Ecclesiastes, or discover the origin of the Edict of Milan or describe the marriage customs of the small and obscure tribe of the Todi. And yet there can be no doubt that these and similar questions and their answers constitute the great bulk of scientific knowledge that has been accumulated during the past three centuries. They are stowed away in monographic contributions, proceedings and transactions under innumerable rubrics which no single man of science no matter how broad his interests and comprehensive his knowledge could possibly recall. This esoteric treasury of knowledge, the very existence of which is unknown, or indifferent, even to the so-called educated classes, is like a vast safety deposit vault with its many boxes large and small. The keys are in many hands, but few there be that can open more than two or three of the boxes.

Nevertheless the scientific investigator and the scholar has his own peculiar rewards. He finds a few like-minded persons to cooperate with him. Scientific research is not simply a solitary indulgence of infrequent and eccentric individuals. Little drops of knowledge coalesce into bigger drops, and odds and ends of detailed information gradually get shifted into patterns of great interest and beauty. For the world proves to be indefinitely investigable. Then there is much refreshingly human in the pursuit of knowledge. The investigator is the hero in a romance; he is keener than the sleuth of the detective tale and knows it. He has his territorial disputes, his ententes and his wars with his fellow scientists.

It is apparent however that the sustained and arduous scientific research which has gradually built up our fund of knowledge is a pursuit for the few. It is far from a seductive occupation for even creative minds of the poetic and religious type. It often requires years to ascertain facts and record observations that will in the end fill a small, abstruse and technical pamphlet. For research is mainly looking for things that are not there and attempting processes that will not occur. The layman has little notion of this. Experimental science is tireless fumbling and groping or, in its taxonomic aspects, the painful discrimination and comparison of detail. It is subject to innumerable disappointments in following trails that lead out into a boundless desert or up against barriers that it seems hopeless to try to scale. For the scientist does not make his own landscape as does the poet and even many philosophers, nor can he fly hither and thither at will, but he subjects himself to the tyranny of the natural phenomena or processes that he is observing, and, as Bacon says, he works "according to his stuff and is limited thereby."

The successs of modern scientific emulation lies very largely in its stubborn refusal to consider natural phenomena in terms of human impulse and mankind's native interests. During the Middle Ages the world was thought to be made for man. It was the vestibule to an eternal existence that awaited every human soul beyond the grave. As his transient sojourning place and scene of trial it had a moral and edifying quality which underlay a great part of the speculation about natural things. Around about the earth were the heavens, the ever perfect and incorruptible dwelling place of God and the angels and of the blessed who were found worthy to see His face. Those who began the reconstruction and further amplifying of knowledge, from the early seventeenth century onward, were on their guard against these older genial anthropomorphic and geocentric conceptions of Nature, and they also found various excuses for neglecting the sanctified interpretations prevailing in the universities. The preferences of the observer were to be ruled out. He was to be merely a careful and neutral spectator who must not allow himself to become so warmly implicated in his discoveries as to sacrifice a whit of his eager indifference. Of course this proud isolation was subject to many compromises, conscious and unconscious. And from a philosophical standpoint the onlooker, as has often been pointed out, is always one of the essential elements in the observing and recording. The ideal was, however, and still is, to dehumanize scientific investigation so far as may be. And this method has approved itself by its exceeding fruitfulness.

III

The question here arises, how did this scientific ambition ever come to be a matter of public concern? How did this professedly idle curiosity, as Veblen ironically calls it, confined as it is to rare and eccentric intellects and affecting a superb indifference to human interests, ever come to influence the beliefs and daily lives of great masses of mankind? The indubitable and ever growing social significance of modern experimental science is the result chiefly of three historical tendencies.

1. In the first place the minute and scrupulous observations and calculations and careful inferences of the natural scientist have in a few cases formed themselves into such impressive generalizations as to catch the attention of laymen. Examples of such large reconstructions are the reduction of the celestial bodies to physical and chemical processes; a growing substitution of respect for so-called natural laws, and a corresponding decline of confidence in miracles and magic, the partial elimination of the diabolical in the theory and practice of medicine, and latterly the frank inclusion of man himself in the order of nature. This process of transforming a naturally unscientific creature into a scientific one has of course not gone very far, and the tendency has met with varied and insistent opposition with which we are all familiar.

2. In the second place the inventor and engineer have in the interest of practical utility seized upon certain details of scientific discovery and with the connivance of the business man, influenced by motives of pecuniary profit, succeeded in revolutionizing industry and intercommunication, thereby gravely altering the conditions, possibilities and problems of civilization. Scientific research originally carried on for its own sake has thus produced indirectly the most far-reaching effects on our daily life. Moreover the constant refinement of technology has led to the invention of scientific apparatus without which research could never have reached the point it has. A striking example of this is the perfecting of electrical apparatus which has recently rendered possible the discovery, bewildering in its implication, of the electrical nature of matter.

In the beginning mankind was in no position fundamentally and permanently to modify his environment in his own interests. He had to make such terms as he could with the uncontrolled order of nature. To-day through scientific knowledge and experiment he is constantly engaged in remaking the world to suit his convenience. He indeed often yields to the temptation to exploit his resources with a reckless abandon which raises many serious problems in regard to the future of the race. He substitutes mechanical devices for the human hand; he generates and distributes new forms of power, and has finally learned through synthetic chemistry to create an indefinite number of new substances. Achievements of this class are the most spectacular outcome of applied knowledge and have done more than anything else to secure the scientist a specious popular esteem. But the problem is becoming acute whether that esteem is of such a character that it will permit the overwhelming process of readjustment to be guided and controlled by those best qualified by natural competence and training to prevent varied catastrophe.

3. A third less theatrical but none the less significant effect of the progress of natural science has been the influence which its ideals and methods, so successfully applied to the investigation of physical, chemical and biological processes, has had on the conception of man himself, his origin, history, habits and institutions. Anthropology, history in all its branches, philosophy, psychology, economics, and all other departments of research bearing on man's nature and conduct are undergoing changes of a momentous nature so revolutionary in their theoretical and practical implications that some recent writers go so far as to maintain that a great part of what has passed for social science

is obsolete or obsolescent; that it will pass away in the light of new scientific knowledge even as the scholastic philosophy was supplanted by experimental science. Man suddenly finds himself a bewildered actor in a new drama where he must learn his part all over again on pain of disastrous failure in his appointed rôle.

To summarize the preceding reflections: Modern scientific research, in spite of its professed aloofness and disregard of human feelings and motives, has succeeded in unfolding to our gaze so new a world in its origin, development, workings and possibilities of control in the interests of human welfare that practically all of the older poetic and religious ideas have to be fundamentally revised or reinterpreted. Scientific knowledge ingeniously applied and utilized by inventors and engineers has, with the assistance of business men and financiers, metamorphosed our environment and our relations with our fellow men. Lastly, our notions of our own nature are being so altered that should we discreetly apply our increasing knowledge of the workings of the mind and the feelings a far more successful technique might finally emerge for the regulation of the emotions than any that has hitherto been suggested. This is at least an exhilarating hope.

Now if all this be true we are forced to ask whether it is safe when our life has come to be so profoundly affected by and dependent on scientific knowledge to permit the great mass of mankind and their leaders and teachers to continue to operate on the basis of presuppositions and prejudices which owe their respectability and currency to their great age and uncritical character, but which fail to correspond with real things and actual operations as they are coming to be understood. For a great part of our beliefs about man's nature, the rightness and wrongness of his acts date from a time when far less was known of the universe and far different were the conditions and problems of life from those of to-day. Do we not urgently need a new type of wonderer and pointer-out whose curiosity shall be excited by this strange and perturbing emergency in which we find ourselves and who shall set himself to discover and indicate to his busy and timid fellow creatures a possible way out? Otherwise how is a race so indifferent and even hostile to scientific and historical knowledge of the preciser sort—so susceptible to beliefs that make other and more potent appeals than truth—to be reconciled to stronger drafts of medicinal information which their disease demands but their palates reject?

IV

It is this paramount question that I had in mind in preparing this address. I have not the time nor indeed the capacity to make its multiform and urgent necessity clear as I should wish. But many of you, I know, have already been thinking of the matter and will concede the necessity and urgency without further argument. Others will have experienced a vague anxiety and foreboding about the present state and prospects of scientific advance, and what has been said may help to clear their minds if they do not agree forthwith that the present crisis is of the precise nature and gravity that it seems to me to be.

Much has been written of the conflict of science and religion. But this is to narrow down the real problem, which is nothing less than the stupendous task of cultivating an appreciation of the nature and significance of precise thought and exact knowledge in a being by nature and nurture so careless of truth and given to modes of thinking repugnant to scientific intelligence. For even the more magnificent scientific discoveries, especially those of recent years, have not penetrated into our general education and are entirely disregarded in most discussions of social problems. And yet an imposing accumulation of critical information of wide bearing is at our disposal which could become an active factor in the readjustment of the troubled relations of man were it possible to overcome the obstacles to its general dissemination and acceptance.

A striking illustration of the present ineffective methods of popularizing cardinal scientific discoveries has recently been supplied by the revival of a strong and threatening opposition to the knowledge we now have of man's affinity and obvious relationships with the rest of the organic world. The idea of organic evolution is perhaps the most momentous in its bearings of all the great generalizations which have come with increased knowledge of the globe's history and the history of its inhabitants. Those who will take the trouble to consider even in the most elementary manner the multifold and concurrent evidence of the successive appearance of vegetable and animal species on the earth and the reasons for including man among the primates, can not fail, unless they be utterly blinded by prejudice, freely to concede the animalhood of man. The matter has been set forth by skillful writers such as Huxley, Wallace, Haeckel, John Fiske, Drummond and many others in a manner so plain and convincing that it would seem that no one would have the slightest inclination to take issue with them on the general proposition. But to judge from the conscious and unconscious confusion that seems to prevail in the minds of many the matter is still very ill-understood by even intelligent laymen.

Recently a serious misunderstanding has resulted from the report that men of science are giving up "Darwinism," that "Darwinism is dead." This has puzzled those who supposed that evolution was a well substantiated assumption, and has filled with a somewhat malicious joy those who have always denounced the notion as wicked and opposed to Scripture. To the public, Darwinism means evolution, man's monkey origin, as the matter is popularly but inexactly phrased. But to the paleontologist and biologist Darwinism does not mean the theory of man's animal descent, which was formulated long before the publication of the *Origin of Species,* but is confined to the ingenious theories which Darwin so patiently worked out to account for the facts of evolution. The statement that Darwinism is dead does not mean that the evidence for the evolutionary hypothesis has in any way been weakened or that any really competent man of science doubts our animal derivation. It only means that Darwin's explanations of how one species may have been derived from another have proved, as a result of increasing knowledge, to be mistaken or wholly inadequate. It means that we can not any longer assign the importance he did to sexual and natural selection and the hereditary transmissibility of acquired characters. But the confessed failure so far of biologists to clear up the process of evolution, or experimentally create a new species from an existing one, does not affect the facts derived from many converging sources which lead to the unavoidable conclusion that man has a genealogical relation to the higher animals.

It is the extraordinarily illuminating discovery of man's animalhood rather than evolution in general that troubles the routine mind. Many are willing to admit that it looks as if life had developed on the earth slowly, in successive stages; this they can regard as a merely curious fact and of no great moment if only man can be defended as an honorable exception. The fact that we have an animal body may also be conceded, but surely man must have a soul and a mind altogether distinctive and unique from the very beginning, bestowed upon him by the Creator and setting him off an immeasurable distance from any mere animal. But whatever may be the religious and poetic significance of this compromise it is becoming less and less tenable as a scientific and historic truth. The *facts* indicate that man's *mind* is quite as clearly of animal extraction as his *body.* Those older observations which are classed under paleontology, zoology, comparative anatomy, bio-chemistry, physiology and embryology, which reveal innumerable conformities and affinities between man and the higher mammals in structure, function and development from the egg, are now being parallelled by observations, classed under comparative psychology, functional psychology, anthropology, prehistoric archeology and intellectual history, which show that man's mind like his body is akin in its nature and fundamental operations to that of the higher animals.

The historical and comparative methods of approaching the study of the human body are largely responsible, as you are all aware, for our present rapidly growing understanding of it. The historical and comparative study of psychological phenomena—of what we call reasoning, emotions, impulses, the will—promise to be quite as clarifying and revolutionary when they can be freely applied. They will alter the whole conception of the various old divisions of philosophy—logic, epistomology, psychology, ethics—and tend to put these hitherto rather unreal and half mythical disciplines on a firmer foundation of observable facts. To cite a single example of this hopeful tendency, John Dewey has recently issued a book called "Human Nature and Conduct" in which he frankly reverses the usual procedure of writers on ethics. He first takes up the nature and workings of the human animal and then attempts to deduce the general rules that would seem appropriate to a creature like man. Now, the moralists in the past have in general neglected man's nature, of which with their mistaken presuppositions they could at best know but little, and have devoted their attention to accepted standards of conduct, ancient and dubious in origin, which they sought to justify by subtle theories and ingenious applications. This was, of course, to do little more than to rationalize the prevailing morals and mores. Hence the general barrenness of ethics as commonly understood.

Those who follow the recent developments in philosophical speculation can not fail to see how deeply they are influenced by the methods and discoveries of natural science. Indeed this old distinction between "natural" science and our knowledge of man himself is an artificial and misleading one. Man is an integral part of the natural order; he and his environment are constantly interacting. Such well-tried old terms as the will, consciousness, selfishness, the instincts, etc., when reinspected in the light of our ancestral background and embryological beginnings, all look very different from what they once did. The soul is no longer the pale little creature, *Hospes comesque corporis,* as described in Emperor Hadrian's famous lines. Nor is the human body, made up as it appears to be, exclusively of electrical charges, so lumpish a thing as it seemed. Mind and matter can no longer be divorced but must be studied as different phases of a single vital and incredibly complicated situation. Mind, as a recent writer has well put it, is no longer to be viewed as "primary but eventual." It is in the making, and a historical consideration of human intelligence, taking into account its animal and prehistoric substrata, its development in historic times and the profound effect of childhood on adult thought and feeling, reveals all sorts of previously neglected elements in the estimate of mind itself and of its untold future possibilities.

V

The chief aim of education for us who really grasp the value of a scientific attitude and appreciate the inherent obstacles which oppose themselves to its successful cultivation in the human species should be the inculcation of the profoundest of truths, namely, that science is one. It is nothing more or less than the most accurate and best authenticated information that we possess, subject to constant rectification and amplification, of man's nature and history, and of the nature and history of the world in which he finds himself. It is just the most reliable knowledge we have. It is not history, philosophy, psychology, ethics, politics, economics; it is not astronomy, physics, chemistry, geology, botany, biology—these are merely historical divisions of labor, which are now being profitably transgressed as we learn more of the essential interweaving and mutual dependence of all things. Those consecrated divisions may still have a declining significance in research, but I can not but think that they are one of the chief barriers to the cultivation of a really scientific frame of mind in the young and the public at large. They are aspects of a single supreme theme, Man and his World. *Once it was well to dehumanize science; now it must be rehumanized.*

The prevailing misapprehension of the evolutionary or historical conception of life and its unity should not be permitted to afflict the coming generation. But the precautions necessary to prevent this, demand our most careful thought and planning. The problem is nothing less than so revising our education that a new type of mind will be cultivated appropriate to our present knowledge and circumstances. Education is, however, controlled to a large extent by those who still adhere to many ancient conceptions which appear to them to be based on the best wisdom of the past, to be tested by time and substantiated by a consensus of human experience. These they do not wish to see disturbed. No two persons might agree as to exactly what these approved findings are, but so long as a notion is familiar it is assumed that it will not do any particular harm. Now, new knowledge, if taken seriously, is very likely to prove an indictment of those very ideas which are dearest to the ill-informed. So in order to avoid inconvenient discussion the doctrine has become popular that so-called 'controversial" matters should be carefully excluded from both the schools and colleges. This means, when stated in a bald form, that instruction which might stir religious prejudice, no matter how unintelligent, business, political or racial prejudice, or violate the proprieties, must be avoided. College presidents, school superintendents, text-book writers and their publishers are at present almost helpless in this situation. Teaching must be made as little disturbing as possible, when its chief function should be to stimulate thought and furnish new and reconstructive ideas. The plight of the directors of education is indeed pitiable. College presidents have to sit up late at night reconciling the noble doctrine of freedom of teaching with the practical necessity of dodging controversial questions—for at all costs nothing must happen to arouse the resentment of timid parents and donors. Like Milton, the college head can not endure the humiliating imputation that his teachers are under the wardship of an overweening fist; and yet he is constantly haunted by the nightmare of the fist which will refuse to write any more checks to the order of the institution if an instructor is carelessly charged with Bolshevism or with teachings tending to immorality, sedition or irreligion. And what is perhaps still worse the religious, moral or patriotic critics rarely take the trouble to find out what an instructor or text-book writer whom they attack really has said or believes. This scandalous state of affairs is too little understood. Those best informed about it are for various reasons disinclined to tell all they know. Those who plan out courses of study and write books for the schools are not free but must often make very humiliating terms with unintelligence.

Fifty years ago Matthew Arnold described education as "the getting to know on all matters which concern us the best which has been thought and said in the world; and through this knowledge turning a stream of fresh and free thought upon our stock notions and habits." This ideal would be accepted by most educators, but how very far are we from realizing it in practice. Teachers and text-book writers can not proceed directly toward this goal as they conceive it. They must hedge and suppress, compromise and extenuate, lest the authentic things now known which it concerns boys and girls to learn should unluckily start them thinking. For this might rouse the apprehension of some defender of the social and moral order, some professional patriot or some adherent of the Mosaic authorship of the Pentateuch. The politicians in the Kentucky legislature think themselves competent to decide whether the state should grant funds to any institution in which man's animal extraction is taught; the politicians in the New York legislature have provided that no one shall teach in the schools of the state who is known at any time to have expressed any distrust of our institutions.

Now nothing could be more diametrically opposed to the cultivation of a scientific frame of mind. Education should be largely devoted to the issues upon which the young as they grow up should be in a position to form an opinion. They should understand that scientific advance has greatly altered, and promises still further to alter, our environment, and our notions of ourselves and, consequently, the expediency of existing institutions of moral, social and industrial standards. We should have a dynamic education to fit a dynamic world. The world should not be presented to students as happily standardized but urgently demanding readjustment. How are they to be more intelligent than their predecessors if they are trained to an utterly unscientific confidence in ancient notions, let us say of race, heredity and sex, now being so fundamentally revised.

VI

Supposing it be conceded that one at least of the objects of a general education is to help the young to become acquainted with the best that is now known or guessed about mankind and the world; that it concerns them to know this, and that it should be so presented that it will, by encouraging them to busy their minds with our stock notions and habits, best prepare them to lead more intelligent lives and deal more wisely than their predecessors with old and new problems. Would it not be a most important contribution to reorder and restate this knowledge and suggest its implications? Might not this be profitably done with entire disregard of the timidities of educators and the apprehensions of those who now support education? No doubt things would have to be said which have hitherto been regarded as dangerous or inappropriate for the young to know. Issues of a distinctly controversial nature would constantly be arising. So such a task should not be left to any single individual. College faculties and teachers' associations are in no position to run counter to respectable tradition, and few there be that have any disposition to do so. As I have thought over the matter I see no large and influential association so well fitted as yourselves through a peculiarly competent and broad-minded committee, to undertake the task of *humanizing science,* and setting a new standard of education. That it will be easy even with your resources to choose the very best persons for such a committee, or that its work will have any immediate effect on general education is probably too much to expect. There are, however, minds of the requisite temper, training and literary tact. They must be hunted out and brought together in an effective conspiracy to promote the diffusion of the best knowledge we have of man and his world. They should have been researchers at some period of their lives, and should continue to be researchers in another sense. Their efforts would not longer be confined to increasing knowledge in detail but in seeking to discover a new synthesis of what is already known or in the way to get known. They should be reassorters, selecters, combiners and illuminators. They should have a passion for diffusing, by divesting knowledge so far as possible of its abstract and professional character. At present there is a woeful ignorance even among persons who pass for intelligent, earnest and well read, in regard to highly important matters that are perfectly susceptible of clear general statement. The members of the proposed committee should combine a knowledge of the exigencies of scientific research with a philosophic outlook, human sympathy, and a species of missionary ardor. Each of them should have professional familiarity with some special field of knowledge, but this should have come to seem to him but a subordinate feature of the magnificent scientific landscape.

Such a committee should be freed from educational restraints and from all suspicion of having to consider the feelings and preferences of donors and financial supporters. The more open-minded teachers and managers of education, as well as text-book writers and their publishers, would welcome a tribunal of high standing and unimpeachable independence, whose opinion and decisions might be sought from time to time to offset the complaints of importunate critics, who are now a constant nuisance and occasionally a great danger. There is at present a growing discontent with our education which appears even among the hitherto docile student bodies. The trouble lies not so much in our sometimes inept and now and then tyrannical form of administration; nor is it to be met by devising new ways of teaching old things. We must look to the very core of the instruction given; to what is being taught and to what is not. There is a recognized failure to make connections between the work in school and college on the one hand and the obligations and amenities of later life on the other. The whole substance and content of our general education needs a thorough overhauling. Something should be found to replace the effete and disintegrating old arts course. A good and sound idea underlies it, but its aims and methods and assumed results will not stand inspection in the light of modern knowledge and modern conditions of life. The elective system was but a confession that the tree of knowledge had put forth so many and such thick branches that the trunk was no longer visible. The stately proportions of knowledge are now lost in its ramifications. This difficulty can only be met by a novel synthesis—groping and tentative at first, but which will at least recognize and proclaim an essential need and suggest at least one way of meeting it.

At present there is no proper interplay between the so-called natural and social sciences; and each of these grand divisions of human knowledge, which belong so intimately together, dealing as they do with man and his world, are artificially separated by old boundary lines, defended against invaders and smugglers by jealous vested interests. This is an inevitable outcome of transplanting into our educational system the technical divisions of scientific research. It seems to me that our various scientific courses rarely produce either of the main results to be expected from them. They neither engender in the student a discriminating and exacting tendency of mind—that combination of open-mindedness and caution which should be the finest fruit of successful scientific training; nor do they foster such a lively understanding of the workings of nature that the fascination of ever discovering new wonders will endure through life and mitigate sorrow, boredom and disappointment. Of course, judged by this standard, the failure of education is no less conspicuous in the fields of literature, history, language and philosophy.

We need some new organized effort to bring together in an imaginative and novel manner the prevailing and sometimes conflicting knowledge of the material world, its fundamental nature as it is coming to be understood in the light of the astonishing new theories of matter itself; the general story of life, with some attention to the great classes of living creatures; the discoveries in regard to man's nature and functioning and the history of his achievements and perplexities.

To give a single instance of the way in which this might be done I will explain that a good many years ago I became bored with what passes for history and began to consider those things in the past that interested me. These proved to be such evidences as we have of how the beliefs we now accept about man and his world grew up and developed. I found myself a trespasser roaming about in the preserves of the philosopher, theologian, anthropologist, comparative psychologist, prehistoric archeologist and of the historians both of literature and science—to mention only a few of my divagations. Now this has proved very amusing and instructive to me, and I have found many hundreds of young men and women to follow me in my wanderings. When we got through we had discovered a new world, and man's past and the possibilities of his future were no longer what we had taken them to be. What I have done others can do in better and more ingenious ways; and the history of man's achievements and growing understanding of himself and his world could be made a branch of study beginning early and running through all the years of school and college. For, as Francis Bacon said, the history of the world without the story of man's education is like a figure of the mighty giant Polyphemus with his single great eye left out.

An Association for the Advancement of Science representing theoretical knowledge and some of its multiform practical applications, should not confine itself merely to forwarding the progress of research; coordinating, systematizing and applying the discoveries made. It must assume the further responsibility, in the juncture in which mankind now finds itself, of cultivating and spreading an appreciation of our best knowledge of man and his world among those now indifferent or actively hostile to it. We have every reason to dread unintelligence, but are as yet altogether too considerate of the unintelligent; for we know that they usually have the whip hand. How shall we escape from this unworthy bondage?

I am aware that the new organization at Washington under the auspices of this association, Science Service, is already doing what it can to spread the knowledge of new discoveries and keep the public *au courant* of scientific advance. I know that the admirably edited periodicals, Science and The Scientific Monthly, are performing the same service for those sufficiently prepared to read them with interest and understanding. But excellent as is this beginning we must prepare to go much farther by making scientific knowledge in the broadest sense an integral part of education from beginning to end. We must so identify it with the experience of the child and the youth that no longer will a deeper import lurk in the legends told us in our infant years than in "the truth we live to learn."

James Harvey Robinson
New School for Social Research

THE FOOD RESEARCH INSTITUTE OF STANFORD UNIVERSITY

The Food Research Institute of Stanford University was founded in February, 1921, by the Carnegie Corporation of New York in conjunction with the trustees of Leland Stanford Junior University, California. It is organized for the purpose of intensive scientific study of the problems of the production, distribution, and consumption of food. The institute grew out of a suggestion offered by Mr. Herbert Hoover, and its location at Stanford University was due partly to the fact that this university possesses, in the Hoover War Library, a large and unique collection of documentary material relating to the food problems and other economic aspects of the Great War. The Carnegie Corporation guarantees stated funds for the work for a period of ten years. Stanford University provides quarters and facilities and has appointed the directors of the institute to positions on the Stanford faculty.

The control of its policies and the active direction of the work of the institute are entrusted to three joint dirctors. The plan of the founders called for the selection of an expert in agriculture and food manufacture, an expert in economics and food distribution, and an expert in the physiology and chemistry of nutrition. In accordance with this plan, the following directors were appointed in April, 1921: Carl L. Alsberg, M.D., Joseph S. Davis, Ph.D., and Alonzo E. Taylor, M.D. At the same time an advisory committee was appointed comprising the presidents of Carnegie Corporation and Stanford University, *ex officio,* and the following additional members: Hon. Herbert Hoover, secretary of commerce; Dr. James C. Merriam, president of the Carnegie Institution of Washington; Mr. Julius Barnes, formerly president of the U. S. Grain Corporation; Dr. William M. Jardine, president of the Kansas State Agricultural College; Mr. J. R. Howard, president of the American Farm Bureau Federation; and Mr. George Roeding, formerly of the California Horticultural Commission.

The founding of the Food Research Institute is an outgrowth of war experience. During the late war, possibly for the first time in history, food production and distribution, nutrition and dietetics had to be considered by governments as national and even international problems. In determining policies required to meet the emergency, food administrators sought certain scientific information, from agriculturists, economists, physiologists, and physicians. Many valuable data were readily furnished. On the other hand, much of the desired information was not in existence, not because, given time, it would have been difficult to obtain, but because no one before the war had asked these questions or attempted to reach an adequate answer. Nutrition and dietetics had been studied mainly as individual problems, not as mass problems. The food supply had seldom been examined with adequate reference to its international aspects and to the particular commodities entering into it. Marketing problems had received mainly local investigation. There had been little coordination of studies in several important fields, and serious gaps were numerous. In many instances, therefore, the lack of essential information led to action more or less in the dark.

The founders of the Food Research Institute were convinced that the scientific study of such problems, from a broad national and international viewpoint, was important in peace no less than in war. While recognizing the essential services which research work in federal and state agricultural departments and colleges had rendered and will continue to render, they considered that a non-governmental organization with university affiliations could have advantages in attacking certain kinds of problems without the limitations which apply to these agencies.

The institute proposes, therefore, to investigate significant food problems from the standpoint of their bearing upon national economy and well-being, to deal with them as mass problems, and to emphasize the commodity and international aspects. While it will frequently study data of individual businesses, it will do this not in order to serve as a business adviser, but primarily in order to discover principles of general importance.

The precise program of the institute will be developed gradually. Its exact form will be determined partly by the readiness with which essential data on particular subjects can be assembled, and by the work which is already in progress elsewhere. In the course of its activity the institute will concern itself with such subjects as the food elements in actual and normal standards of living, and the physiological and social aspects of sub-nutrition; the sources, production, marketing, and utilization of important staple foodstuffs, such as wheat; the financing of farm operations and the manufacture and marketing of food products; the analysis of important food industries and the problems which they present; the technology of food manufacture, and the desirable scope of public control thereof; and the elements in a sound national policy with respect to food production, internal distribution, and international trade.

Numerous existing organizations are already conducting research into food problems, from one angle or another, notably the Department of Agriculture, state bureaus of markets, agricultural colleges and experiment stations; research organizations of banks, business houses, trade and marketing associations; and university departments, committees, or individuals. It will be the policy of the institute to avoid, so far as possible, any serious overlapping of the work of established research organizations, public or private. It will endeavor rather to enlist the aid of existing organizations in the prosecution of researches in which there is a common interest, in which essential data are already collected or in process of collection, or in which another organization is in a better position to perform a portion of the research. Moreover, in numerous instances the institute will consider its purpose accomplished if methods which it may develop, or sample studies which it may make, can be utilized by public or private agencies in undertaking similar investigations on a far more extended scale.

The research work will be done, for the most part, at Stanford University. In general, subjects for investigation will be selected which do not necessitate extensive field work, or in which the results of field investigations conducted by other competent organizations can be utilized. It is recognized, however, that certain investigations which the institute can undertake will require more or less field work by the directors, fellows, or assistants, and for these necessary provision will be made.

The institute is organized as an integral part of Stanford University, with the status of a department for the purpose of directing research and recommending degrees. For the year 1922-23 it has established four fellowships for graduate study in the field of food research. The directors will guide the work of these fellows, and occasionally a few other well-qualified graduate students, in studies which fall within the scope outlined above and which will frequently constitute a specific part of a piece of research which the institute has in process. Such individual research will ordinarily form a part of the work toward a higher degree at Stanford University, and will be supplemented by such work in other departments of the university as may be necessary to fulfill the usual requirements for degrees.

While the institute does not contemplate undertaking extensive experimental work on its own account, the university's established facilities for experimental research on foods, nutrition, etc., are available to graduate students, and to a limited extent the directors of the institute will cooperate in the direction of research in these fields. In addition, the directors will occasionally offer courses of instruction in other deparments of the university.

In part the results of researches will be published through established technical journals. Where circumstances render this undesirable, the results will usually appear in a series of publications to be issued by the Food Research Institute. In cases where certain lines of research are of interest to specific groups of readers, other or additional channels of publication will be sought in order to reach those concerned.

The first year of the institute has been largely occupied with the establishment at Stanford, the determination of general policies, the organization of a small staff, enlarging the collection of data which will be required for research, and making certain preliminary surveys and investigations designed to furnish the basis for more intensive studies. The work will be fully under way by the autumn of 1922.

SCIENTIFIC EVENTS

CANADIAN SOCIETY OF TECHNICAL AGRICULTURISTS

THE Canadian Society of Technical Agriculturists held its second annual convention at Macdonald College, Ste. Anne de Bellevue, Que., in the week of June 26 to July 1. In addition to the business sessions, a number of advanced lectures were given, the expense of which was borne by the Dominion Department of Agriculture. Professors W. T. Jackman, of the University of Toronto, and A. Leitch, of the Ontario Agricultural College, discussed topics appertaining to rural economics. Professor L. J. Cole, of the University of Wisconsin, spoke on "Genetics"; Dr. A. Bruce Macallum, of the Synthetic Drug Company, Toronto, on "Vitamins"; and Dr. M. O. Malte, National Herbarium, Ottawa, and Professor R. G. Stapledon, director of the Plant Breeding Station, Aberystwyth, Wales, on "Plant Breeding." President L. S. Klinck, of the University of British Columbia, delivered the presidential address and was succeeded in the chair by President J. B. Reynolds, of the Ontario Agricultural College. An interesting feature of the convention was an excursion to the Oka Agricultural Institute, La Trappe, Que., where the members of the society were very hospitably entertained by the staff of the institute under the Reverend Father Leopold. Speakers at the luncheons and banquets included the Honorable J. E. Caron, minister of agriculture, Quebec; Dr. J. H. Grisdale, federal deputy minister of agriculture; Dr. Jas. W. Robertson, Ottawa; the Reverend Father Leopold, principal of the Oka Agricultural Institute, and Principal F. C. Harrison, of Macdonald College. Professor W. H. Brittain, of the Nova Scotia Agricultural Society, was appointed representative of the society on the council of the American Association for the Advancement of Science. The society maintains a Bureau of Records of its members, which serves as an employment agency, and a bilingual journal, *Scientific Agriculture* (*La Revue Agronomique Canadienne*), both of which are conducted by the general secretary-treasurer, Mr. F. H. Grindley, B.S.A., Gardenvale, Que.

BISHOP MUSEUM FELLOWSHIPS

FROM the list of applicants for the Bishop Museum fellowships Yale University announces the selection of the following fellows for the year 1922-23:

Henry W. Fowler, ichthyologist, Philadelphia Academy of Science.

N. E. A. Hinds, instructor in geology, Harvard University.

Carl Skottsberg, director of the Botanical Garden, Gotenberg, Sweden.

Dr. Fowler will devote his attention to a study of the fish of Hawaiian waters; Dr. Hinds will continue his investigations of the geology of the island of Kauai; Dr. Skottsberg plans to make a study of the flora of Hawaii with particular reference to comparison with the plant life of Juan Fernandez and other islands of the southeast Pacific.

The four Bishop Museum fellowships yielding $1,000 each were established in 1920 by a cooperative agreement between Yale University and the Bernice P. Bishop Museum of Honolulu. They are designed primarily for aid in research on problems in ethnology and natural history which involve field studies in the Pacific region.

The Bishop Museum fellows for 1921-22 were Dr. F. L. Stevens, professor of botany in the University of Illinois; Dr. Stephen S. Visher, professor of geography in the University of Indiana, and Ruth H. Greiner, graduate student in ethnology in the University of California. The results of Professor Stevens' work on Hawaiian fungi and of Miss Greiner's study of Polynesian art have been submitted to Bishop Museum for publication.

THE HULL MEETING OF THE BRITISH ASSOCIATION

THE association meets from September 6 to 13 under the presidency of Sir C. S. Sherrington, Waynflete professor of physiology at Oxford, who will succeed Sir Edward Thorpe.

The London *Times* states that the presidential address will be on "Some aspects of animal mechanism." In the course of the meeting there will also be two evening discourses, the first by Professor W. Garstang on "Fishing: old ways and new," and the second, which will raise a question that created great interest at the last meeting in Edinburgh, by Dr. F. W. Aston, F.R.S., on "The atoms of matter: their size, number and construction." An interesting part of the proceedings will be the series of Citizens' Lectures, in development of the movement started by Huxley in the "sixties." These lectures will be four in number. Dr. E. H. Griffiths, F.R.S., will speak on "The conservation and dissipation of energy," Sir Westcott Abell, of Lloyd's Register, on the "Story of the ship"; Dr. Smith Woodward, of the Natural History Museum, on the "Ancestors of man"; and Professor A. P. Coleman, Toronto, on "Labrador." There will also be special lectures for children, at which Professor H. H. Turner, F.R.S., will speak on "The telescope and what it tells us," Professor J. Arthur Thomson on "Creatures of the sea," and Mr. F. Debenham on "The Antarctic."

Since the program was first arranged Dr. W. H. R. Rivers, F.R.S., president-elect of the Psychology Section, who was to have spoken on "The herd instinct and human society," has died, and his place will be taken by Dr. C. S. Myers, F.R.S., who will speak on the influence of the late Dr. Rivers on the development of psychology in Great Britain. The following are the titles of the other addresses to be given by sectional presidents:

Mathematics and Physics: Professor G. H. Hardy, F.R.S., "The theory of numbers."

Chemistry: Principal J. C. Irvine, F.R.S., "Research problems in the sugar group."

Geology: Professor P. F. Kendall, "The physical geography of the coal swamps."

Zoology: Dr. E. J. Allen, F.R.S., "The progression of life in the sea."

Geography: Dr. Marion Newbigin, "Human geography: first principles and some applications."

Economics: Professor F. Y. Edgeworth, "Equal pay to men and women for equal work."

Engineering: Professor T. Hudson Beare, "Railway problems in Australia."

Anthropology: Mr. H. J. E. Peake, "The study of man."

Physiology: Professor E. P. Cathcart, F.R.S., "The efficiency of man and the factors which influence it."

Botany: Professor H. H. Dixon, F.R.S., "The transport of organic substances in plants."

Education: Sir R. Gregory, "Educational and school science."

Agriculture: Lord Bledisloe, "The proper position of the landowner in relation to the agricultural industry."

The special interest of Hull as a fishing center will receive prominent attention in a series of sectional discussions dealing with the North Sea. On the more technical side, a discussion of intense interest will be that on "The origin of magnetism," which will be opened by Professor P. Langevin, Paris, and in which Professor P. Weiss, Strasbourg, will also take part. Another subject to be discussed is that "Economic periodicity," which arises out of the theory expressed by Sir William Beveridge that there is a bad time coming in a few years. Lord Haldane will lecture on "The ideal of our national education," and, among the other topics which will be dealt with are "Training in citizenship," "Psycho-analysis and the school," "Vitamins," "The present position of Darwinism," "The possibility of increasing the food supply of Great Britain," and "Our bones and teeth" (the latter, a lecture by Professor W. D. Halliburton, F.R.S.).

A special effort is being made this year to attract the younger generation of students. Thanks to the beneficent gift of £10,000 of War Stock recently handed over to the association by Sir Charles A. Parsons, the association has offered a certain number of exhibitions to universities and university colleges in Great Britain.

SCIENTIFIC NOTES AND NEWS

Professor Edward Sylvester Morse, of the Peabody Museum of Salem, Massachusetts, and the Boston Museum of Fine Arts, an authority on Japan and the Nipponese people, their habits, customs and arts, was in 1898 decorated by the Japanese government with the Order of the Rising Sun. He has now received through the Imperial University of Tokio, from the department of foreign affairs, Japan, the second class of the Order of the Sacred Treasure, "in recognition of meritorious services rendered to the cause of learning and culture" in Japan.

A complimentary dinner was tendered to Professor and Mrs. G. F. Hull, of Dartmouth College, on July 15, by the departments of physics, astronomy and physiological optics, in celebration of the twenty-fifth anniversary of Professor Hull's doctorate. Professor Hull received the degree of Ph.D. from the University of Chicago on July 1, 1897. Later the party was entertained at the home of Professor and Mrs. A. B. Meservey. Congratulatory letters were read from Dr. E. F. Nichols, formerly of the department of physics of Dartmouth, from Sir J. J. Thomson, of Trinity College, Cambridge, with whom Professor Hull has studied, and from others with whom he has been associated.

A complimentary dinner was recently given to Dr. Henry Head, F.R.S., on his retirement, in recognition of his services as editor of *Brain* for seventeen years. The chair was taken by Sir Charles Sherrington, F.R.S., professor of physiology at the University of Oxford and president of the Royal Society and of the British Association.

The James Scott Prize of the Royal Society of Edinburgh, established in 1918 for a lecture or essay on the fundamental concepts of natural philosophy, was presented on June 5 to Professor A. N. Whitehead for his lecture entitled "The Relatedness of Nature."

Honorary degrees have been conferred by the University of Sheffield on Sir Charles Parsons for his work on the turbine engine, and on Mr. T. W. Hall for researches in paleography and archeology.

M. Amé Pictet, professor of chemistry at the University of Geneva, has been elected a corresponding member by the French Academy of Sciences.

Professor George H. F. Nuttall, of the University of Cambridge, has been elected a corresponding member of the Société de Biologie, Paris, and of the Society of American Bacteriologists.

The Swedish Medical Association at a recent meeting voted to commemorate the sixtieth birthday of Professor A. Gullstrand, in June, with a special gold medal and the foundation of a fund in his honor. He was given the Nobel prize in medicine in 1911 for his contributions to the science of ophthalmology.

Professor T. Petrina, of Prague, professor emeritus of internal diseases and president of the German section of the Bohemian Medical Society, retired from this and other positions on reaching his eightieth birthday recently. The German-Bohemian members of the society have founded the Petrina Endowment in his honor.

Mr. V. H. Gottschalk, of the technical branch of the Western Electric Company, at Hawthorne, Ill., has joined the research staff of the Society of Automotive Engineers, New York City.

The following men have accepted temporary appointments at the Japanese Beetle Laboratory, Riverton, N. J., for this summer and have reported for duty: Professor W. A. Price, of Purdue University; Dr. Henry Fox, of Mercer University; H. H. Pratt, a graduate of Rutgers College, and J. H. Painter, a graduate of the University of Maryland. There was received at the Japanese Beetle Laboratory earlier in the spring what is believed to have been one of the largest shipments of imported parasite material ever brought into this country from abroad. Something over a hundred thousand cocoons of a tachinid known to be parasitic on the Japanese beetle in Japan were sent to the laboratory by C. P. Clausen and J. L. King, who are stationed in Japan and working upon Japanese beetle parasites there. A fairly large proportion of these cocoons were apparently in good condition upon their arrival at the laboratory and emergence has just commenced.

THE British Commissioners of 1851 announce the following appointments to science research scholarships (overseas):

Canada: J. M. Luck, University of Toronto, biology; W. H. McCurdy, Dalhousie University, physics; D. F. Stedman, University of British Columbia, physical chemistry.

Australia: Miss M. Bentivoglio, University of Sydney, crystallography; J. S. Rogers, University of Melbourne, physics.

New Zealand: J. C. Smith, University of New Zealand, chemistry.

South Africa: I. Low, University of Stellenbosch, meteorology.

DR. T. T. READ, chief of the information service of the United States Bureau of Mines, has been appointed by the president of the American Institute of Mining and Metallurgical Engineers as the official representative of the institute to attend the International Congress of Engineering to be held in Rio de Janeiro, Brazil, in September. Dr. Read expects to leave for Rio de Janeiro about August 15.

DR. A. B. STOUT, of the New York Botanical Garden, will be in residence as professor at Pomona College during the year 1922-23, being on leave of absence for one year.

A PARTY in charge of Dr. C. H. Edmondson and Dr. Stanley C. Ball, of the Bishop Museum staff, sailed on July 10 for Fanning Island. They plan to make a study of the bird life and marine fauna and to procure representative collections.

PROFESSOR ARTHUR JOHN HOPKINS, of the department of chemistry of Amherst College, has started on a tour of eleven months through Spain, Italy and Egypt. He will search for traces of alchemy.

DR. W. B. CANNON, professor of physiology at the Harvard Medical School, gave a Mayo Foundation lecture at the Mayo Clinic on June 20. His subject was "The effects of the emotions on the body."

J. D. SISLER, of the Pennsylvania Geological Survey, is spending the summer mapping the geology of the Myersdale quadrangle in the southwestern part of the state, and M. E. Johnson visited the Tidioute oil pool in the northwest part of the state a few days ago and will shortly resume geologic mapping of the Pittsburgh quadrangle.

THE name of Dr. Keating Hart, who lived in Paris, is gazetted in the *Journal Officiel* on June 16 as having "deserved well of France and humanity." The order points out that he had specialized for twenty-five years in electrical and X-ray therapy, and had rendered great service in research work. During the war he showed the utmost contempt of danger while attending to the wounded under bombardment. Injured by exposure to X-rays he underwent two operations on his right hand, but nevertheless he continued his work until his death on January 25 of this year.

THE French Senate has unanimously voted 2,000,000 francs to observe the hundredth anniversary of the birth of Louis Pasteur, which will take place this year. The Senate in voting the appropriation described Pasteur as the "symbol of French science."

MORIZ WEINRICH, sugar expert, well-known in the beet, cane and refining industry throughout the world, died on July 15 in Rosendale, New York, after a brief illness, at the age of seventy-six years.

MR. ERNEST WILLIAM LYONS HOLT, chief inspector of Irish fisheries, died on June 10, at the age of fifty-seven years.

DR. JACQUES BERTILLON, who had charge of the bureau of statistics at Paris, in which position his father and grandfather had preceded him, has died at the age of seventy-five years.

A RECENT exploration of Palmyra Island, lying about 1,000 miles south of Hawaii, has resulted in a map and a large collection of zoological material, especially mollusca and crustacea, which go to enrich the collections of the Bishop Museum.

IT is announced by Professor E. Perroncito, president of the Second International Congress of Comparative Pathology, that this congress, which was to have convened at Rome on September 20, 1922, has been postponed until sometime in 1923. The date will be given in later announcements.

The Congress of the German Society of Geneticists will be held from September 25 to 27, immediately after the Mendel celebration in Brünn. It is open to members, as well as to guests interested in research in genetics. The following addresses are on the program and will be followed by a general discussion of the subjects: R. Goldschmidt, Berlin, "The problem of mutation"; H. Spemann, Freiburg i. B., "The hereditary material and its activation"; E. Rüdin, Munich, "The inheritance of mental disturbances." On September 27 a special session will be held, which will be addressed by E. Baur, Berlin, on the "Tasks and aims of the science of genetics in theory and practice." In addition to these addresses, a large number of other papers are on the program. Information on all matters concerning the congress and its program may be obtained from Dr. H. Nachtsheim, Berlin, N. W., Invalidenstrasse, Nr. 42.

A meeting was held recently at Harvard University, at which the subject under discussion was the killing of flies and mosquitoes. Sanitary experts, business men and the heads of women's and children's welfare organizations of the metropolitan district were present. J. Albert C. Nyhen, director of fly and mosquito suppression of the Brookline Board of Health, and Professor G. C. Whipple, of the engineering department of Harvard University, called the meeting, at which Professor Whipple presided. Its purposes were to consider action to be taken in a cooperative movement for the suppression of mosquitoes and flies in the metropolitan area and to call a later meeting to start a state-wide mosquito campaign. It is hoped that all insect nuisances affecting public health may be abolished and the movement will try to include the flea and the biting fly.

The Forest Service of the United States Department of Agriculture is using airplanes for locating and photographing undiscovered lakes in the national forests of Alaska. It has long been known that there are many lakes on the headlands and islands traversed by the inside passage between Seattle and Skagway that do not appear on any map. During the New York-Nome flight made by army aviators, lakes were frequently sighted which could not be found on the latest and most authentic maps of the territory. Tales of unknown water bodies are constantly being brought in by trappers and prospectors. Less than a year ago a lake four and one half miles long and one half mile wide was discovered at the head of Short Bay. This lake has over 1,000 acres of surface area and is less than one and one fourth miles from tidewater, yet because of the surrounding country's rough topography, it has remained unknown and unnamed. Recognizing that many other of these "lost lakes" may be sources of valuable water power, the Forest Service has laid plans to map this no man's land of the north by means of aerial photographs. A few days' flight, it is said, will be sufficient to cover the area with a degree of accuracy that would require many years and great expense to accomplish by ordinary methods. The work, which has been approved by the Federal Power Commission, will be done by seaplane, flying from Ketchikan as a base.

The *British Medical Journal* states that the annual report of the Gordon Memorial College at Khartoum for 1920, which is the nineteenth, shows steady progress in all directions; it pays a tribute to the late Sir William Mather, one of its most generous supporters and an energetic member of the governing body for seventeen years. The Wellcome Research Laboratories are accommodated in the Gordon Memorial College; they are under the supervision of Major Archibald, who is maintaining the high standard set by his predecessors, Drs. Andrew Balfour and Chalmers; it contains research departments in medicine, chemistry and entomology, the activities of which are duly set forth. Research work in the bacteriological section was interfered with by depletion of the staff and by the large amount of routine work that had to be carried out. But the director has a number of articles awaiting publication—namely, notes on urinary amœbiasis in the Sudan; on kala-azar in the Sudan; on tropical splenomegaly caused by a hitherto undescribed bacillus; on juxta-articular nodes, their etiology and pathology; and on baciluria as a cause of pyrexias of uncertain origin in the tropics. According to the report, the time when the prophets of research had to clamor for a hearing is happily past, and there is no longer any hesitation on the part of government departments or private enterprise in appealing for assistance. Of the two possible methods of extension to meet these increased responsibilites Major Archibald advocates decentralization, by the establishment in various parts of the Sudan of local laboratories, temporary or permanent, for medical, chemical, and entomological research. This he considers preferable to the creation of new and larger laboratories at Khartoum. His recommendation has been unhesitatingly approved by the government.

In order to present to the public more promptly the results of its scientific investigations, the Bureau of Mines issues a series of brief mimeographed reports of investigations as an adjunct to the printed publications. Besides affording a medium of prompt publication of information, the reports of investigations provide a vehicle for the publication of briefer material which would hardly justify issuance in the form of printed bulletins. These reports deal with major metals, minor and rare metals, non-metallic minerals, petroleum, gasoline, coal, coke, safety, sanitation, mine accidents and other subjects. The reports are mailed free to interested applicants as long as the editions are available. Descriptive notices of issues in the series are mailed regularly to all who desire to receive the information. Serial 2316, just issued, is a subject list of reports of investigations issued to December 31, 1921, and describes some 300 reports, whose range covers such subjects as abrasives, automobile exhaust gases, breathing apparatus, carbon black, Fuller's earth, liquid oxygen explosives, mine telephones, oil pipe lines, slate dust, valuation of oil properties, airplanes in mine-rescue work, powdered coal, helium, mine timbers, lead poisoning, smoke prevention, clays, building stones, safety in quarrying, etc. Serial 2316 may be obtained from the Bureau of Mines, Washington, D. C.

The *Journal* of the Royal Geographical Society reports that a short account is given in *Ymer* of the scientific expedition organized by Prince William of Sweden for zoological research in the region of the Kirunga volcanoes, north of Lake Kivu. The expedition left Marseilles towards the end of 1920, landed at Mombasa, and passed through the Kenya colony and Uganda to its destination. Various camps were established among the volcanoes and on the north shore of the lake, and extensive zoological collections made, including specimens of the mountain gorilla. Near the lake the barren lava-fields due to the sudden eruption of a new volcano in December, 1912, were found to be but sparsely covered here and there by new vegetation. The expedition went north to the Belgian post of Ruchuru and Lake Edward, through a district described as a paradise for sportsmen. Passing rapidly through the Semliki valley, where interesting collections were made in the outliers of the great equatorial forest, it spent some time at the Belgian post of Isumu, and made some study of the Wambutti dwarfs. Thence the return was made by Lake Albert and the Nile. The collections, which have been deposited at the Natural History Museum at Stockholm, include about 1,000 mammals, 1,700 birds, and some hundreds of reptiles and amphibia, besides a large number of insects.

UNIVERSITY AND EDUCATIONAL NOTES

Six medical students from Polish universities have been selected to go to America to finish their studies preparatory to entering the new Institute of Hygiene recently established at Warsaw by the Rockefeller Foundation. Professor Selskar Gunn, representing the Rockefeller interests, has made the final choice of the students after a competitive examination organized by the Polish ministry of health. An endowment of $250,000 has been given for the establishment of the institute by the Rockefeller Foundation.

The departments of engineering and medicine at the Kyushu Imperial University have just been opened to women students. Women are still barred from attendance at the Imperial University in Tokio and at most of the other higher schools.

At Stanford University, Dr. Lewis M. Terman has been appointed head of the department of psychology to succeed Professor Frank Angell, who retired at the end of the academic year 1921-1922. Other additions to the department include Dr. W. R. Miles, professor of psychology, and Dr. Calvin P. Stone, assistant professor.

Professor J. J. Thornber, director of the Arizona Agricultural Experiment Station, has in addition received appointment as dean of the College of Agriculture of the University of Arizona, succeeding Dean D. W. Working.

Mr. Charles W. T. Penland, A.M., Harvard, has been appointed instructor in biology in Colorado College for the ensuing year. Mr. H. R. Remmers, A.M., Iowa, has been appointed instructor in psychology.

Mr. R. A. Brink, who has for the past two years been at the Bussey Institution of Harvard University, has been appointed assistant professor of genetics at the University of Wisconsin. He succeeds in this position Dr. E. W. Lindstrom, who goes about September 1 to the Iowa State College at Ames as professor of genetics, where he will organize a new department.

DISCUSSION AND CORRESPONDENCE

FILTERED AIR

In Science of June 2, 1922, in mentioning the work of the Committee for the Investigation of Atmospheric Pollution, reference was made to the work of Dr. Owens on the amount of dust found in expired air. It has been taken for granted, I think, by many medical men that in passing through the nasal and buccal passages efficient filtering of the air took place; and that all dust particles were deposited on moist membranes and automatically removed by secretion flow. Dr. Owens' experiments seem to prove that in ordinary breathing the expired air still contained as much as 70 per cent. of the suspended impurities which entered during inspiration. So that only about 30 per cent. of the impurities in air are removed in transit through respiratory passages.

Dr. Chase S. Osborn, formerly governor of Michigan and one who had much to do with mines, referring to the above mentioned insufficient filtering, suggests that there may be something in the fact that the influx of air has not the velocity and current strength of the efflux, and states that the finding of Dr. Owens that air is not purified in its passage through the body appears to be proved without doubt by sillicosis in the Transvaal mines. He says:

> It takes very little time comparatively for a miner's lungs to fill up. He is then subject to all sorts of pulmonary diseases. Dr. Gorgas was summoned to see if he could offer anything to prevent or cure. Even when the men wear masks these do not entirely avail, as often the men are in close places and will not wear the masks.

Good water, sterilized milk and insect screens have aided materially in reducing disease. May we hope to add to the list filtered air? There seems to be no doubt but that the use of a mouth mask was helpful in combatting the spread of influenza.

Alexander McAdie

THE "PROCESSING" OF STRAW

In a recent number of Science, Professor Harold Hibbert calls attention to the work done in Germany in converting straw into a feed of greater value by boiling it with soda and suggests that American farmers may convert a waste product into "a profitable and palatable cattle food of high nutritive value" by following the German example. Professor Hibbert has apparently overlooked the fact that this feed is extremely low in proteins. This fact was mentioned by Lorenz Hiltner in his pamphlet in 1917-18 and is recognized as being a point against "processed" straw as a feed. Various methods have been tried by the Germans to increase the protein content, some of which are mentioned by Hiltner.

The Office of Forage Crops has been interested in the development of this German work but has not been convinced of the value of the process for the American farmer. While it is not possible to make accurate estimates of the expense involved it is quite evident that the labor item would be considerable. The farmer would have to set up a plant however simple whether he used the cold process with NaOH or the boiling process with soda. Such a plant would necessarily be of considerable size since straw is light and considerable quantities of liquid (eight times the weight of the straw) must be used. Besides the treatment, the processed straw must be washed to remove the alkali. All of this involves labor and increases the cost of the process. Besides it seems probable that in America it will always be possible to grow corn or sorghum for feed much more cheaply than to process straw even if the latter were wholly a waste material, which is not the case.

Without doubt the attention of experiment stations should be and probably has been called to this process but it seems unwise even to suggest it to the average farmer.

A. J. PIETERS
OFFICE OF FORAGE CROP INVESTIGATIONS,
U. S. DEPARTMENT OF AGRICULTURE

DOES THE BIBLE TEACH EVOLUTION?

THE creation of man according to the story in Genesis is placed by chronologists at about 4004 B.C. The acceptance of this date or indeed of any variation from it that has been suggested carries the imperative implication that all existing types of man—white, yellow, red, brown and black—Englishman, Japanese, Malay and Negrito—have all descended from Adam and Eve. It matters not what anthropological characters may be assumed for Adam and Eve, the diversity of their supposed progeny illustrates what the biologist means by evolution. The Biblical story with its logical implications stamps every believer in it as an evolutionist. However, no serious scientific man will admit for a moment that human evolution has proceeded as rapidly as the story in Genesis necessarily supports. Viewed from the evolutionist's standpoint, the theory involved in the Biblical story makes Darwin's ideas seem exceedingly conservative. Really Mr. Bryan ought to attack Darwin as a hide-bound reactionary whose notions regarding the slow rate of modification in species seriously challenges the truth of evolution as taught by the Bible.

CHARLES V. PIPER

SCIENTIFIC BOOKS

A History of the Whale Fisheries, from the Basque Fisheries of the Tenth Century to the Hunting of the Finner Whale at the Present Date. By J. T. Jenkins, D.Sc., Ph.D. London, H. F. and G. Witherby, 326 High Holborn, W. C., 1921. 336 pages, with reproductions from photographs and old engravings.

In the preface to this book, the author tells us that no attempt has hitherto been made to give within a brief compass a detailed history of the whale fisheries: to the best of our knowledge and belief, this statement is in the main correct and the volume under consideration may be looked upon as an effort to remedy this lack of information. Parts of the story have, it is true, been told, and told very well, particularly that relating to the United States, and these Mr. Jenkins has passed over somewhat lightly, devoting much time and care to bringing together and making available for the reader who knows only English the story of the early days of the fishery and especially the important part played by the Dutch who, having practically dispossessed the English, for more than a century successfully prosecuted the chase of the whale about Spitzbergen or, as it was constantly called, Greenland. At the height of this fishery, the decade from 1680-89, nearly 2,000 vessels sailed to Spitzbergen—1,966, to be exact—and the catch of whales was 9,487, but from that time, with certain spurts, the industry gradually declined, coming to an end about 1800.

Mr. Jenkins has been at great pains to give us the details of this whaling, the size of the vessels—often much larger than the average American whaler of the fifties—their crews, equipment, even provisions and the manner of capture and trying out. All of this is interesting and important, to most of us it is new, and for this information we are most grateful. In one detailed list of equipment is noted "150 hogsheads of cidar and four tunnes of wines, eight kintals of bacon and six hogsheads of beefe," proportions that might have met with the approval of Falstaff.

One point is surprising—the comparatively small number of whales taken per vessel, the average being about three and seldom as many as five. To give an idea of the intensive, not to say destructive, methods of modern whaling, it may be noted that the day's catch of a steam whaler is often as great as the season's catch of these early days.

There were, however, some exceptionally "fat" years when the number ran up to ten or twenty whales per vessel, which possibly means better weather and better ice conditions.

The English in their first attempts did little better and it is small wonder that later on the Americans attained preeminence in their field, though they in turn failed sadly to realize the possibilities of modern steam whaling and the industry fell into the hands of the Norwegians. As practically the same weapons and methods were used by the Americans as by their predecessors and competitors, it would seem as if this success might justly be ascribed to the greater energy in the pursuit of whales.

The Americans seem to have had an inborn contempt for the use of any gun harpoon, for while it was employed by the English as early as 1780 in the capture of the Bowhead, it was never adopted by the Americans and it took a visit to South Georgia to convince the modern New Bedford whalers that the Norwegian whaling methods were really any improvement over their own. For that matter, even the English did not adopt their own gun harpoon until well along in the nineteenth century.

The English and Dutch did not have an entirely happy time owing to troubles with one another and with the French, and if a whaler secured a cargo of oil, it was by no means certain that he would reach home with it. In those days the line between privateering and piracy was none too sharply drawn and often the only rule followed was

> That they should take who have the power,
> And they should keep who can.

Spanish and French, Dutch and English, with some participation by Danes and Germans, Americans and Norwegians, each in turn led in the whale fishery and each has played, or is playing, an important part in the slaughter of the whale, and Mr. Jenkins tells us of them all.

The book opens with a chapter on Whales and their Classification, their habits and haunts, which is followed by one on the Economics of Whaling, including under this head the methods employed, utilization of products and the possibility of conservation. In discussing the measures that have been proposed or taken to preserve the whales, Mr. Jenkins seems inclined to give some credence to the argument of the whalers that the industry will in a way regulate itself, that long before whales can be exterminated, their capture—on account of lessened numbers—will cease to be profitable. This, as shown by experience in other "fisheries" and even by the collapse of Newfoundland whaling after a few years of prosperity, is a fallacy, as is the statement made in connection with the Natal whaling, and often used with all manner of statistics, that there is a tendency for the whales to abandon the coast altogether. Altogether is quite correct; as in the case of seals and walruses, the abandonment is due to the fact that the whales have been killed off and put beyond all hope of return. To illustrate, it may be said that Right Whales were formerly common off the eastern end of Long Island but that during the past decade only two have been seen and these fortunately escaped.

While steel and the automobile have temporarily stayed the extermination of the Bowhead since his "bone" is no longer in demand for whips and corsets, the species increases but slowly at the best and some new demand may blot the species out of existence.

So we subscribe most heartily to a previous statement, on page 47, that "in no case has the cessation of whaling taken place sufficiently soon to render possible the recovery of the whales to any appreciable extent."

About the only real protection that has been given whales is the prohibition, by the Norwegian government, of whaling in some localities and the establishment of close seasons in others. This has been done in response to the protests of fishermen whose reasons are set forth in the Last Phase of Whaling.

There is an occasional little slip here and there, as where it is said a superior kind of oil was found in the head of the Sperm Whale, which might lead a careless reader to think that this was the sole source of Sperm Oil, even though in dealing with the Sperm Whale fishery it is apparent that this is not the case. Another statement capable of misinterpretation is that the "entire Arctic fleet was destroyed by pack ice in 1871," which happily was not the case, as, while 34 ships were crushed in the ice, seven vessels were left which brought home the crews without the loss of a single life.

In the very useful bibliography, we miss, among some others, any reference to Starbuck's "History of the American Whale Fishery" with its wealth of information and detailed lists of vessels and their catch. That the "Speckshioner" and his duties are not defined nor his title mentioned in the index is possibly a personal grievance due to "satiable curiosity" aroused by Kipling.

But these are trivial matters; destructive criticism is the easiest thing in the world, and to point out all the good things in the book would be to write another. Jenkins' "History of the Whale Fishery" is simply indispensable to any one interested in the subject of whaling, and in these days, when information in regard to the early days of the industry is eagerly sought for, and paintings, models and relics of the old whale ships bring surprisingly large prices, this book should be most welcome.

F. A. Lucas
American Museum of Natural History

SPECIAL ARTICLES

BACTERIAL PUSTULE OF SOY BEAN

Ever since 1904[1] there have been scattering references in phytopathological literature to a bacterial leaf spot or bacterial blight of soy bean, due, it was assumed, to *Bacterium phaseoli* Erw. Sm., but there has been no publication of any experimental proof of this theory. In 1917 Johnson and Coerper[2] published a note on a bacterial blight of soy bean caused by a white organism which in a later paper by Miss Coerper[3] was named *Bact. glycineum*. Since then Wolf[4, 5] and Shunk[5] have described a bacterial leaf spot caused by an organism which the former has named *Bacterium sojæ*, but which is very similar to if not identical with *Bact. glycineum* Coerper.

Since the publication of these papers there have been an increasing number of references in the literature, including the reports of the plant disease survey of the U. S. Department of Agriculture, to "bacterial blight" or "bacterial leaf spot" of soy bean without any mention of the causal organism, due to the assumption, presumably, that there is but one disease and that due to *Bact. glycineum* Coerper.

In 1917 the writer isolated from soy bean leaves from Texas a yellow organism very closely resembling *Bact. phaseoli* Erw. Sm. With pure culture inoculation with this organism infection has been repeatedly produced both on soy beans and several varieties of garden beans belonging to the genus *Phaseolus*. From these artificial infections the same yellow organism has been re-isolated and with it infections have been produced on sound plants. The infections on *Phaseolus* when made in favorable circumstances are not to be distinguished from those caused by *Bact. phaseoli* isolated from *Phaseolus*, but, except under very abnormal conditions to be described in a paper in preparation, no infections have ever been obtained on soy-bean with the latter organism, although repeated attempts have been made. Furthermore, there are certain internal markings very commonly though not universally present in the colonies of the soy-bean strain of the organism which have been observed in only two colonies of the many thousands isolated from *Phaseolus*. The markings

[1] Smith, Erwin F.: "Bacterial Leaf-spot Diseases," Science, N. S., XIX, No. 480, pp. 416-418, 1904.

[2] Johnson, A. G., and Coerper, Florence M.: "A Bacterial Blight of Soy Bean" (abstract), *Phytopathology*, VII, 65, 1917.

[3] Coerper, Florence M.: "Bacterial Blight of Soy Bean," *Jour. Agr. Res.*, XVIII, No. 4, pp. 179-193, 1919.

[4] Wolf, F. A.: "Bacterial Blight of Soy Bean," *Phytopathology*, X, No. 3, pp. 119-132, 1920.

[5] Shunk, I. V., and Wolf, F. A.: "Further Studies on Bacterial Blight of Soy Bean," *Phytopathology*, XI, No. 1, pp. 18-24, 1921.

have the appearance of central convolutions. They are wholly internal, the surface of the colony being smooth. Illustrations will be published in a later paper. The markings might be described in brief as a mottled, wrinkled (convolute) central area fading to a homogeneous margin, appearing in five to seven days and visible for one to two weeks. In view of these facts the writer, rightly or wrongly, has decided to name the soy bean organism *Bact. phaseoli* var. *sojense.*

The writer has never seen the *Bact. glycineum* blight in the field, but, judging from Miss Coerper's description and illustrations and her own greenhouse experiments the two diseases very closely resemble each other in the later stages. In the early stages, however, they are quite different, *Bact. glycineum* causing a water-soaking, a phenomenon never observed in the disease under consideration. *Bacterium phaseoli* var. *sojense* does, however, produce water-soaking in *Phaseolus.* Another difference—only noticeable in young infections is a slight raising of the center of the infected area in the case of infection with *Bact. phaseoli* var. *sojense,* hence the name "pustule." This raised portion may occur on one or both sides of the leaf and rarely, if ever, exceeds 1 mm. in diameter. It ultimately collapses or is sloughed off. Microscopic examination of these pustules shows both hypertrophy and hyperplasia. In the later stages the disease is characterized by angular reddish brown spots on the leaves, varying in size from tiny inconspicuous specks to large irregular brown areas involving a considerable portion of the leaf. Frequently the leaves have a ragged appearance due to the dropping out of portions of the large spots. A conspicuous though not universal accompaniment of this disease is a pronounced yellowing. The writer believes that in this stage only the isolation of the parasite could make possible a correct diagnosis of the disease, and it is in the hope of avoiding further confusion that this preliminary note is published. A paper covering the results of work since 1917 is in preparation. This disease occurs from Washington southward.

Florence Hedges
U. S. Department of Agriculture

THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

DIVISION OF DYE CHEMISTRY

William J. Hale, chairman
R. Norris Shreve, *Chemistry*

The preparation of phenylglycine-o-carboxylic acid. I. From anthranilic acid and monochloracetic acid: Herbert L. Haller. A study of the preparation of phenylglycine-o-carboxylic acid from anthranilic acid and monochloracetic acid has been undertaken. Optimum conditions have been determined for (1) concentration in water of the reacting substances, (2) time allowed for reaction, (3) ratio of reacting materials, (4) condensing agent, and (5) temperature of reaction mixture.

On the preparation of 7-7′ Di (α-hydroxyisopropyl) indigo: Max Phillips. Starting with p-cymene obtained from "sulphite turpentine" and using a modified procedure of the Heumann phenylglycine-o-carboxylic acid synthesis of indigo, a new indigoid dye has been prepared. The method used consists in first nitrating p-cymene, then oxidizing the nitro cymene to o-nitro p-hydroxyisopropyl benzoic acid; reducing this to o-amino p-hydroxyisopropyl benzoic acid; condensing the latter with monochloracetic acid to hydroxyisopropyl phenylglycine-o-carboxylic acid and finally fusing with potassium hydroxide. This new dye has a similar absorption spectrum to that of indigo and has quite similar dyeing properties.

A new method for the preparation of dicyanine and related dyes (By title): S. Palkin.

The necessity for reclassification and standardization of dyes: C. R. DeLong and W. R. Watson.

The influence of sulphur on colors of azo dyes: W. R. Waldron and E. Emmet Reid. Some 30 different bases containing sulfur in a variety of positions and associated with various alkyl and aryl radicals have been prepared, diazotized and coupled with representative dye intermediates to form dyes so as to show the influence of sulfur groups in various positions on the color. Bases having sulfur in the sulfide and sulfone condition have been compared with the sulfur-free bases, and it has been found that the sulfide sulfur is bathochromic while the sulfone group is usually hypsochromic.

Experiments with dehydrothio-p-toluidine and related compounds: Marston Taylor Bogert and Martin Meyer. When dehydrothio-p-toluidine is subjected to Skraup reaction, it yields the corresponding benzothiazolyl quinoline. The Atophan reaction was unsuccessful. Attempts to prepare dehydrothio-p-toluidine by fusion of nitro-toluene or of p-nitrobenzal-p-toluidine with sulfur gave very poor yields of the product sought. 2-p-tolyl-benzothiazole was prepared by the Jacobsen method from thio-p-tolanilide and some of its derivatives investigated.

Uses of p. toluenesulfonyl chlorine in the manufacture of dyes and intermediates: JULES BEBIE. p. Toluenesulfonyl chloride is a by-product in the manufacture of saccharin. A great amount of chemical work has been devoted to the utilization of this material and one of its derivatives, chloraminte-T, is generally known as an excellent germicide. Other derivatives have found application in the dye industry. The p. toluenesulfonyl chloride itself can be used in various ways in the manufacture of dyes and intermediates, particularly as a component or a part of a component for the production of various classes of azo dyes and in the combination with azo dyes containing hydroxyl groups with the purpose of making the resulting dyes fast for alkali and soap.

The method of determining the class to which each dye belongs: ANDREW J. LEDDY.

The function of assistants used in dyeing cotton: ANDREW J. LEDDY.

The application of the direct dyes in coloring paper: WALTER C. HOLMES.

The functions of the dye testing laboratory: R. E. ROSE.

The analysis of B. naphthylamine: HENRY R. LEE and D. O. JONES. Methods are presented for the analysis of B. naphthylamine in the presence of its common impurities, namely, B. naphthol, a-naphthylamine and B B dinaphthylamine. By sulfonation of B. naphthylamine the nitrate titration can be applied in the presence of B. naphthol. A separation of D. naphthylamine from B. naphthol and B B dinaphthylamine is made by precipitation of the former as the hydrochloride from benzol solution. The hydrochloride is dissolved in water and titrated with N/2 nitrite at 0-5° C. The benzol solution is evaporated to dryness and the B. naphthol determined by titration with diazo p-nitro-benzene. The Kjeldahl Gunning method has been modified by sulfonation of the sample with 25 per cent. oleum in the cold and the use of a glass wool plug in the neck of the flask during digestion. B. naphthylamine, a-naphthylamine, B. naphthol and B B dinaphthylamine were prepared in the pure state and some of their physical constants determined. Melting point curves are given for B. naphthylamine with each of these impurities up to 10 per cent.

DIVISION OF BIOLOGICAL CHEMISTRY

Howard B. Lewis, *chairman*

J. S. Hughes, *secretary*

Higher alcohols formed in the fermentation of sugar: J. C. SWENARTON and E. EMMET REID. Crude fusel oil, from the large scale fermentation of molasses with pure culture yeast, contains substances boiling above isoamyl alcohol even up to 270°. A quantity of the high boiling portion has been repeatedly fractioned in vacuum and the alcohol part of each fraction extracted by treatment with phthalic anhydride. The alcohols obtained by saponification of the mono-alkyl phthalates boil up to 110° at 8 mm. and vary in density at 25° from 0.8007 to 0.9067. Some are optically active. They are being studied further with the hope of identifying the individual alcohols. The non-alcohol portions of the fractions boil up to 155° at 10 mm. and have densities at 25° from 0.80 to 0.90. Some are optically active.

The toxic constituent of greasewood (Sarcobatus vermiculatus): JAMES F. COUCH. Greasewood is an important forage plant for sheep on the winter ranges in the west. It is common in the semi-arid alkali valleys of the far western states, and, while it is extensively grazed, it has been found by Marsh, Clawson and Couch to be poisonous. Chemical examination of the edible portions of the plant showed that they contain a large proportion of oxalic acid and unusually large amounts of sodium and potassium salts. Toxic alkaloids, glucosides and saponins were absent, and it was shown by experiments upon sheep that the poisoning is due to sodium and potassium oxalates. The leaves of the plant contain the largest proportion both of ash and of oxalic acid; in the stems most of the oxalic acid is combined as calcium oxalate.

Influence of breeding upon oil and protein content of cotton seed: C. L. HARE.

The iodine absorption of urine: JACK MONTGOMERY.

Influence of sodium chloride upon animal excretion: E. R. MILLER.

Further experiments on the isolation of vitamin: ATHERTON SEIDELL. The method as now used for the preparation of highly active vitamin fractions consists in heating fresh brewer's yeast mixed with water to about 90° C.; adsorbing the vitamin present in the filtered solution by means of English fuller's earth; extracting this latter with saturated barium hydroxide solution; and concentrating the extract, after acidifying with sulfuric acid and filtering, by rapid vacuum distillation. More detailed experiments on the precipitation of the vitamin in these concentrated extracts by means of silver salts have shown that approximately one third of the solids present unite with the silver salts to form insoluble silver compounds. About one half of the total vitamin, as determined by feeding experiments on pigeons, is present in these insoluble silver precipitates and the other half remains in the filtrate. This unexpectedly large unprecipitable fraction of the vitamin raises the suspicion that the portion accompanying the silver precipitates may not be in chemical combination but simply held by adsorption. Further studies of the silver precipitates and filtrates are in progress.

Cow's milk versus goat's milk as a source of the antiscorbutic vitamin: C. H. HUNT and A. R. WINTER. Four weeks before the experiment started two cows and three goats were placed on the same ration, consisting of equal parts of a grain mixture and alfalfa hay. Forty-four guinea pigs were divided into eleven lots of four each and were given a weighed daily amount of a basal ration consisting of rolled oats 69 parts, autoclaved alfalfa flour 25 parts, casein 5 parts and NaCl 1 part. All of the pigs received, with the exception of the control lot, in addition to the basal diet, a measured amount of milk each day; one half of the lots receiving cow's milk and the other half goat's milk. The amount of milk fed varied from 10-50 cc in increments of 10 cc. The control lot died of scurvy in 26-30 days. The pigs receiving 10 cc. of cow's milk survived from 42-53 days, while the survival period of those receiving 10 cc goat's milk was from 60-103 days. Up to a period of 90 days one death from scurvy occurred among the lot receiving 20 cc. cow's milk, while no deaths from scurvy occurred among the pigs receiving 20 cc. goat's milk. There was a decline in weight of both lots receiving 20 cc. milk, but the decline was greater with those receiving cow's milk than with those receiving goat's milk. When the amount of milk fed daily was increased to 30 cc. or more no difference was noted between cow's and goat's milk as a source of the antiscorbutic vitamin (C).

Results obtained by feeding breeding gilts a ration low in vitamin: J. S. HUGHES and H. B. WINCHESTER. Breeding gilts receiving a feed low in vitamin A and C developed no abnormalities during the first ten months. At this time they developed the eye trouble common to rats, rabbits, dogs and other experimental animals, and in addition to this they developed a nervous disorder manifested by a general incoordination accompanied by frequent convulsions. Two of the eight did not breed, two died during the latter part of the gestation period, two aborted a few days before they died, one farrowed dead pigs and the last one went fourteen days longer than the normal gestation period. Gilts receiving 5 per cent. alfalfa as a source of their vitamin A showed no abnormalities. Five per cent. alfalfa did not furnish sufficient vitamin for normal reproduction, as 28 per cent. of the pigs farrowed by these sows were dead.

Influence of the vitamin content of a feed on immunity to roup: J. S. HUGHES, L. D. BUSHNELL and L. F. PAYNE. Chickens receiving a feed low in vitamin were much more susceptible to roup than those receiving a similar feed high in vitamins. Four pens, of twelve chickens each, received feeds varying in their vitamin content. One chicken from the pen receiving a feed high in vitamins, eight from the pen receiving a feed low in the fat-soluble vitamin, seven from the pen receiving a feed low in the water-soluble vitamin and nine from the pen receiving a feed low in both fat and water-soluble vitamin, died with clinical symptoms of roup or a disease similar to roup. All chickens were exposed to the roup infection by keeping infected chickens in the pens.

The detection and estimation of inorganic activators in commercial rennin and pepsin preparations: HARPER F. ZOLLER. An activator-free pepsin or rennin solution coagulates dialyzed milk with great difficulty at the optimum temperature (41° C.) for rennin action. The presence of calcium or magnesium ions accelerates the enzyme action and gives the coagulum its normal physical consistency. The differential between the rate of coagulation in dialyzed milk and in undialyzed milk furnishes a factor, which when compared with a similar factor obtained from activator-free enzyme solution under the same set of conditions, furnishes a means of roughly estimating the quantity of activator or accelerator present.

A laboratory disinfectant solution to displace mercuric chloride: HARPER F. ZOLLER. Sodium hypochloride solution furnishes a means of providing an efficient, economical and safe sterilizing agent for use in biological laboratories. In the preparation of the solution it is essential to maintain a sufficiently high hydroxyl ion concentration for maximum stability—about p_H 10.5. Solution containing about 0.15 per cent. available chlorine (0.32 per cent. sodium hypochlorite) will destroy the most persistent of micro-organisms within ten minutes.

The decomposition of food by bacillus botulinus: I. K. PHELPS and J. E. BASCH.

The feeding of non-ketogenic odd-carbon fats *to diabetic patients:* MAX KAHN. It is prohibitive to feed diabetic patients who have a very low carbohydrate tolerance even a moderate amount of natural fat because of the danger of inducting a severe ketosis which may prove fatal. It was found that synthetic non-ketogenic odd-carbon fats could be fed in large quantities to such persons without inducing any acidosis, and that the nutrition of such individuals was improved. A study is now being made of the intermediate metabolism of these fats and their effect on all types of diabetic and normal individuals.

A new source of santonin: ARNO VIEHOEVER and RUTH G. CAPEN. As a result of a survey of American plants it is evident that santonin can be obtained from *Artemisia mexicana* and *Artemisia neo-mexicana,* which grow wild in Mexico, New Mexico and neighboring states. The survey thus far made comprises 17 species and plant material obtained from 30 different sources. The santonin isolated was identified by the form and refractive indexes of the crystals, the melting point, furfural reaction and the formation of santonin periodide. Though no quantitative data are as yet on hand, the manufacture of santonin, now quoted at $150 per pound, from domestic sources appears a distinct possibility. (Contribution from the Pharmacognosy Laboratory, Bureau of Chemistry, Department of Agriculture).

A new method for the colorimetric determination of Peroxidase: VICTOR E. LEVINE. The leuco base of malachite green is used as the reagent. In the presence of peroxidase this compound turns emerald green on the addition of a small quantity of hydrogen peroxide. Proteins of the enzyme extract are coagulated by chloroform, which also dissolves out the green dye. On centrifuging the mixture separates into a green chloroform layer on the bottom and a colorless layer on top. Between these two layers is a zone of coagulated protein. The chloroform solution is separated from the other layer and is made up to volume. The removal of the proteins renders the extract clear for colorimetric examination. The standard is a solution of malachite green in chloroform. It must be made up fresh as it has a tendency to deteriorate on standing.

A simple method for differentiating boiled or pasteurized milk from unboiled or unpasteurized milk; Selenium compounds as biochemical reagents: VICTOR E. LEVINE.

The catalytic properties of the metals occurring in respiratory pigments: VICTOR E. LEVINE and ARTHUR C. ANTONY.

DIVISION OF SUGAR CHEMISTRY
S. J. Osborn, *chairman*
Frederick Bates, *secretary*

The moisture absorptive power of different sugars and carbohydrates: C. A. BROWNE. Comparisons were made of the water absorptive power of anhydrous dextrose, levulose, rhamnose, sucrose, maltose, lactose, raffinose, starch, cellulose, mannite, invert sugar, honey, molasses, malt syrup, commercial glucose and agar under different conditions of atmospheric humidity. The substances of greatest absorptive power at end of one hour exposure (at 20° C., 60 per cent. rel. humidity) were starch (1.04 per cent), cellulose (0.89 per cent.), agar (0.88 per cent.), and of least absorptive power dextrose (0.07 per cent.), mannite (0.06 per cent.), sucrose (0.04 per cent.). At the end of nine days' exposure the substances of greatest absorptive power were agar (20.34 per cent.), starch (12.98 per cent.), raffinose (12.90 per cent.), and of least absorptive power dextrose (0.07 per cent.), mannite (0.05 per cent.), sucrose (0.03 per cent). At the end of 25 days' exposure at 20° C. and 100 per cent. humidity the substances of highest absorptive power were invert sugar (76.58 per cent.), honey (74.10 per cent.), levulose (73.39 per cent.), and of lowest absorptive power cellulose (12.57 per cent.), lactose (1.38 per cent.), mannite (0.42 per cent.). The presence of levulose increases water absorptive power, but the latter is not proportional to the levulose content. The absorptive power of the substances was lowest in February and highest in July and August. The natural fluctuation noted from some substances were: levulose, 11.19-36.31; invert sugar, 11.81-34.73; agar, 21.00-30.74; starch, 12.29-18.41; cellulose, 5.06-10.89; maltose, 5.46-9.37; mannite, 0.22-0.52. The general tendency of sugars is to absorb moisture up to the amount necessary to form a stable hydrate form.

Sugar purity determinations: W. D. HORNE. Great numbers of sugar purity determinations having to be made daily for chemical control of sugar factories and refineries, a very rapid and accurate method has been evolved, by means of special appliances. A Brix spindle containing a complete temperature correction scale gives a correct Brix for any density and temperature. Defecation with "dry lead" is practically instantaneous and more accurate than by the use of lead solution. From the Brix and the polarization thus obtained, one finds the purity on a table of purities printed on a long paper mounted on movable rolls easily exposing the desired portion.

Plastometer tests on alkaline thin boiling corn starches: C. E. G. Porst and M. Moskowitz. Corn starches of various fluidities ranging from ten to fifty (as determined by the Corn Products Refining Company's funnel method) were prepared having alkalinities varying between acid to phenolphthalein up to .12 per cent. alkali. The pastes from these starches were then tested on the plastometer. Results show that the paste from starches which were just about neutral to phenolphthalein were firmer than those that reacted acid. As the alkalinity of the starch increased, the pastes became smoother and more elastic. Methods for preparing the pastes were standardized and made uniform. Two concentrations of starch pastes were used in the tests. Curves were plotted in the regular manner, and also on logarithmic paper. The equation for the flow in cubic centimeters per second in terms of a function of the pressure was determined from the logarithmic curve.

The determination of gums in sugar products: H. T. Ruff and J. R. Withrow. The various analytical methods proposed for gum determination in sugar products were studied and compared for the purpose of determining the method best adapted for control work. Some proposed methods compared with each other on solutions of pure gums in water or refined sugar solutions, but were not comparable on customary sugar products. The method of precipitating the gums with ethyl alcohol acidified with hydrochloric acid was found to be the most suitable and was further studied to determine concentrations of alcohol and acid. While we have no claim to originality in method adopted, the technique is original and is definitely expressed to make results obtained rapid aud reliable. It was found with certain precautions denatured or wood alcohol could substitute for ethyl alcohol. Curves are plotted to show the influence of concentration of alcohol and acid.

The determination of the p_H value of commercial glucose as a substitute for the candy test: O. A. Sjostrom.

Some notes on the determination of reducing sugars: B. B. Ross.

An improved precision refractometer for the sugar industry: Warren P. Valentine. This paper contains a short reference to the development of the refractometer aud its increasing application in the sugar industry; errors and approximations in the present sugar tables and the consequent demand for highly standardized data; the construction and test by the Bureau of Standards on a special refractometer, and the final development of an instrument to utilize new sugar tables now in process by the Bureau of Standards.

The observance of mutarotation in the polarization of raw cane sugar: M. H. Wiley and C. A. Browne. In the polarization of two deteriorated sugars from the Cuban crop of 1921, the direct polarization immediately after solution decreased at the end of three hours in one instance from 90.85 to 90.15 and in another instance from 90.15 to 89.50. The sugars had undergone considerable inversion during storage from the attack of micro-organisms, and the mutarotation is probably due to the very perceptible drying out of the sugar in the bags and the separation of the high rotating modification of dextrose in the sirupy films which cover the crystals of sucrose.

Note on the color range of cane sirups and molasses: F. W. Zerban. Dr. Zerban reported an interesting series of color measurements on cane syrups made according to the Bureau of Standards method with two simplifications, both of which are objectionable—the use of Kieselguhr to obtain an optically pure filtrate and the use of the Hess-Ives instrument with white light. The color values showed a general correlation with the purity.

Manufacture of plantation standard granulated sugar with and without activated char: C. E. Coates. An outline is given of the various methods for making standard granulated sugar in the sugar house, including: Its manufacture direct from the cane without the use of char, using sulfitation or carbonation of the juice; the non-chemical process using heat and Kieselguhr, the clear juice being given immediately a char filtration; making carbonated or sulfited syrup, which syrup is subjected directly by a char filtration; the manufacture of 96 test sugar as usual aud immediately remelting aud treating the melted sugars with char. Much improvement has been made during the last few years, both in quality of product and in yield.

The decolorizing power of bone char (preliminary report): Paul M. Horton. It has been claimed by Patterson that the decolorizing power of boneblack is due to a nitrogenous base which can be extracted by concentrated sulfuric acid. Patterson's experiments have been repeated, the results leading to the conclusion that the nitrogenous base mentioned has no special decolorizing power, and that the decolorizing power of boneblack must be due to other causes. The extract was made with both warm and cold sulfuric acid and the acid removed by dialysis, leaving the acid-free base in a form suitable for testing its decolorizing power.

Color and ash absorption by boneblack and decolorizing carbons: W. D. Horne. While a number of very good decolorizing carbons have been developed, they generally lack the power to absorb ash, which is of great importance in sugar refining. Experiments show that it is the mineral frame-work in boneblack which absorbs most of the ash taken up by boneblack. Calculation shows that a carbon deficient in ash absorbing power could scarcely compete economically with boneblack in refining. Encouraging results in ash as well as color absorption were had with an artificial boneblack formed by the fixation of carbon on a porous earthy substratum. The attention of investigators is invited in this direction.

Control of reaction in sugar house (and refinery) liquors: J. F. Brewster and W. G. Raines, Jr. No matter what clarifying agent was used, in the clarification of cane juice, there always was obtained upon concentration to sirup a precipitate changing in quantity and composition according to the cleanness of the cane and the method of clarification.

The precipitate formed in sugar house sirups: J. F. Brewster and W. G. Raines, Jr.

Modifications in the use and application of the Hess-Ives tint photometer: H. H. Peters and F. P. Phelps. In addition to the Hess-Ives color plate, various Wratten light filters were used in connection with white light. It is pointed out that special lamps (for instance, a mercury vapor lamp in place of white light) may advantageously be employed with special light filters in place of the Hess-Ives three fundamental colors (red, green and blue), for instance, mercury yellow, green and violet. One then obtains scale readings (per cent. transmittancy), which, interpreted as negative logarithms, refer to definite wave-lengths instead of to broad spectral bands. The color values of the Hess-Ives plate and of several Wratten filters are plotted as transmittancies and luminosities, which were also given for Stammer standard color plates, Stammer's ulmine solution and various sugar products. Their absorption graphs are given also. The authors use the subject of tint photometric analysis as introduction to their spectrophotometric investigations. In three of the papers given so far, the chemical aspect of color analysis was discussed, while here the optical aspect is treated in detail. Hundreds of quantitative spectrophotometric analyses of sugar products have proven conclusively that the absorption and transmittancy in the blue end of the spectrum is of paramount importance.

Color values of high grade sugars: W. B. Newkirk and H. H. Peters. The absorption and transmittancies of 204 high class sugars were determined for yellow, green and violet mercury light, using a Stammer colorimeter which had been modified in such a manner that it was practically a spectrophotometer. The Stammer color plate was entirely dispensed with, and a rotating sector disc used in its place. The average results of various classes of sugars are plotted in various ways.

A laboratory vacuum still: E. P. Clark. A laboratory vacuum still is described which is of a simple type of construction and is compact and easily dismantled. The capacity is quite large (12 liters), concentration taking place in glass. An ordinary laboratory water pump furnishes sufficient vacuum.

Preparation of adonitol: R. S. Black. Crystalline adonitol is prepared by extracting adonis vernalis plants with hot water, defecating the expressed liquid by first adding aluminum sulfate solution followed by an excess of slacked lime until precipitation is complete. The yellow precipitate is removed by fitering upon a suction filter. Concentrate the filtrate in vacuum to a thin sirup when basic lead acetate is added, filter, remove the excess lead, concentrate to a sirup and add alcohol. At this point a little phosphoric acid added to the alcoholic solution throws out more impurities and aids in the subsequent crystallization. The alcoholic solution is evaporated to a thick sirup and taken up in an equal volume of 95 per cent. alcohol, is seeded and is allowed to crystallize. Recrystallize from 95 per cent. alcohol.

DIVISION OF INDUSTRIAL AND ENGINEERING CHEMISTRY

W. K. Lewis, *chairman*

E. M. Billings, *acting secretary*

Symposium on Distillation

W. A. Peters, Jr., chairman

Efficiency and capacity of fractionating columns: W. A. Peters, Jr. The efficiency of plate columns and columns filled with spheres and cylinders of various sizes was measured by comparing the performance of each with the calculated performance of a theoretically perfect column. The capacity of the different types of columns was determined by measuring the maximum possible heat input or vapor velocity through the column when various materials were being separated. Both efficiency and capacity were found to vary widely with the type and size of filling and with the materials being separated. From the data determined, it is possible to figure the size and cost of a fractionating column of any type for almost any work. Moreover, it is possible to set up in the laboratory a small column which will duplicate the performance of any plant sized column. Thus, a fractionating problem can be worked out in laboratory apparatus and from the laboratory data a plant sized column can be designed.

The plate efficiency of a continuous alcohol still: Clark S. Robinson. Three tests on a continuous alcohol still under varying conditions indicated average plate efficiency of from 24 per cent. to 56 per cent.

The simple distillation of hydrocarbon mixtures: W. K. Lewis and Clark S. Robinson. It is possible to predict the simple (Engler) distillation curve (boiling temperature plotted against percentage distilled over), for mixtures of two or more components which follow Raoult's Law approximately. This is of great importance in the petroleum industry and in the recovery of the benzene homologues from the destructive distillation of coal. The application to binary mixtures is simple, but when applied to complex mixtures, the problem must be solved graphically. The Engler curve is calculated for benzene-toluene mixtures and is compared with the experimental curve.

Benzol purification: S. S. Heide. The custom has been as outlined in making C. P. products to make separate crude cuts of light oil, such as 90 per cent. benzol, 90 per cent. toluol and crude light solvents and treating these separately with sulfuric acid. With this procedure the benzol fraction is somewhat difficult to wash down to proper color test, due to nature of acid sludge produced by action of sulfuric acid. The toluol fraction gives no trouble, good clean separation being obtained. One point brought out is that C. P. benzol will have lower color test than sample taken from agitator subsequent to acid treatment. Just the reverse is true in operation using 90 per cent. crude benzol fraction.

Wood turpentine: C. A. Lambert. A brief outline of the factory method for the manufacture of steam distilled wood turpentine, the approximate composition and the physical chemical characteristics of the turpentine and of the heavier fractions of the turpentine known as pine oil.

The calculation of the heats of vaporization of various liquids, first by means of the Hindebrandt function; second, from vapor pressure curves: W. K. Lewis and H. C. Weber... This is a short article dealing with an original method of using the molal entropy of vaporization of liquids for determining their heats of vaporization of various vapor compositions, together with a method for determining heats of vaporization from vapor pressure curves.

Present practice of dynamite and chemically pure glycerine distillation: J. W. Bodman. It is shown that the most recent glycerine distillation plants use the principle of double effect evaporation in that the superheated water vapors used as a distilling agent for the glycerine receive superheat from the latent heat of condensation of the glycerine distilled. While the apparatus illustrated and described for distilling dynamite glycerine has thus far been used in the comparatively restricted field of glycerine distillation, the same principle is well adapted for use in connection with any liquids which show a tendency to partially decompose when distilled directly or alone at normal pressure.

Turpentine distillation: McGarvey Cline.

Carburetor adjustment by gas analysis: A. C. Fieldner and G. W. Jones. Road tests on motor vehicles has shown that approximately 30 per cent. of the heat value of the gasoline is lost due to incomplete combustion products in the exhaust gas. At least 50 per cent. of this loss can be saved by proper carburetor adjustment. Curves are given showing how the CO_2 per cent. in the exhaust gas bears a direct relation to the mileage and completeness of combustion from the gasoline used. Tests are given showing proper method of sampling exhaust gases and procedure for adjusting a carburetor on the road. A portable CO_2 indicator for adjusting carburetor is described and examples given showing increase in mileage obtained with increase in the CO_2 percentage in the exhaust gas.

Investigations of whitewashes and aqueous lime paints: G. J. Fink. Results are given on the development of whitewashes and aqueous lime paints which involved exposure tests of 175 formulas. The effects of a large number of ingredients in various combinations are shown and conclusions given regarding the relative merits of the various formulas. Of the siccatives used those as casein forming insoluble films with lime proved best, while those which are water soluble as glues are not so satisfactory for exteriors. Several alkaline salts were used for accelerating the solution of casein, trisodium phosphate proving most satisfactory. Among the addition agents used with lime in mixtures containing no definite siccative alum and table salt were effective on improving the workability and permanence of the whitewashes. Several formulas developed and tested are shown to be superior to most of those in common use.

Can we afford to make potash in America? R. NORRIS SHREVE. Broad economics regarding the manufacture of potassium salts in America and from American raw materials are considered. Cost of materials, labor and freight is discussed and the value of various by-products cheapening the cost of the primary material is treated. Is it worth America's while to pay the cost necessary to finish the development of the potash industry? Past, present and probably future costs to farmers and chemical industry for their potash are described. It will be money in the pockets of American potash consumers to build their own industry here, but the potash industry should be developed regardless of cost for it is necessary to safeguard food and clothing of the country.

Discontinuous extraction processes: L. F. HAWLEY. This paper is a study of Turrentine's extraction process[1] according to the theory of discontinuous extraction formerly developed.[2] By using Turrentine's data in the mathematical theory of the process it is shown that the incomplete extraction is due to the fact that complete solution of the potassium chloride was not obtained in the first treatment of the raw material. The other conditions of extraction were so efficient that the final recovery was only slightly less than the theoretically perfect recovery with the solvent ratio and number of treatments employed in the process.

The classification of coal: S. W. PARR. The use of ratios between certain constituents as an index of coal types shows that the value of a ratio depends upon the freedom of the factors employed from adventitious material, or material not essential in producing the type characteristics to be indicated, and shows that the use of analytical factors in the construction of a system of classification based on ratios is limited, for the ratios do not differentiate with respect to variables inherent in the actual coal substance as oxygen. This factor is significant as between different types, and its effect should be given a place in any system indicating type distinction. Such a factor may enter into the scheme of classification by using heat values referred to the unit or pure coal substance. Accuracy of the values derived from the author's unit coal formula are shown.

[1] *Jour. Ind. and Eng. Chem.*, *13*, 605 (1921).

[2] Discontinuous Extraction Processes, *9*, 866 (1917).

A comparison of the standard gas furnace and micropyrometer methods for determining the fusibility of coal ash: A. C. FIELDNER, W. A. SELVIG and W. L. PARKER. The micropyrometer method for determining coal ash fusibility is quicker than the gas furnace method and better for the operator. Coal ashes fusing under 2,600° F. by the gas furnace method can usually be checked within 100° F. by the micropyrometer method if fused in a reducing atmosphere of combustion gases similar to that employed in the gas furnace method. Very refractory ashes, fusing above 2,800° F. as determined by the gas furnace method, tend to give considerably lower results by the micropyrometer method. The two methods can not therefore be considered as strictly alternate methods for all ashes. The great majority of coal ashes from American coals, however, fuse below 2,800° F. in the gas furnace.

The calorific value of American woods: S. W. PARR and C. N. DAVIDSON. There are no well authenticated values published in the literature for the calorific value of American woods, and the published values for foreign woods are unreliable. The values of the time of Berthier and Winkler are about 50 per cent. of those reported by Gottlieb, yet no basis of fair comparison is possible because of the lack of definite information as to the presence of moisture. The paper reports on a detailed study of the moisture factor in order to base calorific values upon the moisture-free material. The heat values were determined by means of a calorimeter, adiabatic in type, using a bomb with platinum lining.

The shatter and friability tests for metallurgical coke: S. P. KINNEY and G. ST. J. PERROTT. A discussion of testing methods, reproducibility of results, and their interpretation. A large amount of test data obtained at the Southern Experiment Station of the Bureau of Mines is used as the basis of the discussion. A comparison of results of the machine and bag shatter test procedure, an improved method of conducting the bag shatter test, the effect of size of coke on absolute and relative results obtained by the friability or "hardness" test, and the effect of other modifications of the standard procedure are given.

Determination of true specific gravity of coke: Harold J. Rose. Methods published, and in actual use, for the determination of the true specific gravity of coke, include important variations in practically every detail of the test. The writer presents data which shows that discrepancies of many per cent. may be obtained by the use of various wetting liquids. A distinct increase of the true specific gravity figure was found as the fineness of the sample was increased. The paper shows the need for a uniform method for making this determination.

Smokeless fuel for Salt Lake City: G. St. J. Perrott and H. W. Clark. A consideration of the practicability of by-product coking of Utah coals for supplying smokeless fuel to domestic consumers of Salt Lake City. A summary is included of smoke abatement work carried out in Salt Lake City since 1919 and of experiments by the Bureau of Mines in determining the coking properties and by-product yields of Utah coals at low temperatures.

The ultimate analysis of coal by utilization of sodium peroxide fusions: S. W. Parr. All heat developed in combustion comes from the sulfur, carbon and hydrogen present. The amount of the first two constituents being known, their heat value can be calculated and subtracted from the total heat determined by the calorimeter. The remaining heat comes from the available hydrogen whose percentage is equal to the remaining heat divided by 34,450, the accepted value for hydrogen. The formulas are given in the complete paper which is to be published later. The total carbon factor is obtained from a fusion with sodium peroxide and the carbon discharged as CO_2, which is measured. From this the weight of carbon present is derived.

The value of brands to buyers: W. D. Collins. Materials often have been purchased by trade name at higher prices than when purchased on specifications. A pure merchandise law regulating dealings in all kinds of merchandise in the way the food business is regulated by the pure food law has been suggested. The tendency to standardization and adoption of uniform specifications has been marked during the past ten years, but drawing up acceptable specifications and standards of products involves much work and time. Specifications failing to insure proper quality or demanding unnecessarily high standards as to raise the cost out of proportion to the benefits received may be adopted. For a long time small buyers will benefit by securing material by brand than specification.

Acetone, butanol and ethanol in gas from the butyric fermentation of corn: Arthur L. Davis. Gases produced during fermentation of corn by anerobic, spore-forming bacteria (*B. granulabacter pectinovorum*) carry with them considerable quantities of solvents since the temperature of operation is from 39° to 40° C. The enriched gases are passed through activated carbon to remove all condensible material. The carbon is then distilled with cresol and the distillated freed of cresol by agitation with sodium hydroxide solution with subsequent distillation. The volume of total solvents was found by removing water from a definite volume of the aqueous solution with potassium carbonate. The acetone content is determined by the Messinger method. There is no known manner of conveniently separating the butanol and ethanol when only small quantities of a mixture containing them is available.

Crystallization in transparent soap: A. F. Thal. Three types of spots in transparent soap are described. Two are crystalline with evidently the same chemical composition but differing in crystalline structure. The first type consists of a large mass of small needles which are interspersed with soap. These are obtained in an impure state by extracting the soap with boiling alcohol. The second type are compact, hard, glass-like crystals which can be removed mechanically. These consist of two mols of sugar combined with one mol of sodium carbonate probably in the form of a double compound. The third type is amorphous soap which has separated from solution on slow cooling.

The control of industrial processes by light sensitive means: Lloyd Logan. A proposed method of automatically controlling chemical and other industrial processes is described and its possible field of application outlined. This method includes the use of light-sensitive cells to detect, through changes in the optical character of the substance undergoing treatment, deviations from the desired constitution of the product and, by suitable relays and valves, to correct the character of the product. Among the properties of the final and intermediate products, variations in which may be used to alter the illumination of the photoelectric cell sufficiently to operate the control, are color, *e. g.*, on addition of a chemical indicator, absorptive power for white or mixed light, index of refraction, power of scattering light, specific rotatory power, reflective power, or intensity of light emitted at a given temperature.

Charles L. Parsons,
Secretary.

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CONTENTS

A GRADUATE SCHOOL OF GEOGRAPHY[1]

A CASTLE IN THE AIR

IN spite of a wide-spread prejudice against building castles in the air, I propose this afternoon to consider a construction of that kind; for if castles are not to be built in the air, where in the world are they to be built; surely not underground or in the water! All the castles I have ever seen were built in the air; their foundations were in the ground, of course, but the castles themselves were in the air. My proposal therefore needs no defense.

In view of the good number of castles already built, some of them very high in the air, even on mountain tops, for occupation by the defendants of various sciences, it is gratifying to learn that plans are advancing for the erection here in Worcester of a castle of the particular kind in which my own interest is most excited, a geographical castle. But it is on the other hand regrettable to find that the proposal to erect a castle, a stronghold, dedicated to geography alone seems, even in intellectual circles, to need explanation if not justification; so little is the vast and varied content of geography understood, so imperfectly is the great opportunity for original research in geography appreciated, so halting is the recognition of the importance that the results of such research will have in the conservation and consecration of the wide spaces of the earth to the better advantage of mankind. Let us try to rise to a realization of the geographical opportunity before us.

THE EPOCH OF GEOGRAPHICAL DESCRIPTION

We must remember that the geographical epoch, in which the first discovery of the gen-

[1] An address at the annual commencement of Clark University, Worcester, Mass., on June 12, 1922.

eral outline of the lands and waters over the world was made, is now closed. The work that remains for the coming geographical epoch is not the discovery but the description of the earth's features; and their description can be properly prepared only by professional geographers, unlike in disposition and training to the bold pathfinders who made the first entry into remote and unknown regions. Moreover, the labor involved in the future preparation of such descriptions will be enormously greater than that already expended in the epoch of discovery. I fear that few persons have any idea of how much geographical work remains to be done or of the amount of labor demanded in doing it. Let me tell you that even most of our own states, for example, Tennessee or Montana, familiar by name to all of us and well known locally in an empirical way to many of their inhabitants, have not yet been described with professional thoroness. There are absolutely no treatises, not even handbooks in which the regional geography of most of our states is set forth in a thoroly competent and comprehensive manner. How vastly ignorant then must we be of South America, Africa and Asia! The geography of the world is really yet to be written, and in preparation for that writing the world must be explored all over again, not by mere travellers, but by geographical experts. In order to carry on the re-exploration of the world and give adequate opportunity for the preparation of the many scholarly volumes in which a competent description of the re-explored world shall be contained, many institutions in all parts of the world must cooperate; and one of those institutions should be the geographical stronghold which we hope to see erected here.

The Essential Objects of a Geographical Stronghold

What is the essential object of such a stronghold? In the first place, the object of a geographical stronghold may be most advantageously reached if it is built up over a well planned lower story in which introductory collegiate instruction shall be offered in geography and other undergraduate subjects; but in the stronghold itself the object should be primarily geographical research and only secondarily geographical teaching. Let me at once make clear and insist upon this main reason for the construction of a geographical stronghold. It should not be planned primarily to provide either introductory or utilitarian instruction, altho such instruction should not be altogether excluded from it. The main reason for the construction and maintenance of the stronghold should be to *add geographical contributions to the sum of human knowledge,* without regard to what is called their practical value. Immediate usefulness, direct application of the knowledge gained should not be made a prime requisite in an institution of research; and particularly not in a geographical stronghold, because the higher branches of geography are as yet so little developed. The essential tasks of a geographical stronghold will therefore not be the imparting of geographical knowledge so that it may be imparted again elsewhere, as in teaching; or so that it may be applied elsewhere, as in geographical engineering—I will explain later what geographical engineering is. If the work be mainly of that utilitarian nature, the stronghold will be, from the point of view which I wish to insist upon, largely a failure.

The first duty of a geographical stronghold—or, to use its proper name, of a Graduate School of Geography—must be geographical research; and until such research has advanced well beyond its present limits the acquisition and not the dissemination of geographical knowledge must be the main object in view; the dissemination of the acquired knowledge will follow as a secondary duty. It may be well urged for many years to come that, even in the case of graduate students, the best way to prepare them for the higher reaches of geographical science will not be to impart to them the geographical knowledge already gained; teaching of that kind is properly the task of a college. The correspondingly proper task of a professional graduate school is the cultivation of proficiency in the pursuit of new knowledge; and such proficiency is best acquired not by direct instruction in formal lecture courses, but by placing those who wish to acquire it in close association with others who, already proficient, are using their proficiency in research.

Research the Best Preparation for High-Grade Practical Work

Geography is not peculiar in that respect. I have it on good authority that even in chemistry, a science of enormous practical importance, the best training for a chemical engineer is not alone the study of those chemical processes which are already known to have practical value, but the investigation of new processes without regard to their application; and this for the good reason that the essential thing for the really proficient chemical engineer is not simply to know this or that treatment of a problem which has already been solved, but to know how best to attack and solve new problems. Knowledge of that sort comes best by attacking and trying to solve new problems, under the guidance of experts who are themselves chiefly engaged in solving new problems. So with the development of a really proficient geographer. It will not be enough to teach him a certain share of what is already known about geography; he must learn how to find out more than is already known; and the very best way for him to do that is to spend a few years in an institution primarily devoted to geographical research.

A Staff of Nine Professors of Geography

Of what should such an institution consist? I have thus far described it as a castle, a stronghold; but I hardly need say that the most important elements of such a stronghold are not walls but men; geographers. They must of course have rooms to work in; and I hope that the Graduate School of Geography in Clark University will eventually occupy a large building, planned for and devoted to research; but the essential thing is the men. A strong staff of full professorial rank will be needed. There should be at least one professor for each grand division or continent, hence five in all; it would be much better to have two for each of the less known continents, South America, Africa and Asia, or eight professors in all; and another should be added for Australia, Polynesia and the oceans, thus making nine in all. Those nine geographers, or five if nine cannot be secured, would constitute the central and permanent staff of the institution. There should be a good number of others temporarily or peripherally attached, as I will explain later; and all of these should be in addition to and independent of the geographical staff for undergraduate instruction in the college.

If you suggest that one or two geographers for a continent is a lavish provision, I must insist that it is a small provision. For each geographer must be responsible for the regional description of a large area, and that means that he must know the form of its surface, its climate, its more important vegetable and animal occupants, its human inhabitants, its political subdivisions, its products and industries, and its transportation and trade. And all these subjects must be known, not as made up of isolated items unrelated to each other, but as correlated items all in their natural and interdependent juxtaposition, thus constituting the landscapes and manifesting the activities of the region. To know so much as that about a continent is no small responsibility. But in addition to this continental responsibility in regional geography, each member of the staff should be a specialist in the subject of one of the eight larger systematic divisions of geography—land and water forms, climate, plant geography, animal geography, human geography, economic geography, historical geography, and history of geography; the difference between the regional and the systematic aspects of geography being this: In each division or special subject of systematic geography, such as land and water forms, climate, and the rest, all the classes of facts treated under that subject should be studied in whatever part of the world their examples are found; while in each large division of regional geography, such as North America or Africa, all kinds of facts to whatever special subject of systematic geography they belong must be studied in their natural associations. Surely when the work to be done in a geographical stronghold is thus envisaged a permanent staff of nine men will not seem too large.

Regional Geography the Culmination of Geographical Science

Let me make it clear why I lay so much emphasis on regional geography in contrast to systematic geography. However important the different divisions of systematic geography are, they yield only a discontinuous sort of knowledge. Under the division of land forms we may study about volcanoes, and learn as much as possible about all of them wherever they are; but the items of knowledge that we thus gain compel us to leap about all over the world in order to locate them. Similarly, we learn under human geography all about fishing villages wherever situated; but there again we must leap about to locate the items that we learn. On the other hand, the study of regional geography gives us a continuous or areal sort of knowledge. If we study the regional geography of Japan, for example, we shall learn not only the distribution of its many volcanoes and its many fishing villages, but of all its other geographical features; and it is this continuous or areal knowledge that is usually and properly implied when we speak of geography in a general way. The study of the various divisions of systematic geography has, indeed, its chief value as a preparation for the study of regional geography; hence no one should consider himself a geographer until he has become expert in the regional geography of at least one large area, preferably a continent. Moreover, not until such expertness is gained is a geographer's knowledge likely to be of practical application in such a profession as geographical engineering. A thoro representation of regional geography is therefore essential in a well developed Graduate School of Geography.

Research by Exploration

How will these nine geographers do their work? First and foremost, each one of them will be expected to take part from time to time in the actual exploration of the continent for which he is responsible, or in the investigation of his special subject in systematic geography; and between times he must make himself acquainted with the work of other explorers of his continent, and of other investigators in his special systematic subject. His own exploratory work, in which he should be accompanied by one or more advanced students, will require absence from Worcester for periods of half a year or a year every three, four or five years; and the digestion and publication of the results of his exploration will require, after he returns home, at least twice as much time as he spent in the field. The rest of his time at home should be given to the study of explorations and investigations by others, so that each one of the nine professors shall become a recognized center of absorption and radiation of regional and special knowledge. On this plan, two professors would ordinarily be absent every year; three or four others would be engrossed in preparing for publication the material they secured in the field during their absence one or two years before; and each of the remaining three or four professors would be very busy in reviewing and assimilating the work of other geographers in various parts of the world, as far as it referred to matters for which he is responsible. If under these conditions any professor finds that he has some free time left over, he might give it to the preparation and delivery of set courses of lectures.

Curators and Material Equipment

You may have noticed that, apart from the staff of nine professors, nothing has yet been said about the rest of the School's establishment. While I still maintain that the essential feature of the School must be its corps of research professors, there are also other features of equipment which the professors will say are essential, even if I do not.

There must be in the first place a comprehensive library of geography and allied subjects in charge of a scholarly librarian; not simply a man who will put books back in their places on the shelves, but a man well versed in geographical literature, an active collaborator with the professors in keeping the library up to date in all its departments, and perhaps having so great an interest in geographical production as to serve as editor of the School's publications. There must be in the second place a complete collection of modern, large-scale topographical and hydrographical maps of all countries which publish such maps, and this collection should be in charge of a cartographer; not a mere draftsman, but an experienced craftsman with a real understanding of the outdoor things that maps represent and a dextrous hand for the construction of such new maps as are needed in the School work; instruction in so much of surveying and map making as young geographers need might be given by this member of the staff. In the third place there should be a large and growing collection of models, in charge of a trained and skilful model-maker; not a mere artificer but a geographer of artistic capacity and outdoor experience, competent to design and construct truthfully expressive models himself. There should be in the fourth place an extensive and ever-growing collection of geographical photographs, not in charge of a mere photographer, but of a geographer competent to make scientific selection of characteristic views for the illustration of geographical subjects and regions. And in the fifth place there should be a comprehensive collection of the products of all countries in charge of an experienced economic geographer, unless the School proposes to depend for such material on the great Commercial Museum in Philadelphia. The material equipment of a graduate school of geography is therefore a somewhat formidable matter. It must be vigorously looked after.

A Central Bureau for Geographical Illustrations

Let me say a few words more about the collections of geographical photographs and models, in order to explain the manner in which such collections may be made useful not only in Clark University, but all over the country wherever geography has recognition. Every college where geography is taught needs a collection of lantern slides for the illustration of its lectures. At present each professor of geography in all those colleges has to build up his own collection as best he can; as a result such collections are very uneven and imperfect. There is no central bureau where well selected sets of lantern slides for the illustration of special subjects or of special regions can be obtained. What a boon it would be for professors of geography in every part of the United States if the Graduate School of Geography at Clark University would undertake to form a standard collection of photographs and lantern slides; not a finished collection, but a constantly growing collection, from which one could order, for example, an elementary set of 10 slides or an advanced set of 50 slides for the illustration of the physical geography of coasts; or an elementary set of 15 slides or an advanced set of 100 slides for the illustration of the regional geography of Colorado. A great amount of correspondence and travel, of reading and study would be required before such a collection was well developed; but when it came to be known that the sets made up from the collection were composed of pictures critically selected by a competent geographer, so that they would really accomplish their purpose, all geographical eyes would be often turned to Clark.

A Series of Geographical Models

A similarly beneficient work could be done by establishing a standard collection of geographical models, from which duplicates could be had at the cost of casting and coloring, without charge for the making. Like the lantern slides, these might illustrate both systematic and regional subjects. Thus there might be a set of five models to exhibit the successive changes of a volcanic mountain from its youth of eruptive construction to its old age of erosional degradation, and so on for other physical features. Similarly there might be models representing certain striking features of different countries. These, on account of their expense, would be less often sold to colleges than to museums where they would attract much attention; but the systematic series would surely become popular as well as serviceable in the geographical laboratories of colleges; for such models may serve not only in illustration of type forms, but as the basis for very disciplinary exercises in landscape description, a phase of geographical instruction which is too generally neglected. Such instruction may be advisedly begun in field excursions, where it can be grounded on the direct observation of nature; but the variety of landscape on which advantageous exercise may be had will be greatly extended if field excursions are supplemented by models. But I must turn away from this attractive topic, and consider again the Graduate School itself.

An Encouraging Analogy from Astronomy

If we now return to consider the work of the research professor, perhaps you will ask: Is it really worth while to study the world in so much detail as has been thus far implied. Let me answer that question by a celestial analogy. The astronomical observatory maintained on Mt. Wilson in Southern California by the Carnegie Institution of Washington—this being a shining example of one of those lofty mountain-top castles already alluded to—has a corps of high-grade astronomers devoting all their time and abilities to the study of the sun and the stars. They have nothing whatever to do with teaching. They never stop to ask whether their discoveries will have practical application or not. But first informing themselves thoroly in all branches of astronomy as well as in the allied sciences of mathematics and physics, they perseveringly catalog and chart the stars, large and small, as so many facts of occurrence; they measure their brightness with the photometer and they analyze their composition with the spectroscope; and, marvellous to say, by combining spectrum and brightness they determine the distance of stars that are so immensely far away that they have no measurable parallax! They give the most ingenious and penetrating study to the distribution and movement of stars in space. They determine with great accuracy the periods of revolution of what are known as spectroscopic doubles, the two components of which cannot be separated even by the most powerful telescopes. Can you conceive of anything more utterly useless? And yet the world applauds their work.

The spirit of devotion to research which characterizes the staff of an astronomical observatory is the spirit which should dominate and guide the staff of a Graduate School of Geography. For if it be praiseworthy to spend years, without the least regard to what is vainly called "utility," on the construction of catalogs and classifications of stars, most of which are invisible to the naked eye and inconceivably distant from our solar system, shall it not be praiseworthy also to spend years in the study of every geographical feature in every part of the world, without the least regard to whether the study leads to utility or not? The facts of one science are of the heavens, heavenly; those of the other are of the earth, earthy. But who shall say that a ninth magnitude star in such and such a part of the sky is a more worthy object of study than a ridge or a ravine in such and such a part of the earth? The star may be very large, but it is far away; the ridge or ravine may be very small, but it is near at hand. The study of the earth, our own earth, is surely deserving of all the time and skill we can give to it. And even if, among various other geographical strongholds, the one here to be established eventually gains its quota of nine professors of geography, there will be abundant work for all to do for years and years to come. Indeed, it is highly probable that, what with the ever-growing demands of science, the scope of the work to be done in geography will be expanded about as fast as the advance of the work goes on.

The Standardization of Geography

But even as geography is now conceived, do not imagine that the staff of nine professors will find their progress to be all clear sailing, as if their courses were already charted and their duties specified. That is by no means the case. One of the most important parts of their work will be its standardization, both as to content and as to method, concerning which many problematic matters, now unsolved or imperfectly solved, must be carried to a conclusion. Let us examine first those touching the content of geography.

How shall the description of land forms be treated so as to distinguish that special division of geography from its relative in geology? How much physical meteorology shall be included in climatology? What facts concerning the plants and animals of a region shall be treated in a truly geographical essay, so that it shall not duplicate sections of botanical and zoological essays? How shall the essential factors of economic and of historical geography be treated so that they shall have a quality of their own, and not be merely selections from economics and history? All these questions must be examined and answered before the geographer can assure himself that all phases of geography, systematic as well as regional, are not merely restatements of parts of other subjects. He must see to it that all his own statements are essentially geographical statements, and of a kind that other subjects do not directly duplicate. Not that the establishment of sharp limits between the contents of neighboring sciences is desirable, nor that trespassing upon a neighboring science is in itself undesirable; but that when a geographer has so serious a responsibility placed upon him as the regional description of a large area of the earth's surface, he is more likely to meet it if it does not dissipate his time and energy and thought upon subjects for which he is not responsible.

While I am speaking of this matter, let me add that a geographer should resent the implication made by those who argue that the interest or importance of certain non-geographical matters is reason enough for their introduction into geographical essays. To accept that argument is a confession that the truly geographical elements in geographical essays are of so little importance and interest that such essays need the stimulation of irrelevant matters. That is not true. Geography needs no padding, no seasoning by items and scraps of other subjects. It is, like them, sufficient unto itself. Did you ever hear of an astronomer or a geometer or a physicist or a botanist who thought that his science needed to be spiced up by any other in order to attract attention? Never! All kinds of subjects must be studied, and studied for themselves in this studious world; and geography is one of them. Let geography therefore be pursued as earnestly, as devotedly, as wholeheartedly and as single-mindedly as any other subject; and let it accept cheerfully and contentedly the place that it can win on its own merits in the constellation of the sciences.

The Limits of Geography

It is however certainly a curious thing that geography still needs the development and definition of its content in the manner that I have just intimated. One might almost call it a moron among the sciences, for altho it is very old in years it has not yet come into the full possession of its senses. It is a part of the duty of trained professional geographers to arouse and awaken their science, both by defining and by limiting its content, especially in its regional aspect which is the culmination of geography. The solution of this task is largely a question of the point of view; and the essential point of view for a geographer is one from which he can clearly see the actual constitution of a region as it exists in the "today" of human history. Let it be remembered that, as already noted, the geography of a region of the earth must include its land and water forms, its climate, its more significant plants and animals, its human inhabitants, its political divisions, its products and industries, and its trade and transportation; and that all these elements must be conceived in their actual special relations, as they exist together and interact upon one another. Regional geography is therefore an immensely complex subject, even if all non-geographical elements are excluded from it; all the more wisely therefore should a geographer hold only to truly geographical elements, as above intimated.

Indeed, even when properly limited, regional geography is so complex that some critics assert it cannot be successfully mastered and treated by one man. There is no question that it can not successfully be treated by a geographically uninformed, untrained, undisciplined man; or by a trained man who gives part of his attention to other sciences; and it may perhaps be true that it cannot be so well treated by one informed, trained and disciplined geographer working alone as by several informed, trained and disciplined geographers each responsible for a part of the total subject and all working together in a team. No decision need be made on that question now, because the problem has never been given study long enough and serious enough to answer it. My own belief however is that such a staff of professional geographers as I have indicated will, after a score of years or more, reach such a measure of success in their tasks as to show that one-man regional descriptions are of great value. But if that judgment be wrong, and if one-man geography be insufficient, the remedy is simple enough; geographical exploration must then be done by pairs of geographers, or trios, or quartettes or groups working together, each member supplementing the work of his associates. Whatever the decision is on this point matters very little today; the essential thing is that the work must be done, and done in the best way possible. So much then for the content of geography. Now for its method.

The Art of Geographical Description

The staff of a Graduate School of Geography will have to take their share not only in defining and cultivating a scientific method of geographical investigation; they must also develop an artful method of geographical description. While a geographer is in the field, the subject of his investigation and his method of attacking it will occupy his mind. When he returns home the statement of his results in form for their communication to others will occupy his mind. In both occasions his mind will be fully occupied, however great its capacity. The science of investigation is somewhat technical; I can not discuss it here; but the art of presentation may be briefly considered. Many results of exploration may be best presented on maps; some results may be presented in photographs, sketches and diagrams; some in models and some in statistical tables; but the great body of results is best presented in words. Now while the geographical facts coexist simultaneously in their regions, they can not be presented simultaneously in a report upon a region; a written report must present them consecutively, word after word, line after line, page after page. It may surprise you to learn, but I believe it to be true, that the future staff of geographers in the Clark Graduate School of Geography will have a very serious problem to solve before they can establish, even in general terms a standard method of presenting or reporting upon the results of their explorations.

By such a standard method I do not mean anything rigid and inflexible; but a method that will give the reader of a report true and vivid concept of the region described. For just as accuracy is the essential object in the science of investigation, so intelligibility is the essential object in the art of presentation, and one of these high qualities is about as difficult of acquisition as the other. It is unfortunately true that certain leading geographers are stronger in the possession of their science within themselves than in its presentation to others. It would almost seem, from their preference for possession and their indifference to the fine art of presentation, that they hold possession to be in geography, as it is in the law, nine points of the whole ten; but that is an unscholarly attitude. Of what avail is knowledge if it is not clearly set forth; of what value is an obscure presentation in which at least a part of the truth is lost. I trust that no professor or student of geography in Clark University will be indifferent in this matter; for accuracy in investigation and intelligibility in presentation are correlated essentials, and hence lack of intelligibility in presentation is too often an accompaniment of a sort of carelessness that is incompatible with accuracy in investigation.

Errors to be avoided

How is the art of geographical presentation to be acquired and communicated? Perhaps you may imagine that articles and reports of standard excellence in the presentation of problems in regional geography already abound, and that all that is needed is to adopt and copy their method; but such is by no means the case. In the first place a large number of articles and books commonly classed as geographical are chiefly narratives in which the narrator, often an untrained traveller, gives a leading position to his personal experiences, altho they are very subjective matters. Narrative presentation is certainly entertaining to the general reader, and it is not to be dispensed with; but it falls far short of satisfying the objective demands of scientific geography, just as the narrative of a plant collector would fall short of the demands of scientific botany.

In the second place many geographical articles and reports, altho they are presented in a descriptive instead of in a narrative form, nevertheless treat problems of less extent than those of full-fledged regional geography; they are useful contributions to the geographical science, but they fail to reach a complete regional treatment. In the third place, many articles that are in part regional are also in part analytical, in that they attempt to demonstrate an explanation for some fact or phenomenon that they describe; indeed, such articles are often largely geological, in that they turn attention away from the facts of today and direct it to the past conditions and processes by which the present-day facts have been brought about. Articles of this kind are indispensable to progress, but their analytical discussions should be completed before regional description is begun; their results should be standardized and systematized before they can be properly used in regional description; and when the results are employed in their standardized and systematized form, the analysis upon which the standardization and systematization are based should not be repeated. Explanatory description in a regional essay should be used without any analytical demonstration.

THE DIFFICULTY OF REGIONAL DESCRIPTION

Finally, when regional description is attempted, it is too often inexpert in that it fails in the prime object of such description; namely, to give a vivid account of all the geographical elements of a region in their natural and interdependent combinations. Some such articles are faulty in a way that shows clearly enough how uudeveloped the art of geographical presentation still is; for they leave their readers to work out, by the aid of such maps as they may possess, various details of location which the author himself ought to have made clear once for all, by map, diagram or otherwise. Many other such articles are faulty in attempting to define the location of physical features or boundaries in terms of the location of small towns or villages, the names of which are not only unknown to all readers, but undiscoverable even in good atlases! Very few such articles present at the outset a simple account of the whole region and of its subdivisions in such manner that, whenever any local feature is later mentioned, it may be at once and very easily located in terms of the introductory account; and as a result geographical descriptions are often so obscure and difficult to follow that even geographers turn aside from them, discouraged. It is as if the investigator felt indifferent to the labor that his readers must undergo before they can learn what he has done, without realizing that such indifference costs him a loss of influence.

GEOGRAPHERS AND TRAVELLERS

One of the reasons for these various deficiencies in the present status of geography deserves explicit mention: it is that the authors of articles published in the geographical periodicals of the leading geographical societies of the world are in a regrettable number of instances, not trained and disciplined geographers, but simply intelligent and observant travelers. It would seem that such persons, on visiting and returning from a little travelled region, were thereupon popularly classed as geographers, whatever they were before their travels began; and this idea is given support by the character of the membership of many geographical societies, because such membership is made up largely of generously-minded persons who, whether they have travelled or not, are glad to support the work of the societies in which they are enrolled. That they should do so is most gratifying, but that they should be regarded as geographers because of so doing is disappointing.

To return to astronomy for an illustration, do you suppose that the Astronomical Society of America is made up of intelligent persons who like to look at the nocturnal sky and recognize the constellations, and of persons who, whether they like to look at the sky or not, have pleasure in contributing to the cost of publishing an astronomical journal? Not at all; that society is made up of qualified astronomers; no others need apply. But so far as I know only one of the many geographical societies in the world limits its members to geographers; and altho its requirements for membership are not severe and altho diligent search has been made to discover as many qualified members as possible, that society has not yet succeeded in discovering 200 persons fit to be members in its country of over 100,000,000 population.

Whatever the cause of the characteristic imperfections in regional presentation to-day, it is manifest that improvements can be made only by persistent conscious effort. A large share of the attention of research professors in a Graduate School of Geography must be directed to making that effort successful.

MEANS AND MEN

It is an easy matter to outline the constitution of a Graduate School of Geography, as I have just done. It is a more serious matter to establish such a school. Obstacles of two kinds stand in the way. Those of one kind are merely difficulties; those of the other kind are more serious, they are dangers. The difficulties are only those of finding means and men. Difficulties of that kind can be overcome in time if they are attacked energetically and persistently. Whether the means or the men will be the easier to secure I cannot say; but as to the men I believe that relatively few will be found ready made; they will have to be engaged in an immature stage and developed to maturity here and elsewhere. Of course some fully competent geographers will be brought here, ready at once to undertake research. But it is more probable that the staff will be built up gradually by the engagement and promotion of young men. A practical method to that end is to select a young man of promise and give him opportunity for growth by study and travel, during which he may specialize in one subject or another; then on his return he may be given an appointment for a term of years, and at the end of that term he may be given permanent appointment if his work has been such as to justify it. Gradual growth in some such way will I believe lead to better results than can be gained by the wholesale appointment of a full staff, even if that were possible from the financial side of the problem. In the mean time, instruction by visiting lecturers and by professors invited for a year from Europe will add to the attractiveness chiefly in the undergraduate department, of whatever regular instruction can be offered there; but neither visiting lecturers nor temporary professors from abroad can give the solidity and continuity of work that should characterize a properly constituted and truly American Graduate School of Geography. Hence if the proposed staff of nine research professors is established in 10 or 20 years, that will be doing well, remarkably well.

The Proper Standard for a Graduate School of Geography

The dangers to be met are more serious. They will arise chiefly from the pressure and urgency of students, of undergraduate rank geographically, whose needs, indeed, whose deficiencies, will tend to divert the professors of the Graduate School proper from their primary duty, research, to a secondary duty, teaching. I must here point out an essential difference between teaching and studying. In secondary schools, the teachers must do a great deal of teaching because the pupils are only just learning how to study. In colleges, the teaching by the professors and the studying by the students may about balance each other. In properly constituted graduate schools the properly prepared students should be expected to do most of their study by themselves; the duty of the graduate staff of professors is chiefly to set example and pace by doing their own research work, and to give occasional guidance to students working with them, but not to do set teaching.

Now the mere announcement that Clark University is going to establish a Graduate School of Geography will attract college graduates to come here. Some such graduates will be properly qualified by their previous studies to enter the Graduate School at once, but many of them will come from colleges where the undergraduate teaching of geography is so imperfectly developed that they will not be sufficiently grounded in the elements to enter upon truly advanced work. What shall be done with such students when they arrive here? Manifestly they should have more undergraduate instruction, but they will not like to be enrolled with undergraduates again. Yet if they are immediately admitted to the Graduate School of Geography, its standard as a school of research will be injuriously lowered.

I therefore suggest that the present graduate department of the university be continued without specification of subjects studied; and that graduates of other colleges on coming here should be enrolled in that graduate department until they have completed the requirements for admission to the Graduate School of Geography. But even so, the introductory teaching that they will need, as well as the introductory teaching needed by Clark undergraduates who propose to make geography their life work, will demand that a considerable body of undergraduate teaching in geography be offered here; and for that purpose three professors will be called for at the very least. The danger is that the research professors in the Graduate School of Geography will be drawn into this work. Naturally enough, undergraduate geography will be developed here before the Graduate

School of Geography is fully established; and with such a beginning it may be difficult to establish a Graduate School of the kind I have outlined. The college professors of geography will themselves wish to have some time for original studies; some of them will wish to give graduate instruction. And thus even if one or two research professors are added, a half-developed Graduate School of Geography may grow up, in which research is only incidental and secondary, and teaching of an undergraduate grade is the larger duty.

The very respectability of such an arrangement is ominous. It will be so good that a better arrangement, a real professional school of geography may be lost sight of; and yet a mixed school of that sort will only be "another" school of the mixed kind; and being attached to a small university instead of to a large one it will have no particular merits; it will not stand out with preeminence of its own. As I am only a commencement speaker and not a trustee, my duty goes no farther than to point out this threatening danger: it will be for others to provide safeguards against it. I may however note in passing that although a number of other universities have already reached the stage of offering geographical instruction in both their undergraduate and graduate departments, none of them thinks it worth while to segregate the graduate part of such instruction under so ambitious a name as a Graduate School of Geography; and I believe that they are quite right in not doing so because they do not propose, for the present at least, to provide opportunity for advanced work in geography so far in excess of that provided in other subjects as to warrant the announcement of a School of Geography. It is here that the opportunity for geography in Clark University is likely to be for a long time unique; because in this university geography is, if I understand the plans of the trustees correctly, to be given as great pre-eminence over other subjects of graduate study as possible. It can not reach great pre-eminence immediately, for as I have already pointed out it is not possible immediately to secure a staff of research professors. The unique feature of geographical opportunity at Clark is therefore the aim in view; namely, to establish a real Graduate School of Geography as soon as possible. The recent appointment of a geographer to the presidency of the university is evidence of the seriousness with which this aim is regarded by the trustees. They have my heartiest good wishes for their success, but it is evident that success can not be reached if the research professors in the Graduate School are distracted from their proper work by the necessity of giving undergraduate instruction.

Undergraduate Preparation for Graduate Work

There is a second danger about as serious as the first. Properly qualified members of a properly constituted Graduate School of Geography ought not only to have already acquired a good understanding of fundamental undergraduate courses in geography; they should also have acquired a good understanding of some one or two other subjects allied to those systematic divisions of geography in which they propose to specialize. The requisite undergraduate courses in geography itself should represent several of the chief systematic divisions of geographical science; for example, land and water forms, climatology, human geography, economic geography; and also one or two introductory courses in regional geography, for example, North America and some other continent. These taken together should constitute the equivalent of a whole year's undergraduate work at least. But in addition thereto, a student who proposes to specialize in one or another division of systematic geography should have made good undergraduate progress in some other subject closely allied to that division.

Thus one who specializes in human geography should have taken several undergraduate courses in the allied subject of history on one hand, or in anthropology and ethnology on the other. A student who proposes to specialize in economic geography should be well prepared in the allied subject of economics; and one who selects plant geography or animal geography for his special subject of preference, should be well grounded in the allied subject of botany or zoology; and so on. These allied subjects should occupy from half a year to a year of undergraduate study. Furthermore, a real facility in reading French and German, and, still more important, a trained capacity to write good English should be included among the results of undergraduate study. No student, of whatever college he may be a graduate, should be admitted to the Clark Graduate School of Geography if he falls seriously short in any of these undergraduate requirements. He may be admitted of course to the graduate department of the university, if he holds a bachelor's degree from any reputable collegiate institution; but so long as he has serious deficiencies in the undergraduate preparation for the graduate study of geography, he ought not to be admitted to the Clark Graduate School of Geography, or to any other such graduate school. For in just so far as a member of a professional graduate school uses his time there on undergraduate studies, he lowers the standing of the school; and any one who looks on the high standing of his school with pride should be jealous of all influences which tend to lower it.

The seriousness of this danger of unpreparedness and the importance of establishing safeguards against it ought to be manifest to any one who is familiar with the demoralizing influence exerted on a graduate student's work for a higher degree by the necessity of making up undergraduate deficiencies at the same time. Work for a higher degree should occupy a student's whole attention. If in his graduate years he is giving part of his time to undergraduate subjects, which he ought to have studied earlier, he is not only distracted thereby from his proper graduate work, but the graduate work which he does will be weakened by reason of not being based on a completed foundation. In a word, the student members of a professional graduate school ought to be well trained for the work that they have to do there; as such they would constitute a select body of which any institution must be proud.

The Difference between Studying and being taught

You may now understand better than before what was meant by my earlier insistence that teaching should not be a prime duty of the research professors in a true Graduate School of Geography; for the fact that they are not to teach does not imply that they are to have no students. Of course they are to have students, properly qualified graduate students; and the students are to study; but the professors are not to teach in the ordinary sense of the word. The students having reached that stage of their education when they have learned how to study and when they really wish to study, are to study chiefly by themselves on their special subjects. The professors are to propose problems for them, to advise and to guide them in the study of the problems, to hold conferences with them, but not to teach them. And with the conception of a body of professors devoted chiefly to research in the several departments of a single science and of a body of students devoted chiefly to study in different subdivisions of the same science, you may imagine the atmosphere by which a Graduate School should be enveloped. It is one of the most delightful, most inspiring atmospheres in which human beings can live.

The Preparation of Teachers of Geography

A practical question may however rise in your minds. If the requirements of a Graduate School of Geography are so high, is it likely that any students will wish to enter it? I can give several very confident answers to that question. In the first place, a candidate for the position of teacher in a secondary school ought not to be encouraged to enter it. He acquired during his undergraduate college years as much knowledge of the subjects which he is to teach as he will need; and moreover, inasmuch as a school teacher should be more interested in the boys and girls that he teaches than in the subjects which the boys and girls are to be taught, it is not necessary for him to carry preparatory studies to the point of becoming engrossed in research. In the second place, a candidate for the position of professor of geography in a college should without question be encouraged to enter such a Graduate School of Geography as I have outlined, and to stay there long enough to earn a master's degree at least and a doctor's degree if possible. College professors ought to be learned persons; and as a preparatory step toward becoming learned they ought to have breathed an atmosphere of learning for a year or two. To be sure, a candidate for a professorship in a college where the teaching of geography is combined with the teaching of another subject may make the other subject his first interest, and may not therefore feel justified in carrying his geographical preparation very far. But it is encouraging to see that geography is coming to be recognized in more and more of our colleges as a subject large enough and important enough to occupy the whole of a professor's time. Young men who have the ambition to be professors of geography in colleges of that grade should be urged to take a doctor's degree in geography; and to young men of that sort the Clark Graduate School of Geography should be powerfully attractive, if it is organized on the lines I have indicated.

Geographical Engineers

But there is an altogether different group of positions for which young men will be increasingly needed as the affairs of the world, now so disordered, return to a more normal condition, and as, in consequence of that return, international commerce comes to flourish again, particularly those branches of international commerce which have to do with the less known continents of South America, Africa and Asia. At that time, which we may hope will not be too long delayed, many of our larger commercial houses will find, as some of the most enterprising have already found, that they need much more information than is ordinarily available regarding the more distant parts of the world; and they will learn that it is profitable to secure that information from trained experts. In my opinion the experts who can best give that sort of information will be high grade geographers, who have specialized in economic geography as well as in the regional geography of one or another continent.

The Clark Graduate School of Geography ought to make a specialty of training such men: their specialty ought to be called geographical engineering, and those who become proficient in it ought to receive the degree of geographical engineer. Needless to add that training of that kind must be based on a broad and firm foundation of undergraduate studies in a well equipped college, and must be extended by continuing those studies in a thoroughgoing professional School of Geography; and the training will need one other element, namely, after the professional study is well advanced, a year of studious travel in the continent selected for special attention. For although the later work of a geographical engineer must be largely of so practical a nature as to satisfy the money-making demands of commerce, the preparation for that work can not be made by learning definite answers to set questions. The problems that the geographical engineer has to answer will be as a rule so novel, so individual, that his best training for them will be found first in the comprehensive acquisition of all the fundamental knowledge in his specialty, and second in the original study of novel and individual problems in the same specialty, that is, research in economic geography. Hence even for this most practical field of geographical science, experts will be best made ready by close association with older experts who are carrying on researches in the same field. Men who have received high-grade preparation of that kind will be sought for and prized.

The Clark School a Center of Geographical Activity

Can you not imagine the eagerness and earnestness with which the students in a Graduate School of Geography will pursue their studies? They will be proud of their association with a staff of research professors; they will be devoted to their science and delighted with the opportunity that the school affords of advancing themselves in it; they will be ambitious to become proficient in the science and to apply their proficiency to serious tasks in the actual world. Can you not understand also that the presence of such a Graduate School of Geography in Worcester, with its corps of expert professors, its well developed material equipment, its body of enthusiastic students and its exhilarating scholarly atmosphere, will attract intending and returning travelers to visit it, to stay near it for a time, and to establish more or less formal relations with it? An intending traveler may well spend several months under its influence while making preparations for his journey; a returning traveler may advisedly remain an entire year in its wholesome atmosphere while writing his account of an accomplished journey. Can you not see that the school will thus become a notable center of geographical activity if its development follow serious professional lines? It will inevitably become such a center, and it will thereby exert a greatly needed and most beneficent influence on the cultivation of scientific geography all over our country. That the beginning now made should have some such consummation is my devout wish. When that wish is realized, then wherever geography is seriously spoken of in America, the speaker and his hearers will find themselves thinking spontaneously of the Graduate School of Geography at Clark University.

William Morris Davis
Harvard University

THE RESEARCHES OF ALFRED GOLDSBOROUGH MAYOR

Alfred G. Mayor brought to research an unusual personality. He had an extraordinary artistic sense both for color and form; he had a training in physics and engineering in accordance with a parental desire; he had the brilliancy in conversation that made him an excellent companion on expeditions or after work hours; he had a capacity for meeting peoples of all kinds and conditions—whether in social events in cities or among the natives of the shore of Torres Straits; and he had an industry that outran his strength.

After graduating from Stevens Institute he went to Clark University as assistant to Professor Michelson, and then to the University of Kansas where he taught physics for parts of two years. While there he made biophysical studies on leaves, and published the results after going to Harvard. Mayor's artistic sense lured him to study animals. He had as a boy made the most beautiful paintings of butterflies of iridescent types which looked as though their wings had been pasted on the page. His first research at Harvard was on the development of the wing scales and their pigment in butterflies and moths (1896) and this was quickly followed by a contribution of 87 pages and 10 (for the most part colored) plates "On the color and pattern of moths and butterflies." These papers revealed three major interests of the author: (*a*) a fine artistic sense, with a special attraction toward color; (*b*) a tendency to make crucial experiments to test mooted points; and (*c*) a fondness for physical experimentation. Thus he used in these researches the spectroscope to study the pigments and a pendulum to determine the friction of wing scales on the air. In the latter experiment on butterflies the wings were studied with their scales on and also removed. The later paper stimulated Alfred R. Wallace to discuss it in *Nature*.

Five years later Mayor published further researches on Lepidoptera and analyzed the elements of their color patterns. He returned again to the Lepidoptera in 1906, when he published a paper with Miss Soule on some reactions of caterpillars and moths. He studied not only their reactions to light, food and gravity and their feeding habits but continued the studies he had begun six years earlier on mate selection. Wings of males were painted with scarlet or green ink; and males were variously maimed. Color made no difference with matings but the maimed males met more resistance than normals to copulation unless the female was blinded.

Mayor had not been long at the museum in Cambridge before his artistic work attracted the attention of Alexander Agassiz and led to an invitation to him to accompany Agassiz on his trip to the Bahamas in Mr. Forbes' yacht *Wild Duck* in 1893. This was the first of a series of voyages with Agassiz up to 1900; to the Great Barrier Reef of Australia in 1896; to the Fiji Islands in 1897-8; to the tropical Pacific on the *Albatross* in 1899-1900. On these voyages Mayor made drawings and observations on radiates—especially the Medusæ. These fascinated him as they did that other artist-naturalist, Haeckel. The outcome of these studies and those of later years appeared eventually in Mayor's "Medusæ of the World" and "Ctenophores of the Atlantic," published by the Carnegie Institution and illustrated by scores of plates drawn by his own hand and brush. To this period belonged his discovery of the "Atlantic Palolo" and his study on the Partulas of Tahiti.

In 1900 Mayor entered on a new phase of work. He was appointed curator of natural science at the new Brooklyn Museum and, in 1904, curator-in-chief. Here he devoted himself to arranging the rapidly increasing collections; and he also continued his studies on Lepidoptera and Medusæ. But museum work was too static for this experimental naturalist. He agitated the establishment of a marine laboratory at the Tortugas (Science, January 30, 1903) and found the American biologists strongly favored the plan. So it was natural that when the Carnegie Institution of Washington was casting about for the best projects to support it should adopt this and its principal sponsor, Dr. Mayor. In 1905 he published a book, "Sea Shore Life," of which he unselfishly turned the copyright over to the New York Zoological Society; just as he turned over the problem of the Partulas of Tahiti to Dr. H. E. Crampton; and just as he generously gave unsparingly of his time and ideas to others.

And now began a new era in Mayor's life. He erected in July, 1904, laboratory buildings at Loggerhead Key, Florida, and sailed thence from Maine to the Tortugas in the new 57-foot auxiliary ketch, the *Physalia*. Besides providing for the physical care and scientific needs of the zoologists that gathered at the laboratory, Mayor plunged into scientific work. In it he combined his special knowledge of jelly fishes with his fondness for physical and chemical experimentation and showed that rhythmical pulsation may be initiated and maintained independently of the nervous system. During the following seasons he made fundamental studies on the effect of different ions. Thus Mg is stupefying and the NaCl, K and Ca and sea water resist its stupefying effect; many ions have the opposite effect on muscles from that on cilia.

In 1909 the series of "Papers from the Tortugas Laboratory" began to appear, of which 15 large volumes have been published. It took a lot of pertinacious endeavor and much tact on the part of the director to secure a prompt publication of results.

In 1913-14 Mayor made an expedition to Thursday Islands and Murray Islands in Torres Straits, where studies were made on coral reefs, and where he found clear evidence of solution of limestone on the reefs. A summary of the first ten years of work of his department is given in Mayor's report in the *Yearbook* of the Institution for 1914.

Already it had begun to appear that the Tortugas must be abandoned as the permanent site of the laboratory, on account of its destructive hurricanes and its isolation; so Mayor visited numerous other islands to find a better site; also more studies were undertaken in the Pacific Ocean on coral reefs, especially at American Samoa. Later studies were made here upon the theory of coral reef building.

The war seriously interfered with Mayor's scientific work for a year or two—when he was giving much time to instructing naval recruits in navigation. Returning to Samoa in 1919 he demonstrated that the present living coral reefs are not superimposed upon ancient reefs but have simply grown outward from the shore slopes since post-glacial times. Mayor made observations and photographs of corals down to 8.5 fathoms by the use of a diving hood, and it was probably in connection with this trying experience that his resistance was weakened and that illness was started which resulted in his death.

Mayor's scientific influence is not confined to his personal researches; to his activity must be largely ascribed the results of Vaughan's studies on growth of corals, of Bartsch's on hybridization in Cerion, of Drew's on the origin of limestone deposits through bacterial action, of Harvey's on phosphorescent light; and many other researches. The hope may be expressed that since the department which Mayor founded has so amply justified itself the man and means will be found to continue it.

Chas. B. Davenport

A SCIENTIFIC EXPEDITION TO THE ISLANDS OFF THE WEST COAST OF LOWER CALIFORNIA

The most important expedition sent out by the California Academy of Sciences this year has sailed from San Diego for a two months' cruise among the islands off the west coast of Lower California. The expedition has been made possible through the cooperation of the Mexican government with a number of American institutions, including the California Academy of Sciences, the San Diego Museum of Natural History, the Scripps Institution for Biological Research, the National Geographic Society, and the Committee on Conservation of Marine Life of the Pacific of the Pacific Division of the American Association for the Advancement of Science, functioning under authority of the Committee on Pacific Investigations of the Division of Foreign Relations of the National Research Council.

The Committee on Conservation of Marine Life of the Pacific, of which Dr. Barton W. Evermann, director of the Museum of the California Academy of Sciences, is chairman, has for several months been planning this expedition, but not until recently were funds forthcoming to meet the expense. When the matter was placed before the Mexican government it very generously proposed not only to detail their fishery guard boat *Tecate* for the purpose, but also to accept as their guests the naturalists whom the American institutions desired to send on the expedition. The National Geographic Society, always alert to the possibilities of increasing geographic knowledge, became interested in the expedition and has liberally contributed to the fund for meeting the cost of the cruise. With such material aid from these two sources, the proposed expedition has become a reality.

The Mexican government is represented by Sr. Carlos Cuesta Terron, professor of herpetology and biology in the Museo Nacional de Historia Natural de Mexico; Sr. Jose Maria Gallegos, professor of mammalogy and botany in the same institution; Captain Victor Angulo of the *Tecate;* Sr. Jose Rubio, taxidermist; Sr. Gonzales, inspector of fisheries; and Sr. Rodolpho Lazcano, inspector of lighthouses. Professor Terron will be in general charge of the expedition.

The California Academy of Sciences is represented by Dr. G. Dallas Hanna, curator of paleontology and secretary of the Committee on Conservation of Marine Life of the Pacific; Joseph R. Slevin, assistant curator of herpetology, and Frank Tose, chief taxidermist.

The San Diego Museum of Natural History sends A. W. Anthony, curator of vertebrates, and Ernest Hinkley, assistant; and P. S. Barnhart represents the Scripps Institution for Biological Research.

Messrs. Hanna and Anthony will be in immediate charge of the scientific investigations.

The primary purpose of the expedition is to make investigations to determine as fully as may be the present abundance and condition of the southern fur seal, southern sea otter, and elephant seal in the localities visited. It is known that each of those three important and valuable marine mammals was at one time quite common not only about the islands off Lower California but also about the islands on the California coast as far north as the Farallons. Records believed trustworthy show that in the years 1808 to 1811, more than 203,000 fur seals were taken on the Farallon Islands, besides many thousands on the Channel Islands, Cedros, and other islands off the coast of Lower California. Records also show that the southern sea otter was at one time very abundant in the great kelp beds about these same islands, more than 22,000 having been taken prior to 1806. The elephant seal was once abundant on Guadalupe Island and on other islands on this coast.

It is generally believed that each of these interesting animals is now extinct or nearly so; but certain recent discoveries show that at least small remnants of each of the three species still exist. It is the purpose of this expedition to find out the facts in so far as is possible and place them before the State Departments of the United States and Mexican governments in the hope that the necessary steps may be taken by the two governments through an international treaty for the adequate protection of these valuable natural resources.

The scientists of this expedition will avail themselves of the exceptional opportunities for making a general survey of the fauna and flora and geology of the islands visited. They will be equipped for making collections in various branches of natural history, particularly in birds, mammals, reptiles, insects, shells, botany and fossils. These islands have been but little explored and it is believed that many new species will be discovered. Provision is made for taking photographs, both still and moving, adequate for illustrative and educational purposes.

Cooperation of Mexican and American scientists in an expedition of this kind is most gratifying and will do much toward increasing the friendly relations between the two countries and developing a mutual interest in the conservation of the natural resources of our coastal waters.

On Sunday morning, July 9, the expedition sailed from San Diego, with all the scientific staff on board, and with the American flag flying at the masthead and the beautiful Pabellón Mexicano flying gracefully aft.

SCIENTIFIC EVENTS

THE CHEMICAL FOUNDATION

(American Chemical Society News Service)

THE American Chemical Society, representing some 15,000 men and women working in educational institutions, research laboratories and industrial plants, is preparing to fight to the last ditch to preserve the American chemical industry.

Recent acts on the part of the government have made the necessity for such a fight apparent to this group. In the hope of placing a fair presentation of the views of American chemists before the president, Dr. Edgar F. Smith, former provost of the University of Pennsylvania and now president of the American Chemical Society, appointed a committee to serve with him. Their purpose in seeking a conference with President Harding was to lay before him briefly the far-reaching effects which the contemplated action against the Chemical Foundation will have upon chemistry in America. The committee also desired to have any facts which could properly be given to them in order to guide the society in its future actions. The committee with Dr. Smith as chairman is as follows:

Dr. J. E. Teeple, consulting chemist, New York, treasurer of the American Chemical Society.

Dr. R. H. McKee, head of the department of chemical engineering, Columbia University.

Dr. J. F. Norris, professor of organic chemistry, Massachusetts Institute of Technology, Cambridge, Mass.

Dr. A. D. Little, consulting chemist, Cambridge, Mass., past president of the American Chemical Society and of the American Institute of Chemical Engineers.

E. R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Dr. George D. Rosengarten, director and member advisory committee on national policy, American Chemical Society, Philadelphia, Pa.

Dr. Julius Stieglitz, University of Chicago.

William Hoskins, consulting chemist, Chicago, Ill.

H. E. Howe, editor, *Journal of Industrial and Engineering Chemistry*, member National Research Council.

None of the members of this committee is a dye manufacturer or connected with the Chemical Foundation. The committee believes that the president would not have taken this step if he had possessed full information or had called into conference unprejudiced persons well able to advise him.

American chemists believe in the Chemical Foundation and no facts have been presented thus far by the administration to shake their faith in this institution which has become the nucleus of the organic chemical industry in this country.

The request for a conference with the president was made on July 12, and was followed by two reminders. Not until July 21 was official word received from the White House. It was then stated that the president would be unable to meet such a committee for the present because of the other urgent and imperative matters now before him.

The American Chemical Society is about to hold its annual meeting in Pittsburgh, where the situation will be presented in detail to the governing body at the general meeting. The society is planning a vigorous campaign to have the country understand the true situation. The latest evidence of the necessity for this action is an announcement carried in an Associated Press despatch from Chicago, dated July 18, which makes the significant announcement that the Third German-American National Conference adopted resolutions including the following:

We greet with satisfaction the first steps of the administration to correct the iniquities committed by the custodian of alien enemy property.

It is also significant that George Sylvester Viereck was chairman of the resolutions committee. Viereck attracted much attention during the war as a persistent German propagandist.

LECTURES ON SCIENCE AT TEACHERS COLLEGE

TEACHERS COLLEGE, Columbia University, is offering for the summer session of 1922 a special course entitled "Educational Interpretation of Modern Science," under the charge of Dr. Otis W. Caldwell, director of the Lincoln School of Teachers College. The course is open to all students who register and pay the tuition fee. It carries two credit points for those who attend the lectures, and prepare synopses and term papers upon two topics selected from the subjects discussed.

The lectures, which are being given daily in the Horace Mann Auditorium at 2:30 p.m. from July 10 to August 18, are as follows:

"Achievemeents of science," Dr. Otis W. Caldwell.

"Methods and purposes of medical research," Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research.

"Poliomyelitis (infantile paralysis)," Dr. Harold L. Amoss, associate professor of medicine, Johns Hopkins Medical School.

"Epidemic influenza," Dr. Frederick L. Gates, Rockefeller Institute for Medical Research.

"The control, care and treatment of human tuberculosis," Dr. Matthias Nicoll, Jr., deputy commissioner, Department of Health, State of New York.

"Chemistry of Foods," Dr. H. C. Sherman, executive officer of the department of chemistry, Columbia University.

"Influence upon man of climatic conditions and of the physical features of the earth's surface," Dr. W. W. Atwood, president of Clark University.

"Influence of the distribution of natural resources upon human activities," Dr. Atwood.

"Recent advances in long distance telephony," Dr. F. B. Jewett, president of the American Institute of Electrical Engineers and vice-president of the Western Electric Company, and Mr. John Mills, the Personnel Department.

"Chemistry in relation to present day civilization. I. Gasoline. II. Refrigeration. III. Coal tar products. IV. Photography. V. Sugar," Dr. E. E. Slosson, editor of *Science Service*, Washington, D. C.

"The human voice and its electrical transmission," Mr. John Mills.

"Warfare against insects," Dr. L. O. Howard, chief of the United States Bureau of Entomology.

"A modern botanic garden in relation to community needs," Dr. George T. Moore, director of the Missouri Botanical Gardens.

"International health work," Dr. George E. Vincent, president of the Rockefeller Foundation.

"The meaning of evolution," Dr. John M. Coulter, head of the department of botany, University of Chicago.

"Evolution and religion," Dr. Coulter.

"The use of statistics in industry," Mr. R. S. Kellogg, editor of *News Print Service*, New York City.

"What science has done to enlarge our knowledge of the soil," Dr. Milton W. Whitney, chief of the U. S. Bureau of Soils.

"The Endurance of the Soil," Dr. Whitney.

"Forests as economic factors in modern life," Dr. Raphael Zon, forest economist, U. S. Forest Service.

"Forests as physical and biological factors," Dr. Zon.

"Physiological aspects of the modern potato problem," Dr. C. O. Appleman, professor of plant physiology and biochemistry, University of Maryland.

"Physiological aspects of food storage," Dr. C. O. Appleman.

"Vitamins," Dr. Walter H. Eddy, associate professor of physiological chemistry, Teachers College.

PITTSBURGH MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE fall meeting of the American Chemical Society will be held with the Pittsburgh Section on Monday, September 4, to Saturday, September 9, inclusive. All divisions and five sections are planning extensive meetings. The Pittsburgh local committees have already nearly completed their arrangements and an interesting program, together with instructive excursions, is assured. It is expected that two thousand members will be present. The National Exposition of Chemical Industries meets in New York, September 11 to 16, and members can readily go from Pittsburgh to New York for this meeting.

Following the meeting of the council on September 4, the general program is:

Tuesday, September 5

9:00 a.m.—Registration and reception of members and guests at Carnegie Music Hall.

10:30 a.m.—General meeting, Carnegie Music Hall.

Address of welcome.

Response, Edgar F. Smith, president of the American Chemical Society.

General addresses, including the following:

1. J. H. James: "Pittsburgh as an industrial center: historical and industrial."
2. W. F. Rittman: "Pittsburgh as an industrial center: finance and transportation."

2:00 p.m.—General meeting, Carnegie Music Hall. Special addresses will be given, of which the following are part:

1. Thos. Midgley, Jr., and T. A. Boyd: "The chemical control of gaseous detonation with particular reference to the internal combustion engine." (Illustrated by experiments and slides). (One hour). Discussion later in Industrial Division.
2. E. J. Crane: "The journal literature of chemistry."
3. Wilder D. Bancroft: " Structural colors in feathers."

2:00 p.m.—Ladies' trip to Country Club.

8:15 p.m.—Smoker at Syria Mosque. Special features.

8:15 pm.—Drama school play for ladies, Carnegie Institute of Technology.

Wednesday, September 6

9:30 a.m.—Divisional and sectional meetings, Carnegie Institute of Technology.

10:00 a.m.—The ladies will go to the Heinz Factory and lunch there.

2:00 p.m.—Divisional and sectional meetings, Carnegie Institute of Technology.

4:00 p.m.—There will be a musicale for the ladies in the afternoon at the Twentieth Century Club.

8:15 p.m.—Public meeting, Carnegie Music Hall. Reception by the president and members.

Thursday, September 7

9:30 a.m.-2:00 p.m.—Divisional and sectional meetings at the Carnegie Institute of Technology.

5:00 p.m.—Garden party and supper and social evening with music and dancing at the University of Pittsburgh Faculty Club (Oak Manor), Fifth Avenue and Atwood Street.

Friday and Saturday, September 8 and 9

Excursions to industrial plants, etc.

All divisions and sections, as enumerated below, will meet. All divisions and sections will have two full days at their disposal if needed.

The Division of Industrial and Engineering Chemistry will include in its program on Wednesday morning a symposium on "Automatic process control." The chairman, L. W. Parsons, has arranged with various authorities to present papers, many being illustrated, bearing upon the fundamental and practical aspects of the subject.

The Water, Sewage and Sanitation Division will discuss the specifications for lime for water treatment, as a feature of the meeting.

The Biological and the Agricultural and Food Chemistry Divisions will hold a joint symposium on the subject of "Fatty foods," with Dr. David Wesson as chairman. Papers dealing with the preparation, purification, digestibility, adulteration, etc., of various fatty goods are solicited for this symposium. Vitamin papers will be included.

The Rubber Division is planning for the largest meeting in its history, as Pittsburgh is situated near the center of the rubber industry.

The Leather Division has prospects of a very large meeting at Pittsburgh. A symposium on gelatin and colagen will be a feature of the meeting.

The Dye Division is arranging a symposium on "The chemistry of the application of dyes."

The Division of Physical and Inorganic Chemistry will hold a symposium on "Recent advances in applied colloid chemistry," in cooperatiou with the colloid committee of the National Research Council.

The Petroleum Section hopes to perfect its divisional organization at this meeting, and will hold a short symposium on "Lubrication from the chemists' viewpoint."

A Gas and Fuel Section will hold its initial meeting at Pittsburgh, with A. C. Fieldner as chairman. Several authorities have already agreed to preseut papers. A symposium on "Combustion" will be held Wednesday afternoon, with R. T. Haslam, Massachusetts Institute of Technology, as chairman.

The Section of Chemical Education is desirous of being an open forum for settling national questions in chemical education including high school, college, university and industry problems. Bring your problem for discussion. A fifty-word abstract of all papers is required before the paper is presented at the meeting.

The Cellulose Section plans a number of discussions on special topics, such as: (*a*) Cooperative research problems in cellulose chemistry. (*b*) The nature of oxycellulose and its bearing on the artificial silk, viscose and paper industries. (*c*) Dr. Tingle's proposed "Bromine number." (*d*) Absorptiou of salts by cellulose.

THE SOUTHWESTERN DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The third annual meeting of the Southwestern Division, American Association for the Advancement of Science, will be held in Santa Fé, New Mexico, on September 6 to 9 inclusive. It will immediately follow the annual Santa Fé Fiesta.

Three afternoons will be devoted to field meetings; one to a large fossil bed containing remains of extinct animals; another to the ruins at Pecos; and the other to the cliff dwellings at the Rito de los Frijoles, under the direction of Dr. E. L. Hewett.

The Santa Fé museums offer a special archeological and Indian program on the evening of the sixth. The address of the president, Dr. D. T. MacDougal, will be followed by a reception. On the evening of the seventh, the friends and associates of Mr. Springer will present to the State of New Mexico a bust of him, in appreciation of his work in the advancement of science and education.

The scientific papers will be read before five sections:

Physical science: Chairman, Dr. A. E. Douglass, University of Arizona and director of the Stewart Observatory.

Social science: Chairman, K. M. Chapman, artist of the Acheological Museums, Santa Fé.

Biology: Chairman, Dr. E. C. Prentiss, El Paso.

Agriculture: Chairman, Dr. H. L. Kent, president of the New Mexico College of Agriculture and Mechanic Arts, Mesilla Park.

Education and psychology: Chairman, Dr. B. F. Haught, professor of psychology, University of New Mexico.

We wish to extend a cordial invitation to attend this meeting to all members of the association who are spending the summer in the west.

Elliott C. Prentiss,
Chairman of the Executive Committee

SCIENTIFIC NOTES AND NEWS

Professor Mangin, director of the Paris Museum of Natural History, presided over the meeting of the French Association for the Advancement of Science held at Montpellier from July 24 to 29.

Sir Joseph J. Thomson, master of Trinity College, Cambridge, was presented on July 26 with the Franklin Medal by the Franklin Institute of Philadelphia for his "signal and eminent service in science." The presentation was made by the Earl of Balfour.

The Charles P. Daly Medal for 1922 was presented to Sir Francis Younghusband, president of the Royal Geographical Society, at the Americal Embassy in Great Britain on July 19 by George Harvey, the American ambassador, on behalf of the American Geographical Society. The medal was inscribed "For explorations in northern India and Thibet, and for geographical publications on the Asiatic and African borders of the empire."

At its commencement in June, Randolph-Macon College conferred the honorary degree of doctor of laws upon Rear Admiral David Watson Taylor, chief constructor, United States Navy, in recognition of his international reputation as a naval architect and his distinguished services to his country. The occasion was the near approach of his retirement from active service. Admiral Taylor is a native of Louisa County, Virginia, and was a student of Randolph-Macon College before entering upon his special training for the navy.

The degree of doctor of science has been conferred by the University of Manchester on Mr. G. H. Hardy, Savilian professor of geometry and fellow of New College, Oxford, aud on Sir E. J. Russell, formerly lecturer in chemistry at Owens College, Manchester.

THE doctorate of laws has been conferred by the University of St. Andrews on Sir Peter Bedford Scott Lang, emeritus professor of mathematics in the university; Dr. Arthur Lapworth, professor of organic chemistry in the University of Manchester; Dr. Charles Robertshaw Marshall, professor of materia medica in the University of Aberdeen; and Sir Harold Jalland Stiles, regius professor of clinical surgery in the University of Edinburgh.

M. ALBERT RECOURA, professor at Grenoble, has been elected a correspondent of the Paris Academy of Sciences, to fill the vacancy caused by the death of M. Ernst Solvay.

DR. LEGRY, professor of anatomy in the Paris School of Medicine, has been elected a member of the Paris Academy of Medicine in the place of the late M. Ranvier.

IN accordance with an act of the California legislature, a commission of agricultural education has been appointed by the governor to formulate the needs of agricultural teaching and research in California and report to the next legislature. This commission consists of A. C. Hardison, who succeeds the late G. Harold Powell, G. H. Hecke, H. A. Jastro, Senator S. C. Evans, Mark Grimes, R. N. Wilson and Elwood Mead.

DR. HENRY B. WARD, of the University of Illinois, will conduct investigations for the Bureau of Fisheries of the pelican in relation to the fishes of the waters of Yellowstone National Park, with the view of ascertaining to what extent these birds prey upon the fish and whether or not they serve as hosts for the parasite which infests many of the trout of the park waters.

B. LINEBURG, a graduate student at the Johns Hopkins University, has been appointed by the U. S. Department of Agriculture for the summer to conduct work on the responses of bees to lights of various wave lengths and intensities.

THE Rockefeller Foundation has sent a hookwork commission to Honduras. One of its members, Dr. D. B. Wilson, accompanied by Dr. Brizzio, director of public health, has already visited several towns.

DR. CHARLES H. GILBERT, accompanied by Willis H. Rich and W. P. Studdert, sailed from South Bellingham, Wash., on June 1 for the purpose of making a thorough investigation of the Alaska Peninsula Fisheries Reservation to determine whether the present regulations are adequate to keep the fisheries of that district in perpetuity.

PROFESSOR H. H. WHETZEL, who has been for fifteen years head of the department of plant pathology of the College of Agriculture of Cornell University, retired on July 1 from the administrative headship in order to devote his time and energies more fully to teaching and research together with the immediate preparation of one or more text-books. Dr. L. M. Massey, who has been acting head for the past year during Professor Whetzel's absence in Bermuda, succeeds to the permanent position. A correspondent writes: "Cornell was the first American University to establish an independent department of plant pathology and this stands, doubtless, at present as the largest development in its field. It is noteworthy when the leader of a flourishing department like this voluntarily retires from the administrative headship while still in his prime."

PROFESSOR B. M. KOZOT-POLJANSKI, of Dorpat University, Russia, has requested American botanists to exchange papers with him, in order that he may come in touch again with American work. His present address is University Botanical Institute, Woronesh, Russia.

AT a meeting of the Société Mathématique de France in the Sorbonne on July 12, Professor Edward Kasner, of Columbia University, spoke on "Problèmes de géométrie dans la théorie de gravitation Einsteinien."

PROFESSOR G. ELLIOT SMITH, F.R.S., and Professor J. T. Hunter described a reconstruction of the Piltdown skull at a meeting of the Royal Anthropological Institute on June 13.

PROFESSOR C. LLOYD MORGAN, Bristol, has been selected to deliver the Gifford Lectures in the University of St. Andrews in 1922-23 and 1923-24. His subject will be "Evolution, emergent and creative." The first course will begin about the end of next October.

In memory of the late Dr. Howard M. Fussell, friends, officers and students of the Medical School of the university, have presented his portrait to the university. The formal presentation was made by Dr. David Riesman and the portrait was accepted on behalf of the university by the acting provost, Dr. Josiah H. Penniman. Dr. James M. Anders presided.

The Mérida branch of the Mexican Medical Association will hold a medical contest in honor of Pasteur. The prizes will consist of medals and diplomas to local physicians who submit the best papers on local diseases and means of control. The prizes will be awarded on December 27, the centenary of Pasteur's birth.

The portrait medallion of Sir Norman Lockyer, by Sir Hamo Thornycroft, at the Norman Lockyer Observatory, Salcombe Hill, Sidmouth, was unveiled by Sir Frank Dyson, astronomer royal, on July 22.

Dr. Jokichi Takamine, who established the Takamine Research Laboratory at Clifton, N. J., known for his work on diastatic ferments and the active principles of the suprarenel glands, died on July 22. Dr. Takamine was born in Tokyo in 1854.

Dr. Simon Nelson Patten, from 1888 to 1917 professor of political economy in the University of Pennsylvania, known for his contributions to economics, including the relations of the natural sciences to sociology, died on July 25, aged seventy years.

The Honorable Huia Onslow, known for his work on the relations of biochemistry to genetics which he carried on in his private laboratory at Cambridge, has died at the age of thirty-two years.

The sum of $40,000 has been donated to St. Luke's Hospital, Chicago, by Mrs. John J. Borland in memory of her husband. This fund is to endow a fellowship for clinical investigation and is to be under the immediate supervision of Dr. Joseph A. Capps.

The late Prince of Monaco has bequeathed sums of one millions francs each to the Academy of Sciences, the Academy of Medicine, the Institut Océanographique, the Institut de Paléontologie Humaine of Paris, and the Musée Océanographique of Monaco.

Ten government departments have appointed representatives on an advisory committee on governmental broadcasting formed at the request of Secretary Hoover to make recommendations on the distribution of government information by radio. A preliminary classification of the kind of information that should be broadcasted from various stations is being made. The committee will meet at frequent intervals to consider the questions that arise through the progress of radio. Dr. S. W. Stratton, director of the Bureau of Standards, is chairman.

An Associated Press despatch from Moscow states that after a month's negotiations, Leo Kameneff, the acting premier, has definitely refused the American Relief Administration's conditions for feeding the Russian intellectuals as a class. The Commonwealth Fund offered to send food packages to the value of approximately $250,000 to Russia for distribution by the Relief Administration among professors, teachers, doctors, scientists and others selected by the relief authorities. The latter were ready for the government to cooperate in the distribution, but insisted that the final decision as to what persons should receive the packets should rest with the Relief Administration. The government, according to M. Kameneff, is willing to permit the Relief Administration to veto any of the government's selections of beneficiaries, but it is not willing that any outside organization be permitted to assist persons despite a Soviet veto.

The first meeting of the newly formed Association of Maine Geologists will be held on August 11 in Auburn and Lewiston. Professor Frank D. Tubbs, of Bates College, N. B. Tracy, of Auburn, L. C. Bateman, of the *Lewiston Journal*, and other members of the local committee have arranged a program that will take in all the points of geological interest in the vicinity. These include Mt. Apatite, the source of much of the feldspar, and of many of the Maine gems and a large variety of minerals; the Lewiston Falls and a number of other localities. It is hoped that the geologists from other parts of New England will take part in the meeting, and it is expected that Professor George P. Merrill, curator of the National Museum at Washington, will deliver an address in the evening. The headquarters of the association will be at the Auburn Chamber of Commerce.

UNIVERSITY AND EDUCATIONAL NOTES

BOWDOIN COLLEGE receives $500,000 under the will of the late Edward H. Blake, of Bangor.

PHILIP A. LEHENBAUER, professor of plant pathology at the University of Illinois, has accepted a position as head of the department of horticulture at the University of Nevada.

DR. FREDERICK C. LEONARD has been appointed instructor in astronomy and mathematics, in charge of the work in astronomy, at the Southern Branch of the University of California in Los Angeles.

PROFESSOR BENJAMIN A. WOOTEN, Ph.D., head of the department of physics at the Alabama Polytechnic Institute, has been elected professor of physics at Washington and Lee University, in the place of Dr. Walter LeConte Stevens, who has been retired and made professor emeritus.

LELAND H. TAYLOR, who received the degree of doctor of science from Harvard in 1922, has been elected to an instructorship in zoology in West Virginia University.

DISCUSSION AND CORRESPONDENCE

CONCERNING THE BOTULINUS TOXIN

RECENTLY Bronfenbrenner and Schlesinger[1] have reported the death of laboratory animals (mice) as a result of the intraperitoneal injection of 3×10^{-21} cc of a solution of the toxin of *B. botulinus*. In a preliminary communication[2] concerning the matter they state that under suitable "conditions of the experiment the *botulinus* toxin which ordinarily kills mice in amounts not smaller than 3×10^{-7} cc can be increased in potency to such an extent that 3×10^{-21} cc occasionally and 3×10^{-18} cc quite regularly kills mice of 18-20 g. in less than 48 hours after intraperitoneal injection. While the total solids of such a minute dose of toxin amounts to only 3×10^{-23} g (this amount also includes the inorganic portion of the medium), the toxic product thus obtained, nevertheless, possesses all the essential characteristics of bacterial toxins," etc.

Because of the smallness of the quantity it seemed worth while to examine some of the consequences involved. Since a gram molecule of any compound contains 6.06×10^{23} molecules then one gram of water or approximately 1 cc would contain $1/18 \times 6.06 \times 10^{23} = \frac{10^{23}}{3}$ molecules and 3×10^{-21} cc would contain $\frac{10^{23}}{3} \times \frac{3}{10^{21}} = 10^2$ molecules From the quotation given it is apparent that the solution of toxin can not be even a one per cent. solution, but assuming that it is a one per cent. solution and that the molecular weight and density of the pure toxin are the same as those of water then 3×10^{-21} cc would contain only one molecule of toxin. However, the molecular weight is probably higher than that of water and not even one molecule in a hundred would be a toxin molecule. Consequently the average 3×10^{-21} cc quantity of solution would contain no toxin. If one takes the larger quantity, 3×10^{-18} cc, which quite regularly kills mice, and assumes that the molecule has ten times the molecular weight of the water molecule then one hundred molecules of toxin would be present.

In the case of the smaller quantity it is unlikely that at best more than one or two molecules of toxin could have been present and since the animal was killed one seems forced to conclude that the life of an organism is dependent upon the integrity of one or two cells or that the action of the toxin is catalytic and

[1] *Journal American Medical Assn.*, 78: 1519 (1922).

[2] *Proceedings Society Exper. Biology and Medicine*, 19: 1 (1921).

accelerates or inhibits some vital process. In either case a difficulty arises when the probability of a single or even small number of molecules reaching the necessary cells is considered.

Raymond L. Stehle
McGill University,
Montreal

THE PERIODICAL CICADA

To the Editor of Science: It is probably desirable to record the appearance, in accord with expectation, of brood XIII of the periodical cicada or seventeen-year locust (*Tibicina septendecim*) in the Chicago area this year. Reference to Marlatt's excellent paper[1] enables one to satisfactorily identify the present insects as those of the compact brood described by Fitch as brood 6, by Walsh-Riley as brood III, by Riley as brood V and by Marlatt as brood XIII. In Dr. Gideon B. Smith's manuscript chronology the present brood was listed as appearing "in Winnebago, Monard County, and neighborhood in 1854; again in 1871."

The writer first noted the larvæ April 29 of this year, at which time they were present in great numbers at Flossmoor, occupying their characteristic "chimneys." The adults emerged May 28 in enormous numbers, distributed from at least Batavia and Wheeling to Flossmoor and to Crown Point. Two weeks ago oviposition seemed to be past its crest and at the present time in localities visited the adults have practically disappeared.

The precision of appearance of this brood over a period of seventy years is an interesting instance of the uniformity of developmental tempo under natural conditions.

James Nelson Gowanlock
The University of Chicago,
June 30, 1922

[1] Marlatt, C. L.: 1907, "The Periodical Cicada," *Bureau of Entomology Bulletin No. 71*, U. S. Department of Agriculture.

SOME SIDELIGHTS ON THE LIFE OF RUSSIAN PROFESSORS

It has been noted on various occasions that the Russian professors and the research men are "book-hungry." Being shut off from the remainder of the civilized world for nearly eight years, they have but very little and very fragmentary knowledge of what has been and is being done in western Europe and America. To work under such conditions is at least very inconvenient. But in reality the situation is much worse. The Russian men of science literally have been "bread hungry" for the past several years. Every one of us who had a chance to talk to Russian refugees heard of stories of bread hunting for four or five hours at a time. Those days, let us hope, have passed. The conditions in Russia are becoming better. But even the so-called "better conditions" are very far from good, as one can judge from the following extracts from a letter which the writer received from a Russian professor in Petrograd:

> Notwithstanding the fact that the salaries are regulated by associations of professionals and continuously raised in parallel with the value of the ruble, yet the highest paid specialist in various departments will receive in May, 1922, nearly 40,000,000 rubles in Soviet paper money, plus the food ration of 36 pounds of flour, 7 pounds of fish and a pound each of salt, sugar and fat, plus (in exceptional cases) special academic portion (a little in excess of one mentioned above). Meantime, according to quotation of Government Bank for May, $100 is equal to $193,000,000 Soviet paper rubles.

But even this meager portion and the pack of worthless money do not come on time, adding further to the discomfort of professional people in Russia.

> On account of shortage of funds at the government's disposal, the personnel in all departments is systematically decreasing, the salaries come late as well as the food rations. As a matter of fact, the salaries in our division (of an agricultural experiment station) have not been received for March, while the food ration is just being received for April. [The letter was dated May 27, 1922.]

> In the same way, the allowances for current expenses of the experiment station are being decreased and delayed.

> In spite of all these conditions, of which I do not think it advisable to talk in detail, we are still alive and continue our research, although, of

course, not so intensively as in America or other countries.

Sorry to confess, I was unable until now to send you our literature including that which was published during the last few years. Perhaps I will have this possibility in the near future.

Such bits of information fairly well characterize the conditions under which Russian men of science are obliged to live and to keep the "light of knowledge burning," in anticipation of better days for science in Russia.

M. I. Wolkoff

University of Illinois

SCIENTIFIC BOOKS

Genetics, An Introduction to the Study of Heredity. By H. E. Walter. Revised edition, pp. XVI + 354, 92 figs. The Macmillan Co., New York.

This revised edition of a book originally published in 1913 brings the elemental facts of genetics up to date, and meets at once a need for a popular presentation for the general reader as well as an introduction to the study of heredity for the beginning college student. The enormous progress in this field during the last ten years has necessitated eliminations, additions, and modifications in the former text.

About 82 pages have been added in the present edition, 50 of which form three new chapters. A new chapter on the "Factor Hypothesis" contains much material that was formerly discussed under "Old Types and New," but the rearrangement of materials places the subject matter in a more logical position and allows a distinct and important concept to be treated as a separate unit. Hereditary genes are here classified roughly as single or plural according to ways in which they determine the visible hereditary character. Of the plural genes, the discussion of genetic modifiers is the most important new subject, since modifiers play such a large part in present explanations for the results of selection. An entirely new chapter on the "Architecture of the Germ Plasm" reflects the most important advances made since the original edition was published, and deals with the conceptions and viewpoints based largely on the famous Drosophila experiments, such as linkage, crossing over, the chiasmatype theory, interference, and the arrangement of the genes. The author takes the point of view "that it has been possible in a single chromosome to determine not only the relative arrangement of over thirty genes but also to find out the relative distance between these genes." While the order of the genes may be determined readily, our conclusions as to distances between genes have perhaps outstripped the demonstrable evidence. If two linked genes show 1.5 per cent. recombinations, it still remains to be proved that the low percentage of crossing over is due to or proportional to a short distance between these genes on the chromosome, even in the so-called normal population. Possibly it may be, but there are other alternative explanations. To be sure, the possibility of an accurate localization of hereditary genes in their appropriate chromosomes is attractive and even astonishing. While the hypothesis is alluring, the implications are so grave and important, we must await conclusive proof. A new chapter on "Somatogenesis" points out the problem of biological differentiation which must take place between the invisible genes in the fertilized egg and the Mendelian characters as end products, for during this process many external and internal factors (including endocrines) come into play and contribute to the formation of the somatic characters as we see and study them in pedigreed cultures. The present chapter on "Determination of Sex" introduces much new and important material which was unavailable ten years ago, and substitutes for some of the former discussion which now has only a historical significance, such topics as polyembryony, sex-linked inheritance, non-disjunction of the sex chromosomes, secondary sex characters in relation to hormones, sex intergrades and the like. Excellent diagrams make clear at a glance the distinction between the cases where the males are heterogamic (producing two types of spermatazoa) and those cases in which the females are heterogamic (producing two types of matured ova).

Two radical changes occur in the rearrangement of materials in the new edition. A chapter discussing "Pure Lines and Selection" formerly preceded Mendelism but now more appropriately follows this subject because pure lines and selection can be interpreted best in terms of Mendelism. The basic facts of cytology were originally treated in the second chapter but now follow the fundamental facts of Mendelism and prepare the way for an interpretation of the "Architecture of the Germ Plasm" according to recent researches.

To reduce mathematical formulæ to a minimum is a decided advantage to the lay reader to whom these are confusing; but it is perhaps disadvantageous for the college student, whom we seem to be shielding from even moderate mental effort by continually simplifying subject matter. Underlying all distributions of characters in assortative matings are certain elementary principles based on probabilities and the theory of simple sampling. When the student looks upon a Mendelian population in these terms, he has the advantage of a general fundamental law rather than the knowledge of an individual case. The general lack of this element in approaching genetic problems is perhaps more keenly felt than any other one thing. For example, the standard deviation is not used "since for mathematical reasons it is more accurate" (p. 27); but it is more convenient, and preferable to the average deviation because of its relation to probable error. Again, the sum of a set of observed frequencies should equal the sum of the calculated frequencies in any given series of observations, but they fail to do so in the table on p. 157. In discussing the practical applications the author states (p. 119) that "when ten differing characters are combined in the parental generation there would result over a million kinds of possible offspring among the hybrids of the second filial generation, $(3+1)^{10} = 1{,}048{,}576$." While such a hybrid would produce 2^{10} kinds of gametes which might combine in $2^{20} = 1{,}048{,}576$ ways, so many duplications of type appear that it is misleading to consider each combination as a separate "possible kind"; and in reality there would be only $2^{10} = 1{,}084$ different visible classes (phenotypes) and $3^{10} = 59{,}049$ classes differing in germinal constitution (genotypes). At some points, there seems to be confusion as to an exact definition of genotype. On p. 109, the author states that "There are then . . . nine different genotypes in any dihybrid cross," *i. e.*, 3^n where n = number of allelomorphic pairs. This definition agrees with the current usage, but is hardly consistent with the usage on p. 153 and p. 159. A number of minor errors which always occur in the most carefully prepared texts will without doubt be corrected in subsequent editions.

The revised edition maintains the same attractive and readable style of the original. The volume as a whole has a broad usefulness in the related fields of sociology, psychology, education and medicine. Many excellent new diagrams, remarkable for their lucidness and pedagogic value, help the reader to visualize complex groups af fact quickly. Even the experienced teacher of genetics will find the volume most suggestive and refreshing.

J. A. Detlefsen
University of Illinois

SPECIAL ARTICLES

THE EMERGENCY FUNCTION OF THE ADRENAL

We have recently obtained evidence of an emergency function of the adrenal. In some of this work we have confirmed Cannon[1] and his co-workers, who suggested an emergency function for the adrenal. Our method is a modification of Meltzer's[2] denervated eye reaction. The iris is made sensitive to epinephrin by removal of the superior cervical ganglion. Several days later, in order to eliminate central nervous influence, the ciliary ganglion is removed. We have made a study of sixteen cats by this method.

In most animals prepared in this way, stimulation of the moist pinna by rapidly repeated induction shocks will cause a good dilatation of the denervated pupil. Asphyxia for forty seconds will cause almost maximal dilatation. Exposure to cold (immersion in cold water) will usually cause a very decided dilatation after a few minutes, the rectal temperature decreasing meanwhile. As an illustration, a cat whose rectal temperature was 39.0° C. at the start and whose pupil was 0.13 in. in diameter showed the following changes:

[1] Cannon, W. B.: "Bodily Changes in Pain, Hunger, Fear and Rage." 1915, D. Appleton and Co., New York.

[2] Meltzer, S. J.: *Am. J. Physiol*, 1904, II, 37.

Time	1 min.	3 min.	8 min.	10 min.
Temperature	39.25	38.20	34.30	33.0° C.
Dia. pupil	0.13	0.17	0.34	0.425 in.

After removal of the adrenals and before adrenal insufficiency had time to develop, induction shocks, asphyxia and cold produced little or no effect in the same animals which had previously given good responses with the same stimulation.

Our evidence points conclusively to an emergency function of the adrenal.

Frank A. Hartman
Department of Physiology,
University of Buffalo

SEALING QUARTZ TO GLASS WITH SILVER CHLORIDE

Although silver chloride has long been used as a cement, the possibility of employing it as a cement for vacuum purposes has perhaps not been thoroughly appreciated. Recent tests have demonstrated that the substance possesses certain qualities desirable in a cement, namely, it melts at 455° C, a relatively high temperature, it adheres to glass and quartz surfaces and forms a joint that does not leak, it does not give off gas in any quantity, and does not decompose readily with time. By means of the silver chloride quartz windows were sealed to glass mercury vapor lamps and gas discharge tubes for use as sources of ultra-violet light.

The silver chloride was prepared by precipitation from an aqueous solution of silver nitrate with sodium chloride. The precipitate was thoroughly washed, dried, and ground to a powder. To fasten a plate of quartz or other material to a glass tube the following simple manipulation was found workable. The end of the glass tube was ground evenly, warmed above 500°C in a bunsen flame and dipped quickly into the silver chloride powder. This adhered to the glass and upon further heating in the flame melted evenly around the end of the tube. The tube was then clamped in an upright position and the plate laid on the top of it. The bunsen flame was carefully played over the tube and the plate until the silver chloride again melted and crawled into optical contact with the plate. Little difficulty was experienced in sealing fused quartz plates to glass tubes, but with plates cut from crystal quartz considerable care was necessary to heat them to the required temperature without fracture. Slow even heating by a furnace would have been better than the bunsen flame. It was found that if the glass tube was either too thin or too thick it was liable to crack near the seal upon cooling. Glass tubing of medium thickness stood the strain well. Of course in such a seal strains exist because of the different heat expansions of quartz and glass, but the fused silver chloride, being tough and not brittle, no doubt yields somewhat and eases the strain.

E. O. Hulburt
Iowa State University

THE NORTH CAROLINA ACADEMY OF SCIENCE

The North Carolina Academy of Science met at the University of North Carolina at Chapel Hill May 5 and 6. Thirty-five new members were added, making a total of 163. The North Carolina Section of the American Chemical Society and the North Carolina Physics Teachers' Association met at the same time and place. The following officers were elected: (Academy) *President,* Dr. A. Henderson, University; *vice-president,* Dr. H. B. Arbuckle, Davidson College; *secretary-treasurer,* Dr. Bert Cunningham, Trinity College; *executive committee,* Dr. H. N. Gould, Wake Forest College, Professor J. P. Givler, North Carolina College for Women, Dr. B. W. Wells, State College. (Chemists) *President,* Dr. A. S. Wheeler, University; *secretary,* Mr. L. B. Rhodes, Raleigh. (Physics Association) *President,* Dr. A. H. Patterson, University; *vice-president,* W. T. Wright, North Carolina College for Women; *secretary-treasurer,* Professor A. L. Hook, Elon College; *executive committee,* Professors C. W. Edwards, J. B. Derieux and A. F. Roller.

In addition to the address of welcome by President Chase of the university and the presidential address, "The search for the ultimate atom," by Professor J. L. Lake of Wake Forest, the following papers were presented:

The variation of the photoelectric current with thickness of metal: Otto Stuhlman, Jr.

Studies on fermentation of rare sugars by plant pathogenic bacteria: F. A. Wolf.

Pod and stem blight of soy beans: S. G. Lehman.

The dipterous galls of the hickories: B. W. Wells.

The stems of grape hybrids: C. F. Williams.

Instincts in social life (By title): C. C. Taylor.

Wild ferns and flowers of Chapel Hill: H. R. Totten.

Coordinate systems in mathematics (By title): J. W. Lasley, Jr.

The calcium content of mixed feeds in relation to the feeding requirements of animals: J. O. Halverson and L. M. Nixon.

Influence of climate on protein content of corn: H. B. Arbuckle.

A note on the pulmonary circulation in vertebrates: W. C. George.

The polymorphic genus clavaria: W. C. Coker.

The geology of the Muscle Shoals area: W. F. Prouty.

Dormancy in the seeds of Diospyros Virginiana: H. L. Bloomquist.

A "nature-experiment" on the development of frogs and one on the physiology of sponges: H. V. Wilson.

Notes on the reproduction of hydra in the Chapel Hill region: H. S. Everett. Presented by H. V. Wilson.

Twenty years of the North Carolina Academy of Science: C. S. Brimley.

Notes on protozoa: Bert Cunningham.

A review of the fulgoridæ of eastern North America: Z. P. Metcalf.

Striations in inorganic solutions: C. M. Heck.

A parasite of the Mediterranean flour moth: J. E. Eckert.

Spore dischargal in some genera of water molds: J. N. Couch.

Laboratory work in elementary genetics: C. O. Eddy.

The Echigo oil fields, Japan: Collier Cobb.

Age of the Talladega and associated rocks of Clay County, Alabama: W. F. Prouty.

Acoustics of auditoriums: A. H. Patterson.

A review of high school science teaching: J. N. Couch.

Sand dunes of Niigata: Collier Cobb.

The structure and development of the seed coats of garden peas and sweet clover: L. E. Yocum.

Some intestinal cestode and nematode parasites of cats of Wake Forest: R. B. Wilson.

A new species of isoachlya: F. A. Grant.

Some investigations into the bacteriology of common colds and a brief trial of autogenous vaccine therapy for six months at Wake Forest College: W. L. Taylor and Chas. Phillips.

The relation of chemistry to the state's public water supply: C. F. Catlet.

New dyes derived from 5-chloro-2-amino-p-cymene: A. S. Wheeler and I. V. Giles.

Chemistry Section

Zirconium ferrocyanide: F. P. Venable and R. A. Lineberry.

Zirconium citrate: F. P. Venable and E. C. Moehlmann.

Modification of the official sodium method: J. O. Halverson, L. E. Morgan and J. H. Schultz.

The determination of potassium in the official sodium method: J. O. Halverson and J. A. Schultz.

A modified thermoregulator: M. L. Hamlin.

A convenient form of condenser: M. L. Hamlin.

Phenolsuphonphthalein and some of its derivatives: W. N. Orndorff and F. W. Sherwood.

Binary systems of metanitrotoluene and another mononitrotoluene: J. M. Bell and J. L. McEwen.

The nitration of certain nitrotoluenes: J. M. Bell and W. B. Smoot.

The nitration of orthonitrotoluene: J. M. Bell and H. G. Pickett.

The chlorination of 2-amino-p-cymene: A. S. Wheeler and I. V. Giles.

New derivatives of 2-bromo-5-hydroxy—1, 4—naphthoquinone: A. S. Wheeler and B. Naiman.

The effects of tops on the wilting of succulent vegetables: L. B. Rhodes.

The determination of the solubility of nickel sulphate by floating equilibrium: F. C. Vilbrandt and J. A. Bender.

Physics Section

How the Einstein theory of relativity was verified: A. Henderson.

X-ray spectra from crystals: J. B. Derieux.

Effect of an electric field upon colloids in non-conducting liquids: N. B. Foster.

Analysis of crystal structure from X-ray spectra: A. A. Dixon.

The color of metals by transmission: Otto Stuhlman, Jr.

Some suggestions for the teaching of physics: A. H. Patterson.

The use of an audion tube as negative resistance: D. A. Wells.

Research in North Carolina: (By title) C. W. Edwards.

Bert Cunningham,
Secretary

SCIENCE

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CONTENTS

THE EXTENSION OF THE FULL-TIME PLAN OF TEACHING TO CLINICAL MEDICINE[1]

YOU have done me the honor to invite me to speak to your graduating class at your commencement exercises. Let me tell you how much I appreciate it, and how glad I am of the opportunity to affirm my profound faith in the special fitness of women for the medical profession. As practising physicians, the large numbers of successful women, of whom your city and your school have had many conspicuous examples, make the question of their value a closed subject. There are perhaps fewer women working on the scientific side of medicine, but no one would now advocate eliminating the work of a Madame Curie, because of a prejudice against the sex of the worker. In relation to education, may I call your attention to the fact that yesterday the Johns Hopkins University honored a woman, Miss M. Carey Thomas, retiring president of Bryn Mawr College, because she is one of the outstanding educators of our day. She has a relation to medical education because her vision and her profound faith in the value of the college training as a preparation for medical education had raised the standards of medical education in this country. Thus it seems to me that the question of giving women a medical training has now been settled, but there is one place where women who are now studying may increase rather than decrease the prejudice against giving women adequate chances for a medical education, namely, if the women who have been adequately trained so lightly give up all use of that training when they marry. English women have been able to carry on the practice of medicine after mar-

[1] Address delivered at the seventieth commencement exercises of the Woman's Medical College, Philadelphia, Pennsylvania.

riage and it is quite possible for married women to do scientific work or public health work of a high order if they have the ability and the training, so there is no reason why the responsibility to the community for using expert training should not be forcibly presented to our students. Indeed, one of the next steps in the feminist movement is for educated married women to claim and to carry on a share of professional work.

I desire, however, to speak this morning on a subject of more general interest in medical education, a subject which it may be possible to apply only to medical schools connected with univerrsities at the present time but one of such general importance to the medical profession that I most earnestly bespeak for it your sympathetic interest. I refer to the extension of the so-called full-time scheme to the clinical branches.

About thirty years ago, the full-time plan of teaching was introduced into the pre-clinical departments of our medical schools. At that time the pre-clinical sciences were unproductive servants of the clinical branches and were taught by practicing physicians as a side issue; they are now represented by professional anatomists, physiologists, chemists and pathologists. No one questions the value of the change. The idea was but the extension into the medical training of the fundamental principle that teaching is a highly specialized profession. It has not been very long since the presidents of our colleges were ministers, now they are professional educators. The thought that it was now time to apply the same principles of education to the clinical branches that had wrought so much progress elsewhere can be traced, I think, to the late Professor Mall and Mr. Abraham Flexner. The experiment is now being tried in several of our medical schools which are a part of universities, but the plan is having an even more difficult time to win support than did the earlier experiment with the scientific side. It is not yet clearly understood by our students and has therefore not yet won their enthusiastic sympathy; and it is still actively opposed by some of the medical profession. The reasons for these difficulties are threefold: first, the failure to keep the fundamental principles involved distinct from personalities; second, the greater complexity of the actual scientific problems involved, and third, certain practical difficulties in putting the plan into effect.

The fundamental principle, as I see it, is a recognition of the value of education to the community. It states boldly that a great educator in clinical medicine is as great an asset to the community as a great practitioner of medicine. To set any great value on teaching runs counter to popular belief. If you are accustomed to look facts in the face you will admit this to be true. You all know the phrase, "he who can, does; he who can not, teaches." You all remember that the most frequent criticism of Wilson was that his training had been only that of a teacher. In Wells' history there is a statement of the exact truth about education; that we treat it in a beggarly, niggardly way. The funds for education are in part an endowment that is given by a few people; and, in part, they have been won from unwilling and uncomprehending legislatures. What a pitiful contrast do the sums we spend on teaching make with the sums we spend on war!

In studying the problem, it is first essential to analyze the relation of research to teaching. On the scientific side, it is now established with sound wisdom that all teachers should be engaged in research. It is based on the idea that universities shall be the home of intellectual progress; that they should have a double function, the advancement of knowledge and the training of those who shall carry it on. Research is the teacher's own professional work, it is that which he does; it makes plain to his students and to his colleagues the quality of his mentality and it is his contribution to the knowledge of his day. Only to minds of feeble comprehension does the carrying on of research mean any lessening of the value of teaching; research lifts teaching to a higher plane. It is perhaps better to say that no one can be a really great educator unless he is himself an investigator, either in the subject matter or in the methods of education, and can lead students, in part, into research, and, in part, to carry into all work the spirit and method of research. It may here be made clear that no school expects all of its students to undertake scientific investigation; indeed only a part and perhaps but a small part of the student body either want to or are fitted for it, but our schools must hold in research those who are to be the next generation of teachers. Thus the extension of the full-time scheme throughout the medical training means putting the entire medical training into the hands of professional educators.

The full-time scheme in clinical medicine substitutes research to be associated with teaching, instead of the practice of medicine. The progress of medicine of the past thirty years has brought us face to face with something quite new, namely, with preventive medicine as a reality instead of a dream. We need no longer say diseases may disappear, but diseases are disappearing. It is this fact that calls for something really profound in the reorganization of medical education. When I began the study of medicine twenty-six years ago, we learned clinical medicine mainly in the typhoid wards. In the fall nearly everything on the medical side gave way to typhoid; now our students hardly see it. The most vivid memories of my year of internship are of typhoid tubs and the elaborate reasons for believing in them; our students will now carry away the impression of the value of sanitation and the efficacy of typhoid vaccine. In China, last summer, the contrast between preventive and palliative medicine became clearer to my mind than ever before. I was hearing of deaths from malaria and discussions as to whether it was wiser for the traveler to take small preventive doses of quinine or not, some saying that the subsequent treatment in case of infection was less effective if these preliminary doses had been taken. I knew that in reality only certain places at home had really eliminated malaria; but I also knew that our own department of clinical microscopy was having a difficult time to get enough blood infected with malarial parasites to teach our students the characteristics of the organism. With our present knowledge it is easy to see that the better way for China to deal with malaria is to get rid of mosquitoes rather than to import quinine, but it is just as clear that until there is money enough and enough of a civic organization in China to undertake sanitation, the palliative treatment of each case of malaria is the only feasible plan. At least it is easy to see which type of work has the greater ultimate value, the research which shows that the mosquito is the intermediate host of malaria and shows how to eliminate the disease or the discovery of the effect of quinine and the treatment of each case. Such a contrast by no means disparages the skill of clinical diagnosis and treatment; it is quite clear that palliative medicine must remain as the measure of the failure and ignorance of preventive medicine. In the full-time scheme as applied to clinical medicine, we recognize that preventive medicine has so far advanced that we can demand that the few leaders of medical education shall have as their major intellectual interest the growth of scientific medicine. The actual dealing with the sick is an ancient and honorable profession; but the science of preventive medicine is a profession on a still higher plane and it is now legitimate to ask that those who are teaching in a profession which is thus changing shall themselves contribute to that change. The research which brings new methods is of greater ultimate value than the immediate practical application of our present knowledge.

It must again be emphasized that practical applications of knowledge are in no way to be despised. The practise of medicine must be palliative but I should here like to pay tribute to the progress of curative medicine. There has developed on the clinical side of modern medicine a degree of expert skill in diagnosis of which I believe many workers on the purely scientific side are unaware and underestimate. Our students must acquire this skill; there are certain parts of the medical training where I believe our students should be really expert when they are graduated, namely: in the technique of clinical microscopy, in the methods of medical and surgical diagnosis, and in the aseptic technique of modern surgery. In their attitude toward curative medicine, those who are working on the scientific side should keep clearly in mind that the amount of curative medicine necessary is the measure of the deficiencies of their own branch of the work. To make up these deficiencies of preventive medicine we must continue to develop the curative side, but beside the technique of curative medicine our students must now have also a training that shall enable them to continue to develop with the growth of medical knowledge and this, the greatest asset of an education, demands educational institutions that are themselves the sources of such growth.

It is frequently said by those who oppose the full-time scheme, that workers in laboratories do not possess technical clinical skill. It is true; moreover, those who are to teach on the clinical side must have clinical skill, their work must be with patients. But for those who are to be our clinical teachers the contrast is not between the laboratory and the clinic but between private practice as against practice with patients in hospitals. From the standpoint of acquiring skill and experience for the doctor, it seems to me that there can be no question but that the advantage lies in having patients in hospitals. To illustrate, Osler's well-known text-book of medicine was written as a record of his experience and that of his colleagues in dealing with the sick in the Johns Hopkins Hospital. One might make it still stronger and say that it is only in hospitals that studies and records of clinical material adequate enough to make any large contribution to clinical medicine can be made. Indeed, to go back historically, the early studies on tuberculosis of the great French physician, Louis, were made from records of patients in a hospital and started the idea that the hospital is the laboratory of clinical material. Indeed, at the present time many of the exceptionally successful physicians in private practice are developing hospitals of their own of which the Mayo clinic is a conspicuous example. For surgery, practically all of the work has already been transferred to hospitals, and for medical practice, the advantages to the patient are producing the same change. Thus, even if it be admitted, and it can not be doubted, that for the study of disease the hospital has every advantage over the home, still the opponents of the full-time scheme have often claimed that on the side of making human contacts, of learning how to deal with people, the private practitioner has a kind of experience that a teacher and a physician who deals only with patients in hospitals never acquires—I deny it. The school and hospital are as much a part of the world as the sick man in his home. The same ability to have really great influence in dealing with people makes toward success in a hospital or in a class room as in a private practice. There are two facts, however, which we should recognize, if we want to see all sides of the question. First, the teacher is somewhat artificially protected from the consequences of poor work. The teacher is always dealing with minds that are immature in his particular subject; and in the organization of our educational system the criticisms of students, that is, of those who are most affected by inefficient teaching, are allowed but little weight. I understand that in England students are not so docile as with us. Moreover, the very low salaries paid to teachers have led institutions to offer security of tenure as a compensation. We should recognize this, our institutions should set an adequate value upon the profession of teaching, and should demand high standards of work. Secondly, hospitals develop a routine in which the feelings of people are forgotten. If many of our hospitals had more of the spirit of exceedingly efficient service that characterizes our best hotels, there would be less room for legitimate criticism of caring for the sick in institutions. I do not think that this criticism applies so much to the smaller hospitals, but in some of the larger ones, where the actual medical work is done exceedingly well, the management of the institution could learn much from efficient business.

Thus we are quite willing to admit the deficiencies of our present educational system; we believe that it should be subjected to criticism, for it is better that its faults should be known than concealed. We recognize all the advantages of curative medicine, and that our present skill in dealing with disease represents a great achievement; nevertheless, we believe that the whole of medical education should be in the hands of professional educators who will recognize that the still more brilliant achievements of preventive medicine have brought us to a stage where we need to reorganize clinical teaching on the basis of research. To my mind this is the fundamental point and the final argument. Up to this time, preventive medicine has been left for the most part to chance and to boards of public health who applied what knowledge they had but attracted to their services, for the most part, only men of moderate ability. The reorganization of medical schools consists in focussing the minds of the ablest men in the profession on the problems of advance in medicine in contrast to the ideas associated with the practical applications of knowledge. This is the meaning of stressing research instead of the practical side in educational institutions.

On this plane, I believe that you will admit the principle of the full-time scheme. What are the practical difficulties? The first one is due to the complexities of clinical problems. If you analyze the progress of scientific medicine, it is astonishing how many of the discoveries that have really changed medicine in any fundamental way have come, not from the clinics, but from the laboratories; for example, diphtheria antitoxin, the whole treatment of infections by means of serums, and the discoveries of the action of the glands of internal secretion. In fact, in connection with this latter subject, there is abundant reason to demand that clinical applications of our knowledge shall measure up to the standards of sound physiological experiments. It is obvious that the materials of research are more readily handled in the laboratory than in the clinic. In the laboratory ideas can be subjected to experiment and the number of variables can be limited in these experiments in a manner not possible in dealing with patients. In the early days of the application of the idea of the full-time plan to clinical work, the first research done in clinical laboratories was pure anatomy, pure physiology and pure chemistry and was done no better than it was being done in the pre-clinic departments. It was asked and asked legitimately if there is such a thing as pure clinical research. Already we see light in this matter. There have now developed certain combinations between the workers in the pre-clinical departments and the clinics of advantage to both. I may instance the brilliant progress which has come from the laboratories of nutritional chemistry and the departments of pediatrics in the study of rickets. Here three different techniques have been brought to bear on a problem of profound interest to clinical medicine, namely, the nutritional experiments of McCollum combined with the clinical and histological methods by Park and Shipley. In the nutritional experiments on rats, McCollum and Simmonds have not only been able to produce rickets but other bone deficiencies as well and are now analyzing the effects of sunlight as well as of diets on these deficiencies. Indeed, the brilliant results in nutritional chemistry of Hopkins in England, of Mendel and McCollum in this country, demand an extension to the clinical field as a logical conclusion of their work.

Surgery gives another example of a place where such combinations are of value, for in surgery we are now passing into a phase where further progress depends on a utilization of various methods of the pre-clinical sciences. The actual technique of surgical operations has now reached a high degree of perfection and any great advance in surgery now depends on a more searching analysis of the reactions of tissues to surgical procedures. Indeed, if I may cite a particular example, we have in Dr. Halsted a man who has not only contributed very greatly to surgical technique during its period of marked development, but has also used surgical technique and the insight which his clinical experience has given him toward solving the problems of scientific medicine. Such an instance is to be found in his work on the thyroid, where he demonstrated that a graft of a thyroid gland does not take in an animal until an artificial deficiency has been produced.

On the other hand, there are certain problems with which it seems to me that the hope of progress lies with the underlying sciences. There are certain subjects where all the results which can be expected from simple methods have been obtained and where progress must be made by going deeply into the underlying causes. Such problems are to my mind illustrated in connection with blood and with the subject of the etiology of malignant growths. In connection with anemias, for example, we have had a complete survey of all the types of blood-cells that appear in the circulation under abnormal conditions, so that the hope of success now lies in a very careful study of the fundamental origin and relation of the types of blood-cells in the hope of finding out how to stimulate them differentially. If you will permit me to speak for a moment of my own work, it is now possible to cut out the blastoderm of a chick and watch it develop under the microscope, in a hanging drop preparation. In such a preparation, one can see the development of the blood-cells in the embryonic membranes of the living specimen. On the second day of incubation only red cells arise and they can be seen to come from the endothelial walls of the blood-vessels. The white cells on the other hand begin to appear on the third day. They come in part from new cells that differentiate directly from mesenchyme without becoming a part of the lining of a vessel. Moreover, the type of the white corpuscles that come from endothelium, namely, the monocytes, have the same kind of phagocytic activity, with the storage of phagocytized material, that characterizes the parent endothelium. These observations seem to me to open up anew the question of relationship of the white cells of the blood, from the standpoint of their classification on the basis of function. In connection with the great subject of new growths it is clear that we now await the discovery of their fundamental cause and that toward this discovery we need certain very fundamental biological studies in connection with the reactions of cells to normal and abnormal conditions; such as, for example, are involved in the investigations of Loeb, Murphy and others.

Problems which can be solved by purely clinical methods, or problems which need for their completion the application of clinical methods are not lacking. Indeed, their roots cover the whole period of modern medicine. In the full-time scheme, it is the argument that these problems can be solved at enormously greater advantage by a group of men concentrating their interests on the study of patients in hospitals rather than in private practice. The idea involves changing the emphasis of the interests of the leaders of the medical profession from the application of knowledge to the cure of disease, to the study of the problems of disease. It is, I believe, clear that, in the development of medicine, there is a very wide range of problems that are immediately feasible, some of them to be attacked in the laboratories of the pre-clinical sciences, some in the wards of hospitals, and some by combinations of workers in laboratories and in the clinics; but that all of them will gain by being in the hands of those to whom their solution is a major interest seems absolutely certain.

In the development of a group of scientific workers in direct connection with clinics who are actually engaged in applying the technique of the underlying sciences to clinical problems, there have grown up two groups of workers doing the same kind of work, one in connection with the clinics and the other in the pre-clinical departments. In this connection there have come discrepancies in salaries, the workers on the clinical side receiving the higher salary and ultimately the greater reward. The student becomes interested in research while still a student and finds that if he joins a clinical staff and does the same type of work that he might have done in a preclinical laboratory he will gain more respect from the university. Already there is beginning to be some surprise that such a system works against the fundamental sciences. It is said frankly that a man who keeps in touch with the clinical branches has a greater earning capacity in the community than the man who severs his connection with practice and devotes himself to the fundamental sciences. This in my judgment is a direct challenge to the leaders of universities to renew their faith in the kind of work for which universities exist. They must remedy this condition before the laboratories are depleted of their workers; they must show clearly that in estimating the use of a university they do not accept the popular estimate of the value of the practice of medicine over and above its study; and finally that they have a clear view of the merits of preventive as compared with palliative medicine. The public would always pay more to have a given case cured than to have all cases of a given disease prevented, but leaders of universities must not fall into this error. Universities should rather lead than follow public opinion. In great contrast to public opinion, it is interesting to note that the most conspicuously successful and hard-headed business man of our time has judged it wise to make his total contribution toward the study of disease. The condition of discrimination against the fundamental sciences is also a menace to universities unless they wish to lose the abler men in the pre-clinical branches who have proved themselves fundamental on two scores, on making progress, and on training workers in the methods of research. I do not believe that increased salaries of those engaged in educational work will come through any organization of teachers. The associations of teachers have always been based on the principle of improving their professional standards instead of seeking for personal gain. The profession of teaching is concerned in a very fundamental way with the ideals of giving and helping, rather than receiving. But there are signs that the community as a whole is beginning to think of the value of education. Progress through the light of reason may not be rapid, but there lurks in the minds of all of us a memory of the poison gases of the late war and a consciousness that no antidotes are to be found against them except through trained minds. It is only with regret that one appeals to the educational force of war, but it can not be escaped. It is probable that the contact of the university with the increased earning capacity of modern medicine and with the need in commercial life for men trained in science will work out to the advantage of education in two ways, first, in the bringing of more adequate funds to education, and second, in the drawing of abler people into universities, thus raising the standards of teaching.

I have claimed that the idea at the root of the full-time scheme is better teaching and more research. In the practical working out of the plan it has not always been clear that the balance of high ideals of teaching lies with the full-time scheme. If this were made clear the plan would readily win the support of the entire body of students. By the time a student has reached the third and fourth years of the medical course, he has no longer the idea that teaching does not matter; he really wants help and guidance. Marked ability to teach is not common; exceptional ability is as rare in teaching as it is in any other profession. A man who is practicing medicine may easily have as much ability to teach as a man who is doing research, and indeed, in many of the medical schools, there are practicing physicians who are doing excellent work in teaching. The universities have asked these men to teach, giving them either no salaries or salaries that are merely nominal, and have expected them to gain compensation in experience as an asset to the practice of medicine. The full-time scheme must not be considered as an attack on these men but merely as the next step in the progress of medical education which demands that educational institutions shall now select, and draw into their teaching force, a group of men who shall devote their entire energy to teaching and research. If this can be done, one can hardly question but that the advances of the past thirty years of professional teaching of the pre-clinical side will be duplicated on the clinical side.

It is clear that two factors have given us a very much larger staff of teachers on the clinical than on the pre-clinical side. The first is the legitimate factor of the development of the great number of specialties. The second is the fact that many clinical teachers have put only a small part of their time into teaching and the fact that the custom of the medical school of paying them practically nothing has made it easy to increase their numbers. With the change of emphasis on teaching and research, it is obviously impossible to put all of this large group on the full-time basis with adequate salaries. The change can be made rapidly in the organization of new institutions but must be made gradually in the older ones, where only a few of the teachers in the main branches of medicine and surgery, together with representatives of some of the specialties, varying according to local conditions, can be put on the full-time plan in the beginning. This can be done with the confident expectation that the principle which is the more sound toward improving education will win out in the end.

The development of modern scientific medicine with all its expert skill, and especially the skill of modern surgery, has brought the same possibilities of exaggerated financial reward into medicine that has followed the development of machinery into industry. Moreover, in the practise of medicine, a chair in a great institution serves as the same enormous financial asset as advertising in business. These facts are conspicuous and hence overestimated. The number of men making conspicuous wealth in medicine is not large. The skill of the physician deserves an adequate reward. Unfortunately it has been made to appear as if the fundamental reason for the full-time scheme was an attack on commercialism in medicine. It is not true; the fundamental reason is much more profound, more constructive, it concerns the development of higher ideals of research and teaching. It is true that the development of the full-time scheme makes large demands in terms of ability; it needs men with ability for research, for teaching, and for organization, but men for whom ideals and the chance for a brilliant achievement may outweigh the pursuit of excessive wealth. I say excessive wealth advisedly; the advantages to the community have already been so enormous in the development of scientific medicine, and it is so logically the next step to bring clinical medicine under the principle underlying this progress, that it should be possible to give adequate support to this new development.

I said at the beginning that there had been considerable opposition on the part of the medical profession to the full-time scheme. This opposition I believe to be due to a lack of understanding of the principles involved and to the difficulties of transition. One certainly hears some suggestion, vaguely expressed, perhaps not wholly consciously formulated, of a fear of preventive medicine. To this there can be only one answer. To preventive medicine the medical profession must adjust itself. It is obvious that eliminating typhoid, malaria, typhus, smallpox, cholera and so forth have so far not emptied our hospitals nor diminished the need for doctors; indeed, along with preventive work, many conditions have come into the range of treatment which were formerly untouched, so that up to the present time the effect of preventive medicine has been expressed largely in a lengthening of the expectation of life. This fact, together with the eliminating of many of the weaker schools of medicine, makes it sure that the effects of preventive medicine on the profession belong to another generation, not to ours. When the time comes, the medical profession will make the only possible adjustment of training fewer physicians.

In conclusion, I may say that I do not think that all the problems associated with the practical extension of the full-time scheme to the clinical side have been solved. Adjustments may have to be made, perhaps radical ones, but I profouudly hope that the plan will be given an adequate trial and that it can win the support of those who are teaching in our medical schools, because I believe it of the utmost importance to the community to range the ablest minds in the medical profession on the side of preventive medicine. Besides an occasional school of hygiene and public health we need to have all of the leaders of medical education engaged in research to advance medicine. It is my sincere conviction that the opposition to extending the modern standards of professional education to clinical medicine will yield readily to sound constructive leadership on the part of those who desire this reform.

FLORENCE R. SABIN
THE JOHNS HOPKINS MEDICAL SCHOOL

PRELIMINARY REPORT ON AMERICAN BIOLOGICAL STAINS

As previously mentioned in this journal,[1] a committee was organized under the auspices of the National Research Council last fall for

[1] "The Standardization of Biological Stains," SCIENCE N. S. LV, 43-44; Conn, H. J.: "American Biological Stains Compared with Those of Grübler," SCIENCE, N. S. LV, 284-285.

the investigation of the biological stains produced in this country. This committee is working in cooperation with the Society of American Bacteriologists, the Botanical Society of America and the American Society of Zoologists. Through the cooperation of these different organizations stains are being tested in their bacteriological applications, and in their histological and cytological uses, both in connection with zoology and botany. The field is a very large one and in some lines the work is only just barely started; but enough information has been obtained in connection with certain uses of some of the stains so that a preliminary report is justified at the present time.

The most important conclusion reached in this work is that in general as good stains can be obtained in this country now as were available before the war. In some cases the American products are distinctly better than were the Grübler stains. The only important stains we have so far failed to find in satisfactory quality in this country are methyl green and safranin. In regard to these it must be mentioned that not all Grübler samples were satisfactory, some of the samples we have tested which were of unquestionable Grübler origin proving as unsatisfactory as the poorest American samples. It must be remembered that Grübler did not manufacture stains, but bought from other concerns in large quantities, and the constancy of his stains was due wholly to the large bulk he was able to buy at once, on account of the large market which he supplied. In general his stains were in no sense pure, and one of the greatest difficulties in this country at present is that as soon as a biologist obtains poor results with a stain he immediately calls for a purer product, which the manufacturer tries to supply, often obtaining stains that are too pure to be used by the same formulæ originally used with Grübler stains. It is not purity so much as agreement with the Grübler products in staining properties that should be desired.

It is hoped that eventually one line of stains may come to have official approval in this country, not necessarily all manufactured by the same house but the production of each stain limited to one concern, so that responsibility of its manufacture can be definitely fixed. Arrangements for this have not yet been made and can not be until more preliminary investigation has been carried on, but at the present time it is possible to recommend certain brands of the most common stains for certain particular purposes.

METHYLEN BLUE

There are various grades of methylen blue on the market, but so far as we have been able to find out, one grade, namely, the medicinal grade generally designated as methylen blue U.S.P., seems to be satisfactory for all purposes. This is the purest grade of methylen blue on the market and, although there are other grades of slightly less purity, designated by such terms as "BX" or "rectified for blood stains," which are perfectly satisfactory for staining purposes, nevertheless the difference in price between them and the medicinal grade is insignificant. It is the committee's recommendation, therefore, that methylen blue U.S.P. be regularly specified. The following brands have been very carefully tested for bacteriological purposes and prove to be very satisfactory. Indications are that they can be used equally well in histological work, although for this purpose they have not been so fully tested. These brands are: Coleman and Bell Company, National Aniline and Chemical Company and Providence Chemical Company.

Of these three brands, the first and last mentioned have been tested in vital staining of shrimps and sea worms. In this work quite a large number of other methylen blues were run for comparison. Of those tested, the sample of medicinal methylen blue from the Providence Chemical Company was the only American sample of known manufacture to compare with Grübler's methylen blue for bacilli when used for this purpose. Only one report on the stains used in this way has been received, but as it is by a specialist in this line of work the results are regarded as quite conclusive.

FUCHSIN, BASIC

This stain has been tested for two different purposes: (1) Staining bacteria, primarily the tubercle organism; and (2) for use in the Endo medium for differentiating the colon and typhoid organisms. For staining bacteria several satisfactory samples have been found, namely, those obtained from Coleman and Bell, Dicks, David & Co., the Goldin Biological Laboratories, the H. S. Laboratories, National Aniline and Chemical Company, the Newport Chemical Works and the Providence Chemical Company. Used in the Endo medium all of these samples have given as good results as Grübler's basic fuchsin, but one of them, namely, that of Coleman and Bell, gives even better results for this purpose than Grübler's samples or any of the others tested.

GENTIAN VIOLET

Gentian violet is not a textile dye. It is not recognized in the regular dye industry and is not listed in Schultz's index, the recognized list of textile dyes. The name was apparently introduced by Grübler and is certainly found nowhere except in the literature relating to biological stains. Grübler's gentian violet was a mixture of various pararosanilin dyes, but its exact composition is a little difficult to determine because of conflicting statements that have been made about it. Somewhat simpler mixtures of these pararosanilin dyes are known to the textile trade under the name of methyl violet, the name being followed by a designation indicating the shade such as B, 2B, 3B, etc.

The methyl violets are regarded as being various mixtures of the following three compounds: Tetramethyl-pararosanilin, pentamethyl-pararosanilin, hexamethyl-pararosanilin, which differ from each other as the names imply in containing 4, 5 and 6 methyl groups respectively to the molecule. The more highly methylated the compound, the bluer its shade, and as in the trade designation of these dyes the number of B's following the name indicates the depth of the blue in the violet, it may be assumed that the more highly methylated compounds are distinguished by the greater number of B's, although these trade designations do not refer to definite chemical formulæ. In the case of methyl violet 5B, 6B and 7B, there is apparently a still different compound introduced in which one or more of the methyl groups have been replaced by benzyl groups.

Only two of these compounds have to our knowledge been put upon the market in a pure form, namely, the pentamethyl and the hexamethyl compounds. The former of these has been claimed to have been obtained pure for use in microscopic work but has never been put on the market widely. The latter is a well-known textile dye sold under the name of crystal violet.

It will thus be seen that there are quite a variety of dyes and biological stains all falling within the group commonly referred to by biologists as gentian violet. Now that it is certainly difficult, and perhaps impossible, to obtain the same mixture sold by Grübler as gentian violet, it becomes a question just what to use in its place. Certainly it is not wise to purchase "gentian violet" at the present time, because every dealer has his own idea as to what to sell under this name and the different gentian violets at present on the market vary from pure crystal violet to various mixtures of methyl violets with crystal violet, some of them possibly containing other dyes as well.

The first point, therefore, that the committee wished to test was as to what dye to substitute for gentian violet. The work so far done along this line has been mostly in connection with the Gram staining technic, the procedure for which the bacteriologist most frequently employs this stain. Work is at present in progress to see whether the conclusions reached in this work will apply also to this stain when used for histological purposes. The indications are that they will.

It has been found that for the Gram stain the compounds of low methylation such as those known under the names methyl violet, methyl violet B and methyl violet 2B are rather unsatisfactory, but that methyl violet 5B and crystal violet can be well substituted for gentian violet. Now, crystal violet is a definite chemical compound and is generally recognized as a textile dye; hence, the source of supply is much more constant than in the case of any of the other dyes in this group, and it seems to be the most logical substitute to use. The committee therefore recommends that, except for work where it is known that crystal violet will not work, this dye be substituted for gentian violet, and that it be regularly substituted for it in the Gram stain for bacteria.

There seem to be but two sources of crystal violet in this country—namely, the du Pont Company and the National Aniline Company. The du Pont product we have tested and found to be of very good quality. The National Aniline product was not obtained in time to include in the cooperative tests, but upon examination by the writer it appears to be entirely satisfactory for the Gram stain.

Crystal violet can be obtained from nearly all the dealers in biological stains but we are informed that nearly all of them buy the du Pont product and rebottle it without any purification or standardization. The du Pont Company does not sell this dye in small bulk, so when ordered for staining purposes it is well to buy it through one of the dealers in stains but to specify the product desired. The National Aniline Company sells crystal violet both in bulk as a dye and in small containers as a stain.

If gentian violet is ordered it is recommended that it be purchased from one of the following concerns, all of which have been tested for the Gram stain and found to be very satisfactory: Coleman and Bell, Goldin Laboratories, H. S. Laboratories, National Aniline and Chemical Company and Providence Chemical Company.

In using any of these dyes it must be remembered that owing to the presence of a large amount of dextrin and possibly other impurities in the Grübler product the American stains are two to four times as strong. This must be allowed for in preparing the formulæ. Those formulæ which call for a definite amount of saturated alcoholic solution of gentian violet do not need to be changed, but those calling for a definite number of grams per 100 cc. must be modified to suit these more concentrated products.

HÆMATOXYLIN

One source of American hæmatoxylin proves to be very satisfactory for general purposes and is specially recommended for cytological work. This is the c.p. product prepared by McAndrews and Forbes. It is handled by all of the dealers in stains but generally without indicating the manufacturer on the label. Although this is probably the only c.p. hæmatoxylin on the market and is handled without modification by every concern that deals in these products, nevertheless users of this stain are recommended to specify the McAndrews and Forbes product in order to discourage dealers of these stains from omitting the manufacturer's name from the bottles when all they do themselves is to rebottle the stains. The McAndrews and Forbes hæmatoxylin has been enthusiastically endorsed by practically every one who has used it, generally with the statement that it is better than some Grübler samples.

EOSINE

The situation in regard to eosine is not quite so satisfactory, but even in this case it is not discouraging. The Grübler samples of eosine seem to have varied considerably, certain samples proving poorer than certain American samples and others distinctly better. For the present it can merely be said that the most promising American samples so far tested have been those from the Geigy Chemical Company and from the Heller and Merz Company, among the manufacturers, while among the dealers in biological stains, apparently satisfactory samples have been obtained from D. H. Pond of Cleveland, Ohio, from the Providence Chemical Company and from Coleman and Bell. The latter has been tested with good results in Mallory and Wright's methylen-blue-eosine formula. These samples have also been used in counterstaining against hæmatoxylin in histological work and for staining red blood cells, and have proved distinctly better than the Grübler samples submitted for comparison with them but not as good as some Grübler samples that the individual investigators have had on hand in their laboratories. These results must be regarded as very preliminary findings. Further work is now in progress and it is hoped in a later report to have more definite information in regard to eosine. For the present no definite recommendations are made. It is suggested that where unsatisfactory results are obtained in counterstaining against hæmatoxylin, Orange G may be substituted for eosine to great advantage.

ORANGE G

Samples of Orange G have been tested from Coleman and Bell, the du Pont, the Geigy

Chemical Company, the Grasselli Chemical Company, and from the National Aniline Company. All of these have been found to work satisfactorily as a counterstain with the hæmatoxylin. They all seem to be more concentrated, however, than the Grübler product and have a tendency to overstain, especially if used in alcoholic solution. In aqueous solution, although they give a slightly browner color than Grübler's Orange G, they have proved very satisfactory. Any tendency to overstain can be counteracted by using weaker solutions. The results are not yet complete but are very encouraging so far as they go.

PYRONIN

Some difficulty has been experienced in obtaining a good American source of pyronin, which is now considerably used in the Pappenheim stain and as a counterstain in the Gram technic. Only two samples have so far been tested under the direction of the committee, one from Providence Chemical Company and the other from the National Aniline Company. The former proves satisfactory, the latter less so. Other concerns list this stain, but their products have not yet been tested. More work on this stain is now in progress.

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F. W. Mallory
F. G. Novy
L. W. Sharp
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Chairman
Committee on Standardization of Stains, National Research Council
Geneva, N. Y.

GEORGE BRUCE HALSTED

George Bruce Halsted, son of Oliver Spencer and Adela (Meeker) Halsted, was born at Newark, N. J., November 25, 1853. He received the degrees of A.B. (1875) and A.M. at Princeton, and Ph.D. (1879) at Johns Hopkins.

For a few years he was instructor in post-graduate mathematics at Princeton, then (1884-1903) professor of mathematics in the University of Texas. Here he rendered with marked success his most important services as a teacher of mathematics. After leaving this institution he was professor of mathematics at St. John's College, Md. (1903), and at Kenyon College, Ohio (1903-6), and finally at Colorado State Teachers' College (1906-12), when he retired from teaching and devoted himself to practical work in electrical engineering. Six or seven years later his health began to fail and in 1921 it broke down completely, so that he could not do any work. He spent his last few months in hospitals and sanitariums, and finally passed away, March 16, 1922, at the Roosevelt Hospital, New York.

After retiring from teaching, Dr. Halsted continued his labors in the field of mathematics so far as his occupation permitted, nor did he abandon them, even after his failing health had become serious, until further work was physically impossible.

At Johns Hopkins he studied under Sylvester, for whom he had the greatest admiration and from whom he seems to have imbibed the view that, whatever else mathematics may be, it is poetry. To this fact may possibly be due his inclination to employ poetic diction in discussing mathematical subjects.

Dr. Halsted was preeminently a geometrician, though he wrote some articles on higher mathematics. He was an ardent devotee of non-Euclidean geometry. Some of his utterances justify the opinion that he believed, not only that space is a genus comprising more than one species, but that our space is actually non-Euclidean and (with Riemann) that, though boundless, space may be finite. He wrote several works on geometry (including mensuration) one of which was translated and republished in France. He wrote many articles for periodicals, most of them on non-Euclidean geometry. He also contributed articles to the *Century Dictionary* and the *Encyclopedia Britannica*. He translated a good many works, written in different modern languages and two written in Latin—Bolyai (the well-known *Appendix*) and Saccheri (*Euclides Vindicatus*). He seemed to attach more importance to his having translated these two works and Lobatschewsky's non-Euclidean geometry than to anything else he ever did. When he was compelled to cease from work of any kind he was preparing a translation of Saccheri's *Logica Demonstrativa* from a copy which he believed to be the only one extant.

He married Margaret Swearingen, who, with three sons, survives him.

Arthur M. Humphreys
University of Virginia

SCIENTIFIC EVENTS

THE FOULERTON PROFESSORSHIP AND STUDENTSHIPS OF THE ROYAL SOCIETY[1]

The Council of the Royal Society gives notice that it has created the Foulerton research professorship, and that the appointment of a professor will be made on the advice of a committee of fellows called "The Foulerton Research Fund Managing Committee." The stipend will be £1,400 a year, and the duty of the holder of the professorship will be to conduct, in a place approved by the committee, such original researches in medicine or the contributory sciences, on lines approved by the committee, as shall be calculated to promote the discovery of the causes of disease and the relief of human suffering. The appointment will be in the first place for five years, but may be renewed for further periods of not more than five years at a time. The normal retiring age will be 60, but a professor may be continued in exceptional cases for a further specified period. Arrangements are being made for superannuation under the federated superannuation system for universities, and the professor will be required to devote the whole of his time to research. The holder of a paid academic or other scientific appointment may, however, be nominated, provided the committee is satisfied that the duties of such other appointment occupy only a subsidiary portion of the applicant's time and that its retention would not interfere with the discharge of the duties of the professorship as essentially a whole-time research appointment. In such case the committee would recommend a reduction of the stipend, of such amount, however, as shall not reduce the total annual income of the professor from his paid appointment and from the fund below £1,400. The appointment will only be made if candidates of sufficient distinction present themselves. The Royal Society also gives notice that it is prepared to appoint one or more Foulerton research students. The duties of a Foulerton research student will be to conduct researches in medicine or the contributory sciences under the supervision and control of the committee, to whom the student will be required to report from time to time on the progress of his work. The studentship will be for three years, but may be renewed from year to year until it has been held for a maximum period of six years from the first award. In recommending a person for appointment as student, the committee will have in view the expressed wish of the donor that awards should be made especially to young workers. The stipend is £700 a year, and a studentship will normally be regarded as a whole-time appointment, but in exceptional cases the holder may be allowed to retain a paid teaching post; in that case the committee may recommend the payment of such stipend as it may think fit. A candidate may be called upon to show that he or she is and that his or her father and paternal grandfather are, or were at the date of the respective deaths, of British nationality. Applications for the professorship or studentship, for both of which members of either sex will be eligible, must reach the Royal Society not later than October 31 next.

[1] From the *British Medical Journal.*

APPOINTMENTS AND PROMOTIONS AT THE JOHNS HOPKINS UNIVERSITY

IN THE FACULTY OF PHILOSOPHY

Joseph T. Singewald, Jr., Ph.D., associate professor, to be professor of economic geology.

IN THE FACULTY OF ENGINEERING

Frederick W. Lee, Ph.D., associate, to be associate professor of electrical engineering.

J. Trueman Thompson, B.S. in Eng., associate, to be associate professor of civil engineering.

IN THE FACULTY OF HYGIENE AND PUBLIC HEALTH

William W. Ford, M.D., associate professor, to be professor of bacteriology.

Carroll G. Bull, M.D., associate professor, to be professor of immunology.

Robert W. Hegner, Ph.D., associate professor, to be professor of protozoology.

Linda B. Lange, M.D., instructor, to be associate in bacteriology.

IN THE FACULTY OF MEDICINE

Warfield T. Longcope, M.D., professor of medicine.

Harold L. Amoss, M.D., associate professor of medicine.

Robert S. Cunningham, M.D., associate, to be associate professor of anatomy.

William S. McCann, M.D., associate, to be associate professor of medicine.

Arthur L. Bloomfield, M.D., associate, to be associate professor of medicine.

Benjamin Kramer, M.D., associate, to be associate professor of pediatrics.

Esther L. Richards, M.D., associate, to be associate professor of psychiatry.

Albert Keidel, M.D., associate, to be associate professor of clinical medicine.

Wilburt M. Davison, M.D., instructor, to be associate in pediatrics.

Leslie B. Hohman, M.D., instructor, to be associate in psychiatry.

Phyllis G. Richter, M.D., instructor, to be associate in psychiatry.

Emil Novak, M.D., instructor, to be associate in clinical gynecology.

Mary N. Buell, Ph.D., associate, to be associate in physiological chemistry.

Ernest H. Gaither, M.D., instructor, to be associate in clinical medicine.

J. Earle Moore, M.D., instructor, to be associate in clinical medicine.

Wilder G. Penfield, M.D., associate in neurology.

Edwin G. White, Ph.D., associate in urology.

Alfred G. Kolls, M.D., associate in physiology.

DEDICATION OF THE UNIVERSITY OF COLORADO MOUNTAIN LABORATORY

The construction of a laboratory building in the mountains near Boulder at an altitude of 10,000 feet marks a new departure by the University of Colorado. The erection of this building is the outgrowth of the field work in geology that has been conducted for the past ten years by Dean W. E. McCourt, of Washington University, St. Louis, and of the University of Colorado Summer School.

The laboratory building is constructed of logs which were hewn from the mountain side in the vicinity. It contains a working laboratory, a kitchen and an office. Sleeping quarters for students and the staff are provided in house tents. The building is located near to the university camp, a summer recreation camp conducted by the associated students of the university, some thirty miles from Boulder. The camp and laboratory are accessible by automobile over good mountain roads.

The dedication of the laboratory building was conducted by the Colorado chapter of the Society of the Sigma Xi on July 22. At these exercises addresses were delivered by Dean W. E. McCourt, Dean O. C. Lester, of the University of Colorado, and Professor F. K. Richtmyer, of Cornell University. Dean McCourt explained the character of work that is being conducted in geology in the mountains. The immediate vicinity of the laboratory has a wealth of varied geological formations which supply an abundant material for class study and research. Dean Lester pledged the support and cooperation of the Graduate School of the university in the project and expressed the hope that this unpretentious beginning may flourish and grow into a formidable institution.

The main address of the occasion was delivered by Professor F. K. Richtmyer, of Cornell University, who, in conjunction with Dr. F. E. Lutz, of the American Museum of Natural History, is spending the summer in the mountains near Boulder investigating the relation of color of flowers to insect visits. Professor Richtmyer spoke on "Sigma Xi and Research." He reviewed the history of Sigma Xi and explained the character of the work that the society is conducting at the present in the stimulation of original investigation. After the formal program Professor Richtmyer and Dr. Lutz explained the character of the problem they are investigating and exhibited the results they have obtained so far.

Besides the work in geology, the university plans to conduct field courses in biology from this mountain laboratory. The fauna and flora in the vicinity of the camp are abundant and varied. It is hoped to enlarge this plant in a few years and to provide facilities for geological and biological investigators of the country who may wish to spend a summer in the mountains. The usual cool weather and the abundant recreational facilities make the mountains an ideal place for summer work.

I. E. W.

PROGRAM ON CONSERVATION OF THE SECTION OF SOCIAL AND ECONOMIC SCIENCES OF THE AMERICAN ASSOCIATION

Section K will hold several sessions at the Boston meeting devoted to the various aspects of our natural resources and their conservation. Invitation papers by many leading specialists have already been promised. This program will constitute a symposium, or a series of symposia, that promises to be nationally of very great importance. It will interest all scientists and all workers in education, as well as all who are looking forward toward the betterment of national and international welfare and living conditions generally. The section is particularly fortunate in having, as its vice-president and chairman for the current year, Colonel Henry S. Graves, dean of the School of Forestry of Yale University. The tentative program for these sessions, as far as it has been arranged, is given below, with the names of those who have been invited to present papers. The majority of those invited to speak have already accepted.

Introductory address, by the vice-president and chairman, Colonel Henry S. Graves, dean of School of Forestry, Yale University.

I

THE CONSERVATION OF HUMAN AND MATERIAL RESOURCES

1. *The conservation of human energy,* by Dr. Thomas S. Baker, secretary, Carnegie Institute of Technology, Pittsburgh, Pennsylvania.
2. *Conservation of labor power,* by Dr. L. C. Marshall, School of Administration, University of Chicago.
3. *Conservation of health,* by Dr. Eugene R. Kelley, state health commissioner of Massachusetts.
4. *Conservation of motherhood,* by Dr. H. B. Hemenway, State Health Department, Springfield, Illinois.

II

CONSERVATION OF FUEL AND POWER

5. *Our national coal problem,* by Dr. D. L. Wing, Washington, D. C.
6. *Economic aspects of the oil problem.* (Not yet assigned).
7. *Conservation of power,* by Mr. William S. Murray, Grand Central Terminal, New York.
8. *Problems of flood control,* by General Harry Taylor, in charge of government flood control work, Corps of U. S. Army Engineers, Washington, D. C.
9. *Conservation and industrial waste,* by Dr. John T. Black, state health commissioner, Hartford, Conn.

III

CONSERVATION OF CAPITAL AND CREDIT

10. *Conservation of capital,* by Mr. H. T. Newcomb, general solicitor, Delaware & Hudson Company.
11. *Conservation of wealth through insurance,* by Mr. Chamberlain, superintendent of the Group Insurance Department, Travellers Insurance Company, Hartford, Conn.
12. *Conservation of America's economic independence,* by Dr. Frederick L. Hoffman, dean of Advanced Department, Babson Institute, Wellesley Hills, Mass.

IV

CONSERVATION AND RURAL DEVELOPMENT

13. *The national problem of land reclamation,* by Mr. F. H. Newell, Washington, D. C.
14. *Problems of rural economics,* by Professor E. G. Nourse, chief of agricultural economics, Iowa State College.
15. *Conservation of the qualities of the rural population,* by Dr. Kenyon L. Butterfield, president Massachusetts Agricultural College.
16. *Home economics,* by Mr. C. F. Langworthy, States Relation Service, Washington, D. C.

V

CONSERVATION OF FOREST RESOURCES

17. *The forests of the world,* by Mr. Raphael Zon, forest economist, U. S. Forest Service, Washington, D. C.
18. *Economic aspects of our timber supply,* by Colonel W. B. Greeley, chief forester, U. S. Department of Agriculture.
19. *Forest research and the forestry movement,* by Professor R. T. Fisher, head of Division of Forestry, Harvard University, Cambridge, Mass.

20. *State policy in forestry*, by Mr. W. A. L. Bazeley, state conservation commissioner of Massachusetts, Boston, Mass.
21. *Forestry and rural development*, by Colonel Henry S. Graves, dean of the School of Forestry, Yale University.

VI

CONSERVATION OF NATIONAL PARKS AND SCENIC RESOURCES

22. *Our scenic resources and their practical uses*, by Dr. G. F. Kunz, president, American Scenic and Historic Preservation Society, New York City.
23. *Our national park policy in its economic aspects*, by Mr. Robert Sterling Yard, secretary of the National Parks Association, Washington, D. C.
24. *Conservation of waters of medicinal and healing value.* (Not yet assigned).

VII

CONSERVATION OF GAME RESOURCES AND WILD LIFE

25. *Economic aspects of game conservation*, by Mr. F. C. Walcott, fish and game commissioner, Hartford, Conn.
26. *Conservation of our whale fisheries*, by Dr. John Franklin Crowell, economist, New York City.
27. *The migratory fish problem*, by Dr. R. E. Coker, U. S. Bureau of Fisheries.

Frederick L. Hoffman,
Secretary of Section K
Wellesley Hills, Mass.

SCIENTIFIC NOTES AND NEWS

Alexander Graham Bell died on August 2 at his summer home in Nova Scotia. Dr. Bell was born in Edinburgh on March 3, 1847.

Dr. W. J. Holland, since 1898 director of the Carnegie Museum, Pittsburgh, has become director emeritus. He is succeeded in the directorship of the museum by Mr. Douglas Stewart.

President John Bracken, of the Manitoba Agricultural College, Winnipeg, formerly professor of field husbandry at the University of Saskatchewan, is to be the next premier of Manitoba.

More than 500 of the pupils and friends of Professor L. Bolk, of the chair of anatomy at the University of Amsterdam, recently presented him with his portrait painted in oils.

Dr. F. T. Aschmann, chemist to the Pennsylvania Bureau of Foods at Pittsburgh, has been elected chairman of the board of chemists of the bureau, to succeed the late Professor William Frear.

Dr. W. H. Brittain, provincial entomologist for Nova Scotia, has been appointed a member of the council of the American Association for the Advancement of Science, to represent the Canadian Society of Technical Agriculturists.

Dr. F. P. Veitch, of the Bureau of Chemistry has been appointed by the secretary of agriculture as a member of the special committee on government paper specifications. This committee will prepare and submit to the congressional joint committee on printing specifications for paper for public printing and binding.

Dr. J. A. Ambler has been appointed chemist in charge of the Color Laboratory of the Bureau of Chemistry. Dr. Ambler has been acting chief since the resignation of Dr. H. D. Gibbs.

Dr. W. H. Rankin, Ph.D., plant pathologist for the Dominion of Canada, has been appointed an associate in research (plant pathology) at the New York State Station, effective July 1, and will take up a special study of diseases and insects affecting raspberries, particularly in the Hudson River Valley. This work has been made possible by a special grant by the legislature. D. W. Carpenter, Ph.D., assistant professor of physical chemistry at the University of Iowa, has been appointed associate in research (chemistry), beginning on July 1. W. L. Kulp, assistant in research (biochemistry), has resigned, effective on the same date, to accept a teaching fellowship in bacteriology and biochemistry at Yale University, the vacancy being filled by the transfer of Millard G. Moore, assistant chemist.

E. E. Clayton, Ph.D., extension plant pathologist at the Ohio State University, has been appointed pathologist at the newly established field station on Long Island. H. C. Huckett, a graduate student at Cornell University, has been appointed associate entomologist, beginning on July 1.

Mr. R. E. Zimmerman, formerly director of the research laboratory of the American Sheet and Tin Plate Company, has been made assistant to the vice-president. Mr. J. W. Whetzel, formerly research associate, has been appointed manager of the research laboratory, and Mr. E. S. Taylerson, formerly physicist, is now assistant director.

Mr. R. L. Howard, associate professor of chemistry in the Medical College of Virginia, has been awarded the research fellowship in pharmacology at Western Reserve University.

The University of Brussels has conferred the "Docteur spécial en sciences physiologiques" on I. Newton Kugelmass, M.A. (Columbia), Ph.D. (Johns Hopkins), for his researches, "Physico-chemical studies of the mechanism of blood clotting."

Dr. Henry Hansen, chief of the Department of Public Health of Peru, who since 1919 has been combating yellow fever there, arrived in New York on August 5 for a visit. Dr. Hansen went to Peru from the Rockefeller Institute at the request of the Peruvian government.

Dr. Aaron Arkin, professor of pathology and bacteriology at the West Virginia School of Medicine, Morgantown, has been granted a year's leave of absence for study and research abroad. He will spend the year in Vienna, Berlin, Paris and London.

Dr. W. P. Wilson, director of the Commercial Museum of Philadelphia, has been appointed by Governor Sproul of Pennsylvania commissioner to represent the state at the centennial of Brazil opening on September 7. He will represent also the city of Philadelphia. Dr. Wilson has in addition been appointed delegate from the Academy of Natural Sciences of Philadelphia and from the Smithsonian in Washington, by Secretary Hughes, to the Congress of Americanists meeting about the twentieth of August in Rio de Janieiro.

Professor Theodore W. Richards, of Harvard University, spoke before the Société Chimique de France on July 12 on "La signification actuelle des poids atomique."

Dr. T. Caspar Gilchrist, of Baltimore, delivered the annual oration, on the progress of dermatology, before the London Dermatological Society.

Dr. Walter B. Cannon gave an address on "What has been accomplished by animal experimentation" during the recent meetings of the Pacific Northwest Medical Association.

A legislative bill that recently passed the French Chamber of Deputies, as we learn from the *Journal* of the American Medical Association, provides for the granting of an appropriation of 3,620,000 francs to enable the state to participate in the commemoration at Strasbourg of the centenary of Pasteur. The committee delegated to inquire into the project has reported that the centenary should be celebrated not in Strasbourg alone but also in Paris and in various cities of Franche-Comté in which Pasteur lived—particularly Dôle, Lons-le-Saunier, Arbois and Besançon. The committees on public instruction and public health, after hearing M. Strauss, minister of public health, who spoke in the name of the government, reached the same conclusion and decided to request the government to modify the scope of the centenary by eliminating the two words "at Strasbourg." Acting on the suggestion of M. Deville, in turn, the municipal council of Paris has unanimously voted an appropriation of 50,000 francs for the celebration at Paris of the centenary of Pasteur.

An appeal has been made for subscriptions to a proposed memorial to Sir German Sims Woodhead, late professor of pathology in the University of Cambridge. It is proposed that the memorial shall take the form of a portrait relief in bronze, to be placed in the library of the Medical School at Cambridge, and that it shall correspond in design to those of Professor Woodhead's predecessors in the chair of pathology, the late Professors Roy and Kanthack.

Professor J. J. Mackenzie, head of the pathological departments of the University of Toronto, died on August 1 at the age of fifty-seven years as a result of infection contracted during his experiment with the pus-forming bacteria.

Dr. Ambrose Robinson Willis, who for many years taught mathematical physics at the Royal College of Science, died on June 23, at the age of seventy-two years.

Dr. Harvey Cushing, of Harvard University, has been awarded the Charles Mickle Fellowship of the faculty of medicine of Toronto University. He has accepted the fellowship, which is for $1,000, but has stipulated that the money shall be used to send one graduate of the University of Toronto to Harvard to work with him. The Charles Mickle Fellowship, bequeathed by the late Dr. W. J. Mickle, is the annual income from an endowment of $25,000 and is awarded annually to the member of the medical profession anywhere who is considered to have done the most during the preceding ten years to advance sound knowledge of a practical kind in medicine. The first award was made last year to Professor I. Pawlow, of the University of Petrograd.

Professor A. Sommerfeld, professor of mathematical physics at the University of Munich, will be in residence at the University of Wisconsin for the first semester of the coming academic year 1922-23, holding the Karl Schurz memorial professorship in the university for that period. Professor Sommerfeld is expected to give a three-hour course on "Atomic Structure" and a second three-hour course either on the "Analysis of Wave Propagation," or a three-hour course in "The General Theory of Relativity." The Karl Schurz memorial professorship in the University of Wisconsin was founded in 1910 as an exchange professorship with the German universities. The appointment of Professor Sommerfeld marks the resumption of the professorship after the interruption caused by the war. Before the days of the Civil War, Karl Schurz was a resident of Watertown, Wisconsin, and served on the board of regents of the State University. The memorial professorship was founded in recognition of his distinguished services to the state and nation.

The following appointments have been made in the Food Research Institute of Stanford University: *Special investigators*—Wilfred Eldred, Ph.D. (Harvard), recently professor of economics at the University of Virginia, who for nearly a year has been carrying on investigations in the baking industry for the institute, and John L. Simpson, A.B. (California), who in 1919 was liaison officer of the food section of the Supreme Economic Council and chief of the A. R. A. Commission to Serbia, and in 1920 special correspondent to the New York *Evening Post* for eastern Europe. *Research assistants*—Susan S. Burr, A. B. (Vassar), A.M. (Stanford); Franklin D. Schurz, A.B., M.B.A. (Harvard); A. G. Silverman, A. B. (Harvard). *Fellows*—Edith Hawley, A.M. (Columbia), a graduate student at Columbia for the past two years; James N. Holsen, A.B. (Indiana), A.M. (Princeton); Olaf S. Rask, A.B., B.S. (Minnesota), a graduate student at the University of Minnesota and formerly a research chemist in the Bureau of Chemistry, U. S. Department of Agriculture; William B. Stewart, A.B. (Reed), a graduate student at the University of Illinois; and Conrad P. Wright, A.B. (Oxford), a graduate student at the University of California.

We learn from the *Journal* of the American Medical Association that Dr. R. P. Strong, of the Harvard Medical School, who has just returned from his fourth trip to Panama, has announced that it has been decided to establish first divisions of bacteriology, pathology, protozoology, helminthology, biochemistry, entomology, plant pathology and animal diseases in the new Gorgas Memorial Institute of Tropical and Preventive Medicine, at Panama. These departments will be organized with laboratories for research work, particularly in connection with the study of the mode of spread of the most important infectious diseases of man and animals. There will be close cooperation between the institute and the Ancon Hospital and Leprosarium. In addition to the foregoing subjects, tropical botany and the biologic effect of sunlight will also receive attention. Provision will be made for the instruction of a limited number of students, the courses of instruction to be designed especially for those who have had laboratory training before. A limited number of research workers will also be received. Dr. Strong states that, since the president of a small South American republic, already overtaxed, had donated a memorial to an American, it was the duty of all American citizens, not only American physicians, to provide a suitable endowment fund with which to carry on the work of the institute.

The conference of the British Museums Association has noted: "That in the opinion of the Museums Association the time has arrived when it is desirable in the interests of the country to appoint a royal commission to investigate and report upon the work of museums in relation to industries and general culture."

At its recent meeting, the Eugenics Research Association voted that it was its sense that Germany should be granted membership on the International Eugenics Commission.

The Canadian Horticultural Council, which was recently organized with headquarters at Ottawa, has taken steps towards the organization of a system for the registration of new varieties of plants. Through the agency of Mr. W. B. Lobjoit, controller of horticulture for Great Britain, the secretary of the Canadian Horticultural Council will be kept informed of the efforts being made not only in England but on the continent, to provide a means for the registration of horticultural plants, shrubs and trees. The secretary of the council has also got into touch with the horticultural authorities in the United States who are interested in this matter. It is expected that a conference on the subject will be arranged for during the present year.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of Miss Harriet S. Hazeltine, Middlebury College receives $25,000.

According to the *Bulletin* of the American Mathematical Society, the title of the chair of "differential and integral calculus" in the University of Paris has been changed to "the theory of groups and the calculus of variation."

Dr. Marcus P. Neal, assistant professor of pathology and bacteriology at the State University of Iowa College of Medicine, Iowa City, has accepted a position as professor of pathology and bacteriology at the University of Missouri School of Medicine, Columbia.

Dr. Leroy S. Palmer, associate professor of agricultural biochemistry in the University of Minnesota, has been promoted to a full professorship.

S. W. Geiser, Ph.D. (Johns Hopkins), has been appointed assistant professor of zoology in Washington University, St. Louis.

F. B. Isely, dean and professor of biology at Culver-Stockton College, Canton, Missouri, has accepted a similar position with Texas Woman's College at Fort Worth, Texas. L. S. Hopkins, of Kent, Ohio, becomes dean and professor of biology in Culver-Stockton College.

Mr. Eliott Frost has resigned his position as director of the Industrial Management Council of the Rochester Chamber of Commerce to accept the headship of the department of psychology at the University of Rochester, the directorship of its Department of Extension, and of its Summer School.

DISCUSSION AND CORRESPONDENCE

THE SPECTRUM OF HELIUM IN THE EXTREME ULTRA-VIOLET

Mr. Fricke and I showed (*Phil. Mag.*, 41, May, 1921) that in the extreme ultra-violet the arc spectrum of helium probably contained but one line with a wave-length near 585 A.U.

I have recently attacked the subject again, using a vacuum spectroscope so arranged that a good vacuum could be maintained in the body of the apparatus while the discharge tube contained helium at a pressure of about a millimeter. No window was employed, the success of the device depending on the use of a very short and narrow slit and upon the suitable application of a powerful pump.

With a continuous current the line at 584.4 is of very great strength, and is accompanied by three new lines at 537.1, 522.3 and 515.7 whose intensities decrease with their wavelength and in a manner strongly suggesting a series relation. Luckily the first three members appear in the second order spectrum, a comparison with the hydrogen line 1215.68 and with the three following lines of the same series is therefore possible, with the result that the wave-lengths are probably correct to one or two tenths of a unit.

The spacing of these four helium lines on the frequency scale is of great interest and importance, for it is found to be identical with the spacing of the first four lines in the singlet principal series. It may be stated therefore with considerable certainty that the line 584 forms the first member of a principal series, which, according to the notation of Professor Fowler, is to be represented by oS-mP.

Besides this series there is a single line at $600.5 \pm .3$ of a feeble and diffuse character; its origin is not entirely above suspicion. In the extreme ultra-violet the arc spectrum of helium appears to contain no lines in addition to those just mentioned.

The relation between the accepted values of the resonance and ionization potentials in helium and the wave-lengths of these new lines is rather puzzling. The ionization potential should certainly correspond to the limit of the oS-mP series; now this limit can be accurately calculated, it corresponds to 24.5 volts but the experimental value is 25.3 volts. This is the chief difficulty, but it is not the only one, for the agreement between the wave-lengths of the individual spectrum lines and the values of the resonance potentials as determined by Franck and Knipping is not satisfactory. A correction of about —0.8 volts if applied to all the potential measurements will bring the two sets of data into fair agreement but at the expense of the first resonance potential which is left without any corresponding line in the spectrum.

The matter should be of some interest to those who are struggling with the model of the helium atom.

Theodore Lyman

Jefferson Laboratory,
Harvard University,
August 3, 1922

THE CALIFORNIA POPPY

It is perhaps strange that students of genetics have not given more attention to the plant which is the glory of California fields, the Copa d'Oro or California poppy, *Eschscholtzia californica* chamiso. It is a plant easily raised from the seed, remarkably affected by external conditions as well as subject to marked variations, fluctuations or mutations, which could be readily confirmed or intensified by selective breeding.

So great is the variability of this plant that Greene has separated the ordinary perennial form into thirty-two different "species," while of the eight or nine other forms, annuals, closely related to the golden poppy, but tangibly distinct from it and from each other he defines seventy-three species with some outlying varieties. To this incredible list, Fedde, a German botanist, adds several more. There is in fact no limit if we regard every peculiar plant as the type of a new species, without evidence as to the origin and permanence of its variation. Such a condition, as observed by Darwin among cirripeds, is attractive to us "as speculatists, however odious to us as systematists."

The flowers of *Eschscholtzia californica* are normally of a deep, rich orange, the four petals with entire edges an inch and a half long. Near the seashore the flowers are smaller, of a more or less clear lemon yellow, orange at base or not. This is apparently "ontogenetic" variation, not entitled to a systematic name, because likely to disappear with a changed environment, as the plant is not only inherently variable but responds directly to all changes of soil and season.

Towards the end of a rainless summer, the upright flower stalks wither and flowers successively smaller spring from near the rootstock. These are of a clear lemon yellow, sometimes more or less orange at base, the orange fading as the flower grows smaller.

Just now looking from my window as I write over a field golden with blossoms, I see numerous variations, some of them perhaps to be called mutations, as they are quite striking and, occurring in patches must be more or less permanent. In several areas the flowers are of a light creamy yellow, the petals holding their place when plucked longer than in the orange form. Another group has large flowers of a citron color. On some plants the petals are more or less laciniate on the margin. Frequently they are five in number, sometimes six, often eight. The number of pistils is not fixed, and the bifid cotyledon and broad rim of the torus, both traits normally characterizing the true *californica* (the smooth perennial), are often as elusive as the other characters.

The color especially lends itself to modification by selection. Burbank once found a plant with a crimson streak like a red thread at the base of each petal. Saving the seed, he obtained through selection alone a poppy with the flowers all crimson. Seedlings from Burbank sometimes have pinkish flowers, almost white.

Eschscholtzia has certain advantages over the evening primrose for experimental purposes. It is a natural species occurring by the million in its habitat. Though very difficult to transplant, it grows readily from the seed. It is therefore not a garden variant, nor a suspected hybrid. *Œnothera lamarckiana,* thus far the subject of most mutation experiments, though cultivated in Europe, is American in origin. No one, I believe, has yet ever found it growing wild anywhere.

In any event, accurate studies of the variation in *Eschscholtzia* should be interesting and repaying.

David Starr Jordan.

THE TEMPERATURES OF METEORITES

In the last number of Science[1] Dr. George P. Merrill discusses some matters connected with meteorites. With regard to their temperature he says, "it seems certain that they have been wandering for an indefinite period in space and at a temperature of 'absolute zero.' At the time of entering our atmosphere it is fair to assume that they are cold throughout to a degree of which we can have no conception." It has seemed to me worth while to examine roughly what temperature a meteorite might reasonably be expected to have just before it enters the atmosphere of the earth. The meteorite has certainly been for some time exposed to radiation from the sun, and it may well be that its temperature is much higher than the absolute zero.

[1] Science, 55, p. 675, 1922.

To get some idea as to the temperature suppose that the meteorite is a sphere with a black surface, and that the material of which it is composed is a perfect conductor of heat. The temperature of this sphere is determined by the condition that the rate at which it loses heat by radiation equals the rate at which it receives heat from the sun. The condition is expressed by the equation

$$4\pi r^2\sigma\theta^4 = \pi r^2 b\frac{e^2}{d^2}, \qquad (1)$$

where r stands for the radius of the meteorite, σ for the constant in the Stefan-Boltzmann radiation formula, θ for the absolute temperature of the meteorite, b for the solar constant, and e and d for the respective distances of the earth and the meteorite from the sun. If we take σ as $1.279\cdot10^{-12}$ cal./cm^2.sec.deg.^{4} and b as 1.93 cal./cm^2.min. (1) leads to

$$\theta = 282\sqrt{\frac{e}{d}}. \qquad (2)$$

Thus if black spheres which conduct heat perfectly were placed at the same distances from the sun as the several planets, (2) shows that the temperatures of these spheres would be the following:

At the distance of

Mercury	180° C.
Venus	58° C.
Earth	9° C.
Mars	—45° C.
Jupiter	—149° C.
Saturn	—182° C.
Uranus	—209° C.
Neptune	—221° C.

We see that in the neighborhood of the earth such a sphere would have a temperature above that of melting ice!

But a meteorite is not a perfect conductor of heat. Suppose we apply the above method of reasoning to a sphere which is a perfect non-conductor of heat, covered, except along a narrow equatorial line, by a thin layer of a substance which is a perfect conductor of heat and is black. The conducting layer forms two separate caps, and if one cap is turned toward the sun and the other away from the sun we find, when the sphere is as far from the sun as the earth is, that the cap which faces the sun will have a temperature of about 62° C. The other cap will be at the absolute zero of temperature, so that the average temperature of the sphere will be about —105° C. We may, therefore, conclude that if a meteorite were spherical and black its temperature when near the earth would lie between —105° C. and +9° C.

If the meteorite is not a perfect conductor of heat the temperature of the inside will not usually be the same as that of the outside. The amount by which the temperature of the inside differs from that of the outside will depend in part on the thermal conductivity of the meteorite and in part on the rapidity of motion toward the sun or away from it, as well as on the distance from the sun. Suppose that the meteorite is a sphere and has a diffusivity of 0.01 cm.^{2}/sec. This is about the diffusivity of limestone and is less than that of granite. Suppose further that this sphere is at the absolute zero of temperature and is suddenly placed where its surface is maintained at 9° C. Then for a sphere 10 cm. in diameter I find[2] that at the end of fifteen minutes the difference between the temperature at the center and that at the surface will be less than 15°, at the end of twenty minutes the difference will be less than 5°, and at the end of thirty minutes it will be less than 0.2°. If the meteorite travels 100 kilometers a second it would require nearly five days to go a distance equal to that from the orbit of Venus to the orbit of the earth. So, unless the meteorite travels much faster than 100 kilometers a second, or is much more than 10 cm. in diameter, it seems likely that the temperature of the inside can not be very different from that of the outside. This, of course, is before the meteorite enters the atmosphere of the earth.

As another way of attempting to get some idea as to the temperature of a meteorite suppose we consider the temperature of a cylinder. Let the cylinder be at the same distance from the sun that the earth is. Let the ends of the cylinder be black, and let one of them point directly at the sun. To simplify matters suppose that there is no radiation from the sides of the cylinder. Then the heat which reaches the end that is turned toward the sun is partly radiated from that end and partly conducted to the other end and there radiated. From this condition we obtain the equations

$$\sigma(\theta_1^4 + \theta_2^4) = b \qquad (3)$$

and

$$\theta_1 = \theta_2 + \frac{l\sigma\theta_2^4}{k}, \qquad (4)$$

where θ_1 and θ_2 stand for the absolute temperatures of the two ends of the cylinder, and l and k stand for the length and thermal conductivity of the cylinder. Taking k as 0.008 cal./cm.sec.deg., which is about the value for granite, equations (3) and (4) lead to the following results.

Length of cylinder	Temperatures of ends		Average temperature of cylinder
1 cm.	61° C.	63° C.	62° C.
10 cm.	52° C.	70° C.	61° C.
100 cm.	4° C.	98° C.	51° C.

In the actual case there would, of course, be considerable radiation from the sides of the cylinder, so that the temperatures would be lower than those given in the above table.

Although these calculations do not tell us precisely what the temperature of a meteorite may be expected to be just before it enters the atmosphere of the earth, they do seem to be sufficient to indicate that that temperature is nearer to 0° C. than to the absolute zero of temperature.

Arthur Taber Jones
Smith College

[2] From eq. (44) on p. 133 of Ingersoll and Zobel, *The Mathematical Theory of Heat Conduction.*

THE BUREAU OF STANDARDS

To the Editor of Science: Considering the enormous interest taken even by the non-discriminating newspaper public in the achievements of the Bureau of Standards, which scientific men are justly proud of as one of the greatest physical laboratories of the world, using physics in its proper sense of including chemistry and engineering, or applied physics, your readers may be interested in the following letter, which I have just unearthed, in one of those single-handed combats in the perennial struggle against dirt, in which an armistice has just been declared. (Pardon the lack of unity in the preceding sentence. It at least does not contain the word "due," nor the adverbial phrase "back of," meaning behind).

I had written an article, the first in English, describing the Physikalisch-technische Reichsanstalt in Charlottenburg, which I had seen in its initial stages, and urging to the best of my ability the establishment of such an institution in this country. This article I had sent to the *Popular Science Monthly,* from whence it was returned with a note from the editor, Dr. Youmans, saying he did not believe that such things were the function of the government. What to do with it I did not know, but finally Dr. G. Stanley Hall took pity on the little wanderer, and published it in his *Pedagogical Seminary,* and the U. S. post-office did the rest. I sent copies to Sir Oliver Lodge, who read an article on the same matter at the meeting of the British Association, but I never heard whether he got them. It was probably as a result of his paper that the National Physical Laboratory was founded. The United States, as usual, brought up the rear. It was not until eight years after my article that the first step was taken leading to the establishment of the Bureau of Standards, which now, in size and expenditure at least, leads all the rest. This is due to the extraordinary tact and skill in management of its able director, Dr. Stratton, whose name is now a household word. May the bureau long continue to have success under his wise direction. The letter follows:

Cambridge, 1892, Jan. 13.

My dear Sir:

Your article on a National Physical Laboratory came duly, and I thank you for sending it to me. By this mail it goes back to you.

I have read it with care and much pleasure, and trust that you may soon publish it, for it can not fail to be useful. What may be the best way to bring it before the public I do not know; but, from my limited means of judgment, it seems to me that some one of the great New York magazines might afford a good opportunity—say the *Century,* or *Scribner's.* I should select a periodical of large circulation—and not a "popular scientific" one, where the public reached is one which would in general require no education on the subject, or else not to be of the influential class of people.

And when it is printed, I hope you will take steps to insure that members of Congress and professors of physics in our leading universities shall have opportunity to read it. Possibly some of the engineering journals might have the sort of circulation which is desirable.

Wishing you all success, and with cordial sympathy with such a movement, I am,

Very sincerely yours,

B. A. Gould

Dr. Arthur G. Webster,
Worcester.

A. G. Webster

Worcester,
July 8, 1922

SPECIAL ARTICLES

BASAL GLAUCONITE AND PHOSPHATE BEDS

As a result of lithologic studies of carboniferous formations in Texas I showed last year[2] that glauconite beds characterized by certain peculiarities occur at breaks in a sedimentary series. Although I pointed out that this observation was merely an extension of Cayeux's observation[3] that phosphate beds occur in similar positions, I thought at the time that the relation of typical glauconite beds to these breaks had not been noted. I was therefore much interested to learn in conversation re-

[1] Published with the permission of the director of the U. S. Geological Survey.

[2] Goldman, Marcus I.: "Lithologic Subsurface Correlation in the 'Bend Series' of North-central Texas," *U. S. Geol. Survey Prof. Paper* 129-A, pp. 1-22 (especially pp. 3-4), 1921. "Association of Glauconite with Unconformities," *Bull. Geol. Soc. America,* 32, p. 25, 1921 (abstract).

[3] Cayeux, L.: *Contribution à l'étude micrographique des terrains sédimentaires, Mém. de la Soc. géol. du Nord.* 4 pt. 2, pp. 427-432, 1897. *Genèse des gisements de phosphates de chaux sédimentaires, Bull. Soc. géol. de France,* 4e ser., *5,* pp. 750-753, 1905.

cently with Professor W. G. Fearnsides, of Sheffield, England, that the association was familiar to him and had been described by him in print. He mentioned a number of other occurrences and gave in addition several references to British publications which discuss the relation of phosphate beds to stratigraphic breaks. As all this evidence serves to establish the principle on a solid basis it seems worth while to bring it to the attention of American stratigraphers.

The deposit of basal glauconite described by Fearnsides[4] and Anderson[5] is at the boundary between the Cambrian and Ordovician of Sweden and is very extensive. Another deposit of wide extent, described by Hayes,[6] is at the boundary between the black Chattanooga shale and the overlying carboniferous in Tennessee. Both of these are associated with phosphate. The association of glauconite and phosphate is, in fact, so generally referred to in the literature relating to either of them, especially in that relating to nodular phosphate, that it may be regarded as established. Anderson[7] not only recognized it but interpreted the relative abundance of one or the other. He formulated the principle that in deposits of the two constituents phosphate predominates in the littoral facies and glauconite in the offshore shallow-water facies (essentially the continental shelf). If this practical equivalence in mode of occurrence of glauconite and phosphate is recognized, then the papers referred to in this note, although most of them deal with phosphate deposits, serve to establish beyond reasonable doubt the association of certain types of glauconite as well as of phosphate deposits with breaks in a stratigraphic succession. As early as 1874 Tawney[8] stated that the fossils in a phosphate bed represent a long time range, indicating a dearth of sedimentation. The development of the conception with various modifications may be followed in the references given. In a very recent paper Vaughan[9] points out the possible bearing of a glauconite bed in solving the problem of the position and character of the Mesozoic-Cenozoic boundary in New Zealand.

Two conclusions seem to have impressed themselves on most students of these basal deposits of phosphate and glauconite: One is that the surfaces on which they occur had not emerged, the other that they represent a long-time interval.

The reasons for supposing that there has been no emergence are not always very clearly formulated. The principal ones seem to be: (1) The usual absence of any *recognizable* erosion surfaces underlying the deposits; (2) The absence of an underlying weathering surface; (3) The absence of fragments of the underlying bed; (4) Lack of evidence of transportation of constituents of the beds; (5) The fact that similar modern deposits form under purely submarine conditions.

There seems to be room for many fallacies in these assumptions, and at best the demonstration of the fact they are called upon to prove—that during the interval between the formation of the underlying and overlying bed there was no emergence—does not appear very essential. A long period during which the sea bottom was at or near marine base-level seems to be implied in any case, and that, so far as I can see, implies also an approximation to subaerial base-level of the adjacent land. Slight oscillations of base-level may safely be assumed and are indicated by some of the evidence. Whether these fluctuations have at times brought part of

[4] Fearnsides, Wm. G.: "The Lower Ordovician Rocks of Scandinavia," etc., *Geol. Mag.*, n. s., Dec. 5, 4, pp. 257-267, 295-304 (especially pp. 264-267), 1907.

[5] Anderson, J. G.: *Über Cambrische und Silurische phosphoritführende gesteine aus Schweden*, *Bull. Geol. Inst. Univ. Upsala*, 2, pp. 133-236 (especially pp. 178-200, 220-229), 1895.

[6] Hayes, C. W.: "The Tennessee Phosphates," *Sixteenth Ann. Rept., U. S. Geol. Survey*, pt. 4, pp. 611-612, 1895; *Seventeenth Ann. Rept., U. S. Geol. Survey*, pt. 2, p. 523, 1896.

[7] Anderson, J. G.: *loc. cit.*, p. 221.

[8] Tawney, E. B.: "Notes on the Lias in the Neighborhood of Radstock," *Proc. Bristol Nat. Soc.*, n. s., 1, p. 174, 1874.

[9] Vaughan, T. Wayland: "Correlation of the later Mesozoic and Cenozoic Formations of New Zealand," *Proc. First Pan-Pacific Scientific Conference*, Pt. 3, Bernice P. Bishop Special Publication, pp. 734-737, Honolulu, 1921.

the area, in which phosphate is found, above water makes little difference. The essential fact is that the phosphate nodules and most of the materials associated with them probably accumulated mainly in place and not as a result of transportation.

The length of the period during which the deposits accumulated is deduced from the following facts: (1) The wide range of the fossils they contain; (2) The great thickness of the "equivalent" section in other areas. Without the fossils this has no bearing; (3) In modern deposits of similar character the decomposition of associated detrital minerals and evidence of prolonged submarine exposure of other constituents; (4) The abundance in the deposits of bore holes made by submarine animals; (5) The evidence of different stages in the formation of the nodules; (6) Differences in the amount of wear on different nodules, indicating formation at different times; (7) The fact that the sand included in the concretions is finer than that in the matrix, indicating a range of conditions; (8) The abundance in the deposits of the teeth of fish without their bones, the bones having been dissolved.

One of the most convincing arguments involves a consideration of the origin of the deposits and the reason for their association with stratigraphic breaks. This is not the place for attempting a complete discussion of the problem, but one explanation formulated or implied by several of the papers cited is so convincing in its simplicity that I wish to state it briefly as superseding the one which, following Cayeux, I proposed in my previous papers. This new explanation is based on the peculiar composition of the glauconite and phosphate beds at stratigraphic breaks. A definition of these peculiarities is almost an explanation of them—they are essentially concentrations. The materials concentrated as I have described them and as they are described in part by Fearnsides and others include the glauconite and phosphate grains and nodules themselves, shells or coarse fragments of shells of marine animals, sulphide concretions, etc. These same constituents are found in the overlying bed and in some localities also in the underlying bed. The reason they are concentrated here is apparently that no detrital material accumulated to separate them. In Teall's picturesque words,[10] "The deposition of sediment acts on the zonal succession [of ammonites] and on the distribution of phosphatic matter very much as a prism acts on the rays of light. It supplies a kind of dispersive power." So far as my reading goes, Hayes[11] is the only one who has made the important deduction from this interpretation that the scarcity of calcareous shells must then be accounted for. He attributed it to solution, which accounts also for the dominance of phosphatic skeletons, the lime phosphate being less soluble than the carbonate. Otherwise the abundance of living phosphatic organisms such as the brachiopods, which usually characterizes these areas of phosphate deposition, would be hard to explain, seeming to imply a puzzling selective action of the environment on the fauna. Murray and Renard[12] noted on the one hand the occurrence of glauconite and phosphate deposits in areas of slow sedimentation, and on the other hand the presence of glauconite, though in much smaller relative amount, in many types of more rapidly accumulating deposits, such as the Blue Muds. But apparently they did not associate the abundance of the glauconite and phosphate with the mere scarcity of the sediment.

It is perhaps surprising that a fact so long and frequently recognized as this association of phosphate and glauconite with stratigraphic breaks should have failed almost completely to penetrate the text-books. I have found it touched on only in Grabau's "Geology of the Non-metallic Minerals."[13] Nevertheless, though it still requires a great deal of interpretation and qualification, it seems to be established well enough to receive general consideration from stratigraphers as a criterion of great possible value in the analysis of stratigraphic sections.

Marcus I. Goldman
U. S. Geological Survey

[10] Teall, J. J. H.: "The Natural History of Phosphatic Deposits," *Proc. Geologists' Assoc.*, London, 16, p. 379, 1900 (bibliography of 45 titles).

[11] Hayes, C. W., *loc. cit.*, 1895, pp. 621-622.

[12] Murray, John, and Renard, A. F.: "Deep-sea Deposits," Report on the Scientific Results of the Voyage of H.M.S. *Challenger*, pp. 382 and 411, 1891.

[13] Vol. 1, p. 306, McGraw-Hill, New York, 1920.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE[1]

SECTION E—GEOLOGY AND GEOGRAPHY AND ASSOCIATED SOCIETIES

The American Association for the Advancement of Science and Canadian Geology: A retrospect: W. G. Miller, provincial geologist, Toronto, Ontario. The working together of Canadians and Americans in the association has done much to promote pleasant relations between the two countries and to advance science. When the association was founded, over seventy years ago, prominent Canadian geologists were among its first members and contributed important papers, some of which, especially that one which introduced the terms Huronian and Laurentian have become classic. Certain views held concerning the age relations of pre-Cambrian rocks in the earlier years of the association are contrasted in the paper with those which are at present current.

Some physiographic forms of western North Dakota: Harry N. Eaton. Illustrations of the Bad-land topography of the Little Missouri River Valley; the Missouri River escarpments and flood plain, with erosional details of the Fort Union formation; the Missouri Coteau; the Altamont moraine; slump topography; clinker buttes, etc.

Mineralography or the microscopy of the ore minerals: Ellis Thomson, University of Toronto. The history of the study; technique and equipment employed in the preparation of polished sections; microscopic examination; microphotography and the practical application of the method.

A new genus and species of dinosaur from the Belly River beds of Alberta: W. A. Parks. A description of a remarkable new genus of dinosaur found recently in the Cretaceous beds on the Red Deer River. It has a peculiar projection backward over the neck of the bone of the skull into a prong over four feet in length.

Tuesday Afternoon Session, December 27

This session was largely given up to the discussion of glacial geology.

The glacial period: its record in Iowa: George F. Kay. For many years Iowa has been recognized as one of the most important areas in the world for the study of the Glacial Period. Distinctive deposits mark five glacial epochs and four interglacial epochs. Attention is directed to the significance of the gombotils, which on account of their distinctive characters and wide distribution are considered to be among the best of horizon markers. They strengthen the view that the Glacial Period was probably hundreds of thousands and possibly millions of years in length.

Some recent and pleistocene glaciers of Argentina and Bolivia: A. P. Coleman.

The drumlins: Colonel John Millis. Since in the opinion of the writer the conditions favorable for drumlin formation are basin-shaped areas with impeded drainage, the radial movement of ice from these basins produced crevasses which became filled with water in summer. On freezing in winter, it produced pressure resulting in a buckling of the drift beneath the ice.

Stratigraphy and paleontology at Toronto: W. A. Parks. The Paleozoic rocks in this district are overlain by the remarkable series of glacial and interglacial beds which have been formerly so fully described by Dr. Coleman and which contain evidences of interglacial epochs warmer than the present climate of the region. The Paleozoic rocks which consist of shales and limestones are exposed at a few rather widely separated points and while there are some variations in the fossil characters indicating different zones there are no physical unconformities in the series.

Outline of the physiographic history of northeastern Ontario: W. H. Collins. A summary of the data showing what important diastrophic movements have occurred in this area and the evidence which fixes the periods in which these revolutions have occurred.

Wednesday Morning Session, December 28

Address of Dr. Eliot Blackwelder, the retiring vice-president of the section, on "The Trend of Earth History."

The remainder of the morning session was mostly taken up with papers bearing on sedimentation.

Sedimentation in Lake Louise, Alberta: W. A. Johnston. The sediments being formed in the lake are glacial silts derived from Victoria glacier near the head of the lake. Conditions of sedimentation are somewhat similar to those which existed in northwestern America at the close of the Ice Age. Core samples from the bottom of the lake taken by means of a bottom sampler and sounding machine show fairly distinct banding believed to be seasonal.

A natural classification of sedimentary rocks: Richard M. Field. Owing to the increased

[1] Toronto, December 27, 1921.

interest in the study of clastic rocks, new terms are needed to describe new phenomena. For instance, conglomerates may differ greatly—not only as to compositions but also as to origin, and the phenoclasts should not always be called pebbles. The petrogenesis of the sedimentary rocks is intimately related to paleogeography and paleobiology. The paper is a suggestion that more attention should be paid to the "life-history" of sedimentary rocks.

The Pre-Cambrian of western Patricia: E. M. Burwash. A summary and comparison of the pre-Cambrian complexes of the Lac Seul region and of the Manitoba boundary north of the Winnipeg River.

Wednesday Afternoon Session, December 28

Some of the physico-chemical properties of colloidal solutions and their relation to geological processes: E. F. Burton. The study of colloidal solutions has to deal with the properties of suspension of small solid or liquid particles in such a liquid as water. Their geological importance rests on the conditions under which such suspensions are precipitated from their solutions, as, for example, in the formation of deltas and, also, on the curious effect of small traces of certain jelly-like substances on the properties of soils. Surface tension, electrical charges and molecular motions play a rôle in bringing about the stability of such suspensions and in regulating conditions of precipitation.

The present status of the medina problem in southeastern Pennsylvania: Harry N. Eaton. The Pennsylvania Geological Survey has investigated recently the extent of the ridge-making sandstone of the North or Blue Mountain in southern Pennsylvania, and the stratigraphic and faunal successions of the superjacent Silurian and Devonian strata on the north side of the mountain. Tentative conclusions were reached as follows: For over one hundred miles in extent the ridge-making sandstone is overlain conformably by the Clinton and probably is of Medina age, apparently correlating with the Shawangunk grit of the Delaware Water Gap region and western New Jersey. The upper Silurian and lower Devonian limestones of the New York State series were not deposited over the area immediately north of the mountain, the Cayuga shale lying directly below the Hamilton sandstone as far east as the Lehigh Gap; isolated exceptions being a thin band of Helderberg-Oriskany chert west of the Susquehanna River valley, and a thin Onondaga limestone bed in Schuylkill County, east of Swatara Gap.

The session then adjourned for a visit to the Royal Ontario Museum under the leadership of Dr. A. P. Coleman and Dr. W. A. Parks.

Thursday Morning Session, December 29

The Mackenzie River Basin: D. B. Dowling. The basin of the Mackenzie River is underlain by Devonian limestones and shales thinly covered by Cretaceous and Tertiary sediments. The shales and dolomites underlying the upper Devonian limestones are of Middle Devonian age and in places are petroliferous. The area which may be considered as forming a possible oil field consists of a belt showing comparatively little disturbance between the crushed and metamorphosed zone of the Rocky Mountains and the overlap of the Paleozoic on the Archean to the east. The field is divided by a line of folds which may be considered a spur of the mountains which cross diagonally in a north and south direction. The eastern part exposed around Great Slave Lake is comparatively undisturbed. The portion west of the mountain spur shows signs of partaking in the earth movements. A triangular area with upturned edge next the mountains shows minor crumplings or lines of anticlines in a general east and west direction near the northern border. These terminate to the east in a probable fault line or line of breaks in which the downthrow is on the east side with the upthrow on the west side showing only in the ridges which are anticlinal in section. The surface east of this line of breaks is a flat plane, covered by Cretaceous, Tertiary and later sediments leading to the hills of the Franklin range to the east. The Devonian shows erosion previous to the deposition of what is probably Upper Cretaceous. Denudation of the Cretaceous is indicated previous to the deposition of the Tertiary and in this interval nearly all the mountain building took place since the Cretaceous is uplifted with the Devonian and the Tertiary but slightly tilted. The structure of the basin included within the pressure folds that bound the part of the oil field west of the Franklin range must be interpreted mainly from the Cretaceous measures assuming that the unconformity with the Devonian was a planation of horizontal beds near sea level. The Tertiary basins represent down warpings of the plane underlain by Cretaceous which was to base level of erosion at the inception of the mountain building. Southward Cretaceous sediments are present in great masses and form thick deposits which were elevated by the earth stresses and now form the plateaus of the plains to the south. The Cretaceous measures against which the pressure from the west was expended extended northward to the latitude of the Liard River at least. Northward there seems to have been less of a barrier and the alignment in the Rocky Mountains, preserved from the boundary line northward to that point, is broken and the Mackenzie Mountains represent the eastward extension of the lines of weakness developed by the lateral compression. The eastern margin of this earth movement affects the area under study.

The influence of rock structure on quarrying methods: Oliver Bowles. While brief reference is made to the effect of joints on drilling and blasting limestone, chief emphasis is placed on the importance of rock structures in dimension stone quarrying, and the influence of such structures on the quality of the finished products. Reference is made to the manner in which marble, slate and granite quarrying methods should be modified to conform to best advantage with such rock structures as slaty cleavage, bedding, grain and rift. The great need of a more extended application of geology to quarry problems is emphasized.

The fluorspar deposits of the Madoc district, Ontario: M. E. Wilson. The fluorspar deposits of the Madoc district are all veins occupying fault fissures of post-Ordovician age, and are similar in type to the fluorspar deposits of the central United States and the north of England. The principal features that distinguish the deposits are that they occur in part in faults on which the displacement has been horizontal and in a region where igneous rocks of later age than the Pre-Cambrian are unknown. The evidence bearing on the origin of these deposits therefore lends greater support to the hypothesis that they have been formed through the agency of meteoric waters than in the case of other fluorspar deposits of the Madoc type.

The geology and surface features of the Torngat Mountains in northern Labrador: A. P. Coleman. The rocks displayed in northern Labrador are chiefly Laurentian granites and gneisses and Grenville sedimentary deposits. On the upturned edges of these rocks there are much later Pre-Cambrian sediments with gentle dip. The earlier Pre-Cambrian rocks, once forming great ranges of mountains, have been cut down to a peneplain of which the northeastern edge has been elevated, forming a tableland. The edge of the tableland has been carved by great valley glaciers into the wildest mountains of eastern North America, and a few small glaciers still survive. This glacial work has excavated some of the most impressive fiords to be found in America.

Gaspé Peninsula: the country, its geology and economic possibilities: F. J. Alcock. This paper is a brief description of the physiography and geology of Gaspé peninsula, with particular reference to an area in the interior where a variety of igneous rocks occur. Associated with these are important deposits of zinc and lead which present certain features of interest.

The geology of oil in Canada: D. B. Dowling. A discussion of the oil producing areas and prospective oil fields of Canada.

No program was prepared by Section E on the afternoon of December 29 in order that the members might meet with Section M (Engineering) and hear a number of papers of interest to geologists and geographers. In the evening a combined dinner for Sections E and M was held in the Music Room of Hart House, University of Toronto, where a very enjoyable time was spent.

E. S. Moore,
Secretary, Section E

SECTION Q—EDUCATION

Section Q held session from December 28 to 30. A dinner and smoker was held on Wednesday evening. The dinner was followed by an address by Dr. R. M. Yerkes, of Washington, entitled "Remarks Concerning the Research Information Service of the National Research Council and Its International Relations." On Friday morning a session was held in conjunction with Section I. At this session E. K. Strong, Jr., of the Carnegie Institute of Technology, delivered his retiring presidential address for Section I, and Dr. Charles H. Judd, of the University of Chicago, delivered his retiring vice-presidential address for Section Q on "Technique of Scientific Revision of the Curriculum." A joint session of Section Q and K was held on Friday afternoon, at which a symposium on "An International Auxiliary Language" was given.

The average attendance at the final sessions included in the program was good throughout, including from 125 to 250 educators and psychologists.

Bird T. Baldwin.
Secretary, Section Q

SCIENCE

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CONTENTS

GEOLOGY OF THE COLORADO RIVER BASIN WITH REFERENCE TO ENGINEERING PROBLEMS[1]

ANY account of the geology of the Colorado River basin falls naturally into two parts: that which deals with the life of the Colorado River and that which describes the preceding ages before the river began to flow. Professor Pack has presented the life history of the river. It is my task to sketch the earlier history of this part of the continent. With reference to the engineering problems, the geologist is concerned with three questions relating to the stability of the dam as affected by possible earthquakes, the nature of the foundation rocks, and the durability of the rocks used in construction. Reference will be made to these matters after the geology has been described.

We have become familiar with moving pictures, which present a succession of views, each one of which differs so slightly from the preceding that the eye sees their sequence as a continuous movement. The intervals are fractions of a second. The action is timed to our human scale. Geographic changes are exceeding slow. If we would present a moving picture of a succession of landscapes, the intervals between the views would be a hundred thousand or even a million years. Even so, the eye would see a continuous procession of views. Mountains would grow to majestic heights and waste away till their sites became plains. Rivers would develop and competing for territory would become master streams or tributaries according to the law of the strongest. Seas would invade the land and retreat from it after ages of occupation. Climates, floras and faunas would change. Such is the moving picture of geologic

[1] Presented in the Symposium on "The Problems of the Colorado River" at the Salt Lake City meeting of the American Association for the Advancement of Science and the Pacific Division.

history. It is timed to the march of the ages.

Even that slow movement of events is beyond our power to present in its continuity. We can at best represent widely separated conditions. And so, in attempting to sketch the history of the Colorado Plateau region, I can give you detached pictures only, some of them so unlike that imagination alone can link them together. It will be simplest to roll the broken film backward from the later, better known events to the earlier scenes, till knowledge becomes guess and guess fades into surmise in the mists of antiquity.

The Colorado River developed during a period before the present plateaus were elevated. So great a river system, like a great empire, is the result of many territorial conquests. The force by which it conquers is due to its fall, for by its fall it carves its canyons and extends its tributaries. Thus the earlier history of the river corresponded with an earlier ancient uplift of the plateau country. But that uplifted mass was first gashed by canyons, then became a land of broad valleys and mesas, and finally was eroded to a low plain. A later uplift has raised that plain to its present position, 7,000 feet above the sea, where it is the surface of the plateau.

The cycle of erosion just referred to is called the "Great Denudation." The time of its duration corresponded with the so-called early Tertiary. The early mammals drank from the growing Colorado. North America then, as now, stretched from the Atlantic to the Pacific, an undivided continent.

Stepping back a million years or so, we see North America divided. A broad, though shallow, strait stretched from the Gulf of Mexico to the Arctic Ocean along the Great Plains of to-day, dividing the continent into an eastern and a western land. The climate was mild and equable. Vegetation flourished in the warm humid atmosphere. It was the Coal period of Colorado and New Mexico. Great saurians dominated the life of the period, yet became extinct, apparently rapidly. Dull brutes, they were incapable of adaptation to changes of environment such as closed the period of their dynasty.

During this period, the so-called Cretaceous, the region of the Colorado plateaus was a watered land with rivers flowing from eastern coast ranges, on the site of the Rocky Mountains, toward the Pacific. Among them may have been the stream which eventually grew to the Colorado, but we can not identify it.

Still retreating down the aisles of time, we come upon the panorama of a wide North America, united from east to west, but submerged along the western margin even to Idaho. This, the Triassic and Permian periods of geologists, might well be called the period of the "Great American Desert." A red wind-swept delta plain covered the Rocky Mountain states from Montana to Arizona and extended southeastward over Oklahoma and Texas. Bleak and arid, it was like the plains of northern Siberia. Similar cold, barren lands existed widely throughout the continents. It was a time of stress for all living things and led to the evolution of higher forms than had previously existed when conditions bettered, just as the severe environment of life during the Glacial Period later led to the evolution of man from his ape-like ancestors.

The red muds and sands of the desert time reached far into the Colorado Plateau country and, in so far as they were not eroded during the "Great Denudation," they give the dominant color note to the upper gorges of the river.

Thus far in our retrospect we have found no epoch during which the plateau country was submerged beneath sea waters. Yet there is written in the strata of the canyon walls a very long record of marine conditions. Whoever has been down the Bright Angel Trail has seen it. The cliffs of sandstone shale and limestone demonstrate by their long horizontal lines of bedding, as well as by the fossils they contain, that they were laid down beneath the sea. It was never a deep sea, yet there gathered in the basin more than 4,000 feet of strata. Evidently the bottom sank gradually and the sediments gathered as the basin deepened. Far more impressive evidence of subsidence is found near Salt Lake. There the strata aggregate more than 40,000 feet in thickness and indicate a corresponding subsidence of the ancient foundation rocks.

It is clear from the great difference between 4,000 and 40,000 feet that we should not regard the subsidence as uniform. On the contrary, it was an unequal warping of the surface, which indeed rose and remained land in the region southeast of the canyon, or was but temporarily submerged.

The invasion of the sea into western North America began with and extended through the so-called Paleozoic age, that vast lapse of time during which life evolved from the grasping crustacean to the ambitious reptile. It is one of the proofs of evolution that although the Paleozoic creatures are long since extinct, their mentalities still persist in individual men. According to geologists the Paleozoic was an era which began with the Cambrian period and closed with the Permian. Various intervening periods are distinguished, but for our study of the Colorado River basin, the Paleozoic stands for one event, the advance of ocean waters over much of the continent, their prolonged occupation of its area accompanied by numerous changes of front, and their retreat into the permanent ocean basins.

Back to the beginning of the Paleozoic era, including the Cambrian period, we have fairly complete records of the physical geography of the earth and we can trace the major lines of evolution of organic life. We can even attempt maps of the shifting lands and seas, follow the course of great climatic oscillations, and image in our minds the habitats in which our remoter and nearer ancestors lived. If we draw a parallel between human history and earth history we may compare the dawn of Assyria with the beginning of the Paleozoic. But the remoteness of Assyria is to be measured only in hundreds, whereas that of the early Paleozoic is to be estimated in as many millions of years.

Let us not think, however, that a hundred million years represents a large proportion of the earth's history, as it is recorded in the rocks of the Grand Canyon. Beneath the earliest Paleozoic strata lie other water laid deposits of sediment, the waste of ancient lands. Only a few fragments of those old records are known, but they testify unmistakably to the passage of unnumbered ages.

We are prone to think the earth must have been in a different state of cooling or had a different atmosphere in so distant a past. But no, the winds blew, rains fell, streams flowed, there was night and day, heat and cold. And within the earth there went on periodically those changes which occasion the rise and subsidence of continents, the growth of mountain chains. The Algonkian strata (such is the name geologists use to designate the era) were deeply buried, tilted up, invaded by masses of molten rock and eroded. They record activities identical in kind and intensity with those which are now active in the most youthful ranges, the Rocky Mountains and the Sierra Nevada. Though we look back two hundred million years we find earth-processes the same.

Even so we have not read the earliest chapter recorded in the rocks of the Grand Canyon. Beneath the Algonkian we come upon an older and different group of rocks. It is a group which never occurs anywhere but at the bottom. It is the foundation of the superficial crust. I speak of the so-called Archean, the oldest rocks known, though by no means necessarily the oldest rocks ever formed.

The Archean rocks are not surface rocks, not like the strata of the plateau country. They have risen from depths in the earth's crust where temperatures are high and pressures are enormous. The typical Archean are crystalline. Whatever the previous state of the minerals may have been, they have recrystallized. Some, which are called schists, have recrystallized in a solid state under overwhelming and unequal pressures. They have thus changed form, shortening anad lengthening to fit their Procrustean bed. Others, the granites, have been melted and have intruded as tongues of magma into surrounding masses, causing changes of crystalline form in them. Melting and recrystallizing, crystallizing and remelting, these rocks have undergone changes so complete that no one can tell what they may once have been nor through what sequence of kneading, mechanical shearing, folding, and chemical changes they may have passed.

The Archean rocks thus represent physical and chemical conditions which exist within the earth's outer shell. I say advisedly *exist,* not *existed.* For while it is true that we see only very ancient rocks of this character, there is every reason to assume that they are forming now beneath our feet. We know that the earth, though solid, is very hot. We know that very great and unequal pressures exist at depths of a few miles beneath the surface. These are the conditions under which the Archean rocks formed and no doubt are forming.

In the laboratory of the Master no reaction occurs except according to law, and law is eternal, unchanging. There is, perhaps, no thought with which we may more appropriately approach the engineering problems of the Colorado River.

The engineers who will speak here of the utilization of the Colorado will describe works of great magnitude: dams surpassing any yet built; reservoirs impounding millions of acre feet of water; values of irrigated lands rising to hundreds of millions of dollars; powers which are to turn the wheels of industry from San Francisco and Los Angeles to Denver. But even so, they speak only as men, of the little works of men. In the laboratory of the Master their greatest accomplishment is infinitely small and transient.

A laboratory is a place where the forces of nature work changes in material compounds or crystal forms according to law. The mechanic, the physicist, the chemist arranges the conditions of some desired reaction and under the same conditions observes the identical effects recurring endlessly, unfailingly. If he makes an experiment the personality of the experimenter makes no difference. Even the Master works by law and can not work otherwise. Nor does time make any difference. A billion years ago the law of gravitation held the stars to their courses as it does to-day. In the earliest conceivable eon of the existence of matter the atoms moved to their places in molecules in the same order as now.

Yet there is a new development, no doubt also in obedience to law, but so subtle that we can not establish the relation. I mean the evolution of mind, which can investigate law, which can conceive and execute great works that rightly constructed will stand for ages. The mind can even trace its own evolution. Backward from human thought to animal instinct, from instinct to mere conscious existence, from consciousness to unconscious molecular reaction runs the chain. It runs unbroken. Life is its characteristic. But if thought is life, then is consciousness also; if consciousness is life, then is molecular reaction also life. In this sense minerals are alive, for they are chemical compounds which react to their environment. The earth is alive, for the reactions of its masses are evidenced in unending change.

The development of thought from unconscious reaction has recently evolved reason. Reason is so young, however, that it is still embryonic and in many humans is in a larval state. Nevertheless, no man becomes a scientist or engineer without having to some degree developed it and therein lies the hope of a successful solution of the extraordinary problems of the utilization of the Colorado.

The major difficulty in damming the Colorado is to establish the dam on a firm foundation. Investigations of the river's bed show that it is filled to depths exceeding a hundred feet with large boulders. The dam, if it be a masonry or concrete structure, must be welded to the solid rock in place. It will tax the resources of the engineer to the utmost to dig so deep through boulders and to place his foundation structure during the few months between floods, which, if unrestrained, will destroy it.

The presence of a boulder bed, of such depth and composed of rocks of such size, was not foreseen. It is due to the power of the floods. At low water the river ripples impotently around the stones. One can hardly conceive that in flood it moves rocks as large as cabins and buoys up a mass of them, rolling them over one another with irresistible force. But the evidence is there. It does. The bottom of the river in flood is a torrent of rolling rocks, of huge size. They roll, they jam, they temporarily resist. The river piles up its waters behind them. The rocks yield and are carried crashing down the channel to come to rest as the victorious waters roll on.

It is one of the most daring conceptions of modern engineering that this awful power may be used to build the dam that shall chain it. How, may best be stated in speaking of the types of dams that are under consideration.

The engineer and geologist are both cognizant of the power of floods. But there are some facts regarding the structure of rocks which lie more exclusively in the province of geology. The first of these is what is called "jointing" in rocks. Jointing is a mechanical effect. It is produced by pressure in the case of massive rocks, like granite, or by torsion in the case of strata, when they are warped. All the rocks of the plateau region are jointed. In the magnificent architecture of the Grand Canyon, the vertical cliffs are the planes of joints. In the pointed forms which are characteristic of the deepest gorges in the granite, we see the effect of two or more intersecting joint planes. Now joints permit water to penetrate under and around a block of rock. The film of water may be very thin, but to the extent that it surrounds the rock it buoys it up, tends to lift it from its bed by virtue of hydrostatic pressure, and may free it from its firm foundations. Engineers are fully aware of this action. They seek to excavate to foundation rocks which show no open joints, or to seal visible joints by cement. Granite is regarded as one of the firmest foundations. It is liable, however, to blind joints, invisible planes on which there has been no actual parting, but the minerals have been strained and are ready to react to forces of decay. Water, not enough to wet, but just enough to moisten, is the agent that sets those forces to work. The engineer can not discover blind joints. Investigation of the minerals by the microscope, a study which is among the most specialized of geologic training, alone can demonstrate whether or not they are present.

We may think that the invisible is reasonably negligible. But the infinitely small is the infinitely powerful and also the infinitely patient. A film of water penetrating a plane of strained crystals may open the way to the ultimate destruction of man's mightiest work.

Minerals decay. That is not a familiar thought with many, although soil, a product of mineral decay, is familiar to every one. I said that minerals are alive. And it is because they are alive that they decay, decay being simply the reaction to a change of environment. Evidence of these facts is found in the rocks which the engineer must use in building a dam in the Canyon of the Colorado. The granites and schists of the ancient formations crystallized deep within the crust in an environment of very high temperature and great pressure. Elevated to their present positions at the surface they are in a cool environment, under little pressure. The change produced in every crystal a tendency to change, to disintegrate into forms and compounds better suited to their actual environment. Thus the seemingly solid granite of the Boulder Canyon site is pervaded with disintegrating forces, which will in the course of time, though probably long time, certainly cause it to crumble.

Let us now consider the two methods of building the proposed dam, which have been suggested. The first fascinates by its unusual character and its daring. It consists in blowing great masses of rock from the canyon walls into the river channel in such quantity that they will form the body of a dam three quarters of a mile up and down stream on the base and six hundred feet high. The blasting is not to be done all at once, but in sections from upstream downward and only to a part of the height at any one time. And the river is to be allowed to flow over the fallen rock masses in such manner that it will by its own power dig the deep hollows into which it shall also roll the great rocks. Thus the river shall work its will, but shall lay the masses where it can never move them again. It shall chain itself.

The success of this operation depends upon providing by blasting rock masses of such magnitude that the river can not carry them away. We have a report by Mr. Ransome, a geologist of the U. S. Geological Survey and one of the highest rank, to the effect that the granite of Boulder Canyon is considerably jointed. Conservative knowledge would suggest that there are many more joints than appear as actual fissures and that they would cause the granite to break into relatively small masses, in the blasting from the cliffs and subsequent rolling by the river.

Another question is how "solid" is the granite? That it is so described is natural, for "granite" and "solid" are almost synonymous terms to English speaking peoples. The significance of words depends upon our association with them and our experience of New

England granite says that it is the very symbol of solidity. But New England granites have been stripped by glaciers of every trace of decayed rock. They are solid because they are freshly exposed. That is not the case with granites in this western country.

For instance there is granite in the immediate vicinity of Salt Lake City. It seems solid. It is used in building. It will take a polish. But I am told it will not hold a polish more than three or four years, because the crystals have begun to decay. Professor Pack tells me that he has examined granite in this vicinity from the surface to a depth of 800 feet below it and found even at that depth that decomposition was in progress, as shown by the clouded appearance of certain crystals, the feldspars, under the microscope.

The granite of Boulder Canyon is decomposed on the surface. No one knows, as yet, to what depth. But the geologist has reason to suspect its solidity and must add his objection to those of conservative engineers against the suggestion that the dam be built by blowing the cliffs into the canyon.

The other type of dam proposed is to be built of reinforced concrete. Concrete may be described as a rock composed of minerals which are permanent under surface conditions because they form in that environment. Moisture promotes the consolidation of concrete. Age increases its strength. So far as the superstructure is concerned, a geologist must reason that a concrete dam will outlive a rock fill dam. The engineering problem in building a concrete dam is that of excavating to solid foundations. It is, in the judgment of conservative and experienced engineers, reasonably practicable to do so. But, if the conditions of jointing and decay of the rocks are considered as they should be, it will be the geologist rather than the engineer who shall determine whether they are solid or not.

The foundations are now being explored by drilling. It is not enough. A drill may bore out a core within a foot of a weak seam and not betray its existence. The preliminary examination will, no doubt, be followed by more thorough investigation and it may be suggested that a method of shafts and tunnel be employed. Shafts sunk, one on each side of the river, and connected by a tunnel at a depth of a hundred feet below the bottom of the channel, would enable a complete examination of the rock, inch by inch. Weaknesses could be excavated and filled. If they should prove too numerous at one hundred feet, the shafts could go deeper to a deeper tunnel. Eventually when solid rock was found, the rock above the tunnel could be cut away to the surface, stoped, as miners say, and the stope filled with concrete would form an impervious curtain wall. Working from the bottom up, the bed of the river would be approached and the deeper foundations would be laid without exposure to the risk of floods. It is not the province of the geologist to instruct engineers and I would not presume to, but the suggestion may stand to illustrate the problem of a deep and secure foundation, that the geologic conditions demand.

The Garden of Eden was created some five thousand or more years ago by the building of huge dams of earth to control the Tigris and Euphrates, and so well did those ancient engineers execute their task that the beauty of the garden became a tradition of all Eurasian races. The garden endured until the state fell. Subtle forces weakened the quality of its citizens as moisture attacks the minerals of the granite. Our engineers can build a dam to endure for thousands of years. What is the endurance of our state? What concrete foundations of national character are we laying to cut off the underground activities that would destroy it?

Bailey Willis
Stanford University

EXPEDITIONS OF THE MUSEUM OF NATURAL HISTORY

In one of the corridors of the American Museum of Natural History the officials of that institution have hung a map of the world to which labels are attached showing the distribution of its exploring parties and field workers. During the present year a larger number of expeditions have been sent out than ever before. Intensive work is being pursued by each department.

In the department of geology, Dr. Edmund O. Hovey is at present on a trip through California, Oregon, Washington and British Columbia, securing data and photographs for the purpose of the construction of a number of relief models, showing most interesting geological formation in these states. Associate Curator Reeds is working in the vicinity of New York, collecting data for a museum exhibit to show the "Climates Past and Present," and Mr. Foyles is continuing his studies in northwestern Vermont on the Fort Cassein terrain.

For the department of vertebrate paleontology, an expedition in charge of Albert Thomson is at work in western Nebraska, seeking fossil mammals from the Snake Creek beds of the Pliocene age. Working in the same vicinity is Curator Matthew, who will shortly be joined by Mr. Olsen. Mr. Barnum Brown, who is well known from his success in securing most of the Brontosaurian material now on exhibition in the museum, is at work in the Siwalik Hills of India, obtaining fossil mammals and other invertebrates from a famous fossil bearing formation. In the late autumn, it is the intention of President Henry Fairfield Osborn to join the Third Asiatic Expedition, which has connected with it, in charge of paleontology, Mr. Walter Granger. Working with Mr. Granger at the present time are Professors Charles P. Berkey and Frederick K. Morris. Already extensive shipments have been made by this expedition. Mr. Childs Frick, one of the trustees of the institution, will continue fossil collecting in southern California, where he has already obtained an extensive collection from the Pliocene.

Dr. Frank M. Chapman, curator of the department of birds, accompanied by Mr. George K. Cherrie and Captain O'Connell, are in Ecuador continuing their studies on the distribution of bird life in the Andes. They will first investigate southern and southeastern Ecuador and will then conclude their work by a boat trip from Guayaquil along the coast to Paita, Peru. Assisting in the investigations in bird life in Ecuador, Henry Watkins is now engaged in the mountains of Peru. His latest shipment comes from the humid regions northeast of Lake Junin. Ernest Holt, formerly of the United States Biological Survey, is engaged in collecting birds and mammals for the museum in the mountains of eastern Brazil. A collection was recently received from him which was secured around Mt. Itatiaya. Later Mr. Holt will explore still higher peaks. The museum's representation of bird life from this important region has until now been confined entirely to specimens in the old Prince Maximilian Collection. José G. Correia is undertaking the collection of birds at the Cape Verde Islands, and Rollo H. Beck, who is working under the auspices of the Whitney South Sea Expedition, is collecting in the Society Islands. Mr. Beck is accompanied by Mrs. Beck and Mr. Quayle. Mr. Griscom is doing work in New Foundland, while other members of the department are engaged in the local field.

The department of mammals has G. H. Tate in Ecuador. He will later be joined by an assistant in order that more intensive investigations of the life of mammals in this region may be studied. H. C. Raven, who accompanied Dr. W. K. Gregory to Australia last year, has nearly completed a systematic collection in Queensland and will next go to the great Nullaboa Plain in South Australia. He has already obtained for exhibition and study a series of the marsupial mammals.

In September, Herbert Lang, assistant curator of African mammals, will leave for British Guiana for a three months' trip. At Georgetown he will join William La Varre and will go up the Essequibo River through the diamond mining district along the Mazaruni. He hopes to go through the savannah country and Mt. Koraima. By studies of the conditions in this section at first hand, Mr. Lang has an opportunity to compare the ecological conditions in the great South American forests and savannahs with those of equatorial Africa, a comparison which has long been needed in connection with the preparation of his reports on his Congo expeditions.

Dr. F. E. Lutz, of the department of entomology, is engaged in work in the vicinity of Boulder, Colo. F. E. Watson, of this department, recently returned from a four months' trip to Haiti where he secured approximately eleven thousand specimens of the lower invertebrates, chiefly insects, and about three hundred miscellaneous specimens of fishes and reptiles. He is now carrying on local field work, having in view the collection of material for several butterfly groups.

R. W. Miner, of the department of invertebrate zoology, is continuing field studies in southern New Jersey in connection with the construction of a new rotifer group. Assisting him is Research Associate Frank J. Myers, whose well equipped laboratory at Ventnor, New Jersey, is the basis of operations.

Dr. Russell J. Coles is collecting material for the department of ichthyology off the coast of North Carolina. Mr. Louis L. Mowbrey has sent in some important material for this department from the Florida waters.

Dr. G. K. Noble, of the department of herpetology, accompanied by Mrs. Noble, has left for the Dominican Republic. The chief object of this expedition is to secure data, photographs and material toward the construction of the two habitat groups for the new Hall of Reptiles in the museum. The West Indian region is rich in reptilian and amphibian life. Perhaps the two most striking creatures in this locality are the rhinoceros iguana and the giant tree frog. Both these forms are confined to the island of Santo Domingo. The expedition will travel over a large part of the island in the course of its investigations. The rhinoceros iguana is found to-day chiefly in the arid southwestern portion of the island in the vicinity of a dead sea, the surface of which is more than a hundred feet below sea-level. The giant tree frog has been taken only in the Central Cordillera and on the Quita Espuala, a range of mountains in the northeastern part of the island. It will be necessary for the expedition to carry on its work during the height of the rainy season in order to secure information in regard to the life history of the giant tree frog. Although this species is the largest and most spectacular tree frog in the world, its life history is entirely unknown, and the expedition hopes to secure valuable scientific data as well as exhibition material.

While field work in the department of anthropology is necessarily restricted for the present year, nevertheless, Mr. Nelson, of the Division of Archeology, is in Europe, engaged in a study of the paleolithic and neolithic collections in the museums abroad, and will endeavor to secure specimens to round out the exhibition series in this museum. During his trip Mr. Nelson will visit Norway, Sweden, Spain and Belgium.

Earl H. Morris, who for a number of years has been engaged on the Huntington Expedition work at Aztec, New Mexico, in company with Charles L. Parnheimer, of this city, is now busy making a general reconnaissance of the Navajo mountain region of New Mexico. Dr. P. E. Goddard, of this department, accompanied by Lieutenant G. T. Emmons of Princeton, left early in June for a trip to the Northwest Coast. It is the intention of this party to secure specimens and authentic data which will make possible an early completion of the North Pacific Coast Hall.

PROPOSED FEDERATION OF AMERICAN BIOLOGICAL SOCIETIES

THE second conference called to consider the question of cooperation or federation among biological societies met in Washington in the rooms of the National Research Council, on April 23, 1922. This meeting was held in pursuance of a resolution adopted at an informal conference in Toronto, December 27, 1921, and approved by the societies there in session. The conference organized under the chairmanship of Professor L. R. Jones, who had also presided over the Toronto gathering.

Plans for the 1922 meeting, in so far as they could be arranged by agreement among the officers of the several societies, were entrusted to a committee consisting of the secretaries of the American Society of Naturalists, Botanical Society of America, and American Society of Zoologists, in cooperation with the permanent secretary of the American Association for the Advancement of Science.

The view was generally expressed that the conference should, if it decided to recommend any form of federation, present a definite plan of organization. A committee was accordingly raised to formulate such a plan. This committee, of which Professor F. R. Lillie was chairman, reported to the conference the following recommendations, which were adopted:

1. That the vote of the Toronto conference in favor of the idea of federation be reaffirmed.

2. That the proposed federation be styled the Federation of American Biological Societies.

3. That the members of the federation be societies, not individuals, and that all societies represented in this conference (a list of which is given below) be eligible to charter membership.

4. That a council of the federation be established, consisting of two representatives from each society, these to be the president and secretary unless otherwise designated by the society.

5. That the council choose an executive committee from its own membership.

The committee that made the foregoing report was continued as an executive committee *pro tempore* of the conference, and to it was intrusted the task of drawing up a constitution and by-laws in accordance with the above general plan. The instructions of this committee call for completion of its work at a reasonably early date, and the transmission of its decisions and recommendations to the officers of the several societies by correspondence. It is expected that it will be possible to distribute the proposed constitution and by-laws to the members of the societies early next fall.

The executive committee *pro tem.* has the following personnel: Frank R. Lillie, University of Chicago; C. W. Greene, University of Missouri; I. F. Lewis, University of Virginia; C. E. McClung, University of Pennsylvania; A. Franklin Shull, University of Michigan; R. E. Thatcher, Agricultural Experiment Station, Geneva; H. B. Ward, University of Illinois; and B. E. Livingston, representing the American Association (Herbert Osborn to substitute for latter at August 4 meeting).

Considerable discussion was devoted to the problem of improving biological publications, a question likely to come before the council, if the plan of federation shall be adopted. This problem was considered so important that it was deemed advisable by the conference that some action be taken without waiting for the establishment of the federation. A special committee was, therefore, appointed to work in cooperation with a committee on the same subject from the Division of Biology and Agriculture of the National Research Council, to study the whole question of biological publications and report to the conference or to the federation if formed. The personnel of this committee is as follows:

A. P. Hitchens, Army Medical School.
I. F. Lewis, University of Virginia.
C. A. Kofoid, University of California.
D. R. Hooker, Johns Hopkins University.

The corresponding committee of the Division of Biology and Agriculture of the National Research Council is composed of the following members:

E. D. Ball, Department of Agriculture.
C. E. McClung, University of Pennsylvania.
J. R. Schramm, National Research Council.
A. F. Woods, University of Maryland.

The biological organizations represented at the Washington conference were as follows:

American Association for the Advancement of Science.

Sections F (Zoology), G (Botany), N (Medical Sciences), and O (Agriculture) of the American Association for the Advancement of Science.

Federation of American Societies for Experimental Biology.

The Executive Committee of the Division of Biology and Agriculture of the National Research Council.

American Society of Naturalists.

American Society of Zoologists.

Botanical Society of America.

Genetics Sections of the Botanical Society of America and the American Society of Zoologists.

American Genetic Association.

Ecological Society of America.

American Phytopathological Society.

American Society for Horticultural Science.

Society of American Foresters.

Society of American Bacteriologists.

American Society of Agronomy.

Entomological Society of America.

American Association of Economic Entomologists.

American Society of Animal Production.

American Dairy Science Association.

A. FRANKLIN SHULL,
Secretary of the Conference

HUIA ONSLOW

AT Cambridge, England, on June 27, Mr. Huia Onslow died. He was born in New Zealand on November 13, 1890, where his father, the Earl of Onslow, was then governor-general. To commemorate the place of his birth, he was given the Maori name Huia, and was regarded as the honorary chief of a Maori tribe. Queen Victoria became his godmother. Favored by circumstance, strong and handsome, he passed through Eton and Cambridge University, with every prospect of a brilliant career. But when taking a holiday in the Tyrol in July, 1911, he struck his head against a rock in diving, and was so severely injured that he became paralyzed from the waist downward. An apparently helpless invalid, he was condemned to spend the rest of his life on a couch, able only to move his head and arms. Many men, so situated, would have given up all idea of useful activities, lamenting a life of supposedly unavoidable idleness. Not so Mr. Onslow. Having been much interested in biological subjects when in college, he returned to Cambridge, secured the necessary assistants, and ardently devoted himself to biological research. Those interested in genetics will remember his papers on heredity in moths, based on breeding experiments carried on in his laboratory. His doubtless most important work, of 74 pages, was "On a periodic structure in many insect scales, and the cause of their iridescent colours" (*Philosophical Transactions of the Royal Society*, July, 1921). In this elaborate and fully illustrated paper the iridescent colors of many insects of various orders are studied, using all the modern refinements of microscopic technique and the latest pertinent researches in physics. All the drawings on the three plates are by Mr. Onslow. A few years ago Mr. Onslow was married to Miss Muriel Wheldale, formerly a fellow of Newnham College, well-known for researches on biochemistry and especially for her book on the anthocyanin pigments of plants. Marriage did not prevent her from continuing her work at the university, and so Onslow lived, as he wished to do, in the atmosphere of the laboratories, closely in touch with whatever was going on, himself an actor in the great scientific drama of the day. When I saw him in 1920 I was struck by the keenness of his mind and the breadth of his interests. His was a remarkable life, fruitful in many ways, and ever worthy to be remembered.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

SCIENTIFIC EVENTS

ILLUMINATING ENGINEERING NOMENCLATURE AND PHOTOMETRIC STANDARDS

THE American Engineering Standards Committee announces that the Illuminating Engineering Nomenclature and Photometric Standards of the Illuminating Engineering Society, 1918 edition, have been approved by the American Engineering Standards Committee as "American Standard," with the substitution of six internationally agreed upon definitions for certain ones of the 1918 rules. The definitions which have been reworded are: luminous flux, luminous intensity, illumination, candle, lumen and lux.

The special committee of the American Engineering Standards Committee which examined the proposal submitted by the Illuminating Engineering Society and which recommended approval of the nomenclature and photometric standards included representatives of the U. S. Bureau of Standards, the American Gas Association, the American Physical Society, the International Acetylene Association, the Optical Society of America, the American Institute of Electrical Engineers, the Illuminating Engineering Society and the National Electric Light Association.

The new tests to be substituted for existing text in sections 3, 8, 9, 10, 12 and 13 of the Nomenclature and Standards Rules of the Illuminating Engineering Society of 1918 are as follows:

Section 3: Luminous Flux is the rate of flow of radiant energy evaluated with reference to visual sensation. Although luminous flux must strictly be defined as above, it may be regarded for practical photometric purposes as an entity, since the rate of flow is for such purposes invariable.

Section 8: The Luminous Intensity of a point source in any direction is the flux per unit solid angle emitted by the source in that direction. (The flux from any source of dimensions which are negligibly small by comparison with the distance at which it is observed may be treated as if it were emitted from a point.)

Section 9: Illumination at any point of a surface is the luminous flux density at that point, or, when the illumination is uniform, the flux per unit of intercepting area.

Section 10: The unit of Luminous Intensity is the International Candle, such as has resulted from international agreement between the three national standardizing laboratories[1] of France, Great Britain and the U. S. A. in 1909.

This unit has been conserved since then by means of incandescent electric lamps in the laboratories which continue (or remain) charged with its conservation.

Section 12: The unit of Luminous Flux is the Lumen. It is equal to the flux emitted in a unit solid angle, by a uniform point source of one international candle.

Section 13: The practical unit of illumination is the Lux. It is equal to one Lumen per square meter, or it is the illumination at the surface of a sphere of one meter radius due to a uniform point source of one international candle placed at its center.

As a consequence of certain recognized usages, the illumination can also be expressed by means of the following units:

Using the centimeter as the unit of length the unit of illumination is one lumen per square centimeter, and is called the Phot. Using the foot as the unit of length, the unit of illumination is one lumen per square foot, and is called the Foot-Candle.

FRENCH VITAL STATISTICS FOR 1921[1]

The secretary (minister) of labor recently published the official vital statistics for France for the year 1921. It is an unfavorable report from every point of view. The number of births is below that of 1920, while the number of deaths has increased; the number of marriages has also decreased. The excess of births over deaths, amounting to 159,790 in 1920, or forty-one for each 10,000 inhabitants, decreased in 1921 to 117,023, or thirty for each 10,000 inhabitants.

A comparison of the number of births and deaths for the years 1921, 1920 and 1913 is shown in the following table:

Year	Total Population	Births	Deaths	Excess of Births
1921	39,209,766	813,396	696,373	117,023
1920	39,209,766	834,411	674,621	159,790
1913	41,476,272	790,355	731,441	58,914

The number of marriages, which reached an unusually high figure in 1920 (623,869), dropped in 1921 to 456,221, but it is still appreciably higher than the number recorded in 1913 (312,036).

An examination of the report brings out the fact that whereas the number of living births for each 10,000 inhabitants in 1920 was 213, it fell in 1921 to 207; in 1913, it was 191. The relative proportion of deaths has risen from 172 for each 10,000 inhabitants in 1920 to 177 in 1921, reaching about the same proportion that was recorded in 1913—176 for each 10,000 inhabitants.

In 1921, sixty-seven of the French departments showed an excess of births over deaths, the total amounting to 127,654, as compared with seventy-three departments in 1920. On the other hand, twenty-three departments showed an excess of deaths over births, the total amounting to 10,631, as against seventeen departments in 1920. The seven departments which, in 1920, showed an excess of births over deaths but in which the balance in 1921 was on the side of the deaths are: Aube, Cher, Côte-d'Or, Maine-et-Loire, Orne, Seine-et-Marne and Seine-et-Oise. In the department of Isère, which in 1920 showed an excess of deaths over births, the excess of births over deaths in 1921 was 292. During the year just preceding the war (1913), an excess of births over deaths amounting to a total of 86,768 for fifty-two departments was recorded, and an excess of deaths over births amounting to 27,854 was found in the thirty-eight other departments.

The departments in which the excess of births over deaths, in 1921, reached the highest figures are: Nord, Seine, Pas-de-Calais, Finistère, Moselle, Bas-Rhin, Seine-Inférieure, Côtes-du-Nord, Morbihan, Haut-Rhin, Aisne, Meurthe-et-Moselle, Ardennes and Bouches-du-Rhône. In all these departments, with the exception of Aisne, Meurthe-et-Moselle and Ardennes, the excess of births in 1921 was much less than in 1920.

The departments in which the excess of deaths over births, in 1921, was highest are: Yonne, Var, Gers, Lot, Lot-et-Garonne, Maine-

[1] These laboratories are the Laboratoire Central d'Electricité, Paris, the National Physical Laboratory, Teddington, and the Bureau of Standards, Washington.

[1] From the *Journal* of the American Medical Association.

et-Loire, Nièvre, Hautes-Pyrénées, Seine-et-Oise, Puy-de-Dôme, Vaucluse, Cher and Allier. In all these departments, with the exception of Puy-de-Dôme and Allier, the excess of deaths in 1921 was greater than in 1920; three of these departments, Maine-et-Loire, Seine-et-Oise and Cher, had shown an excess of births over deaths in 1920.

In 1920 (the figures for 1921 are not as yet available), Germany, exclusive of Wurttemberg and Mecklenburg, showed an excess of births over deaths amounting to 623,367; in 1919, the excess of births was 282,230, and in 1918 there was an excess of deaths over births of 299,885. In England, the excess of births for 1920 was 491,781, and for 1921, 390,355.

PRODUCTION OF DYES IN THE UNITED STATES

The United States Tariff Commission reports that the production of dyes in this country declined last year far below that of the previous year, ascribing as the reasons the loss of much of the country's export trade, the general business depression, and the carrying over of large stocks from the previous year.

The commission states that the progress made during the year includes the production in the United States for the first time of a number of dyes of greater complexity and more specialized application. Many of these dyes, which are of secondary importance from the point of view of quantity consumed, are essential in the dyeing and printing of numerous fabrics. These additions to our list of dyes represent an added step toward a well-rounded coal tar chemical industry. The development of many of these new products is a highly technical achievement.

There were 201 firms engaged in the manufacture of coal tar derivatives in 1921. The output of dyes by seventy-four firms exceeded 39,000,000 pounds, a decrease of 56 per cent. from that of 1920. The sales in 1921 exceeded 47,000,000 pounds, valued at more than $39,000,000, and exceeded production by 22 per cent., indicating that a part of the domestic consumption for that year was supplied from the large stocks carried over from the previous year's abnormally high production. The sales of dyes for 1921 exceeded the imports of 1914, when the United States imported nearly 46,000,000 pounds and produced over 6,000,000 pounds of dyes from German imported intermediates.

The average price of all dyes in 1921 was 83 cents per pound, compared with a value of $1.08 per pound in 1920 and a value of $1.26 for 1917. The total quantity of dyes imported in 1921 was 3,914,036 pounds, valued at $5,155,779, or $1.32 per pound, compared with 3,402,582 pounds, valued at $5,763,437 in the previous year. The imports of 1921 represent 10 per cent. of the production and about 8 per cent. of the total dye sales during the year. Germany supplied about 48 per cent. of the total dyes imported during 1921; Switzerland, 41 per cent.; England, 7 per cent., and all other countries, 4 per cent.

Exports of domestic dyes for 1921 show a decrease of nearly 79 per cent., compared with those for the previous year. The value of our exports for 1921 was $6,270,139, compared with $29,823,591 in 1920. The total exports of dyes for 1921 were less than for the year 1917, when the first considerable expansion of the domestic dye industry from pre-war conditions occurred.

The total production of synthetic organic chemicals other than those derived from coal tar, which are used as medicinals, perfumes, flavoring ingredients, solvents and in numerous industrial processes, was 21,545,186 pounds; the sales amounted to 16,761,096 pounds, valued at $13,746,235. The development of this industry in the United States has been similar to that of the dye industry, as our supply of synthetic organic chemicals was controlled primarily by Germany prior to the war.

FELLOWSHIPS FOR MEDICAL RESEARCH

It is stated in *Nature* that Junior Beit Memorial Fellowships of the annual value of £350, and tenable for three years, have been awarded by the trustees to the following, the subject and place of research being given after each: Mr. E. B. Verney: The physiology and pathology of urinary secretion, at the Institute of Physiology, University College, London; Professor F. Cook: A study of the neuro-muscular apparatus of the uterus, at Guy's Hospital; Dr. J. L. Rosedale: The chemistry of normal and pathological tissue with special reference to the protein and nuclein constituents, at St. Thomas's Hospital Medical School, London; Mr. R. Hilton: The study of the blood gases in various stages of pulmonary collapse produced by artificial pneumonthorax; the condition of the circulation in the collapsed lung, at the Lænnec Hospital, Paris, and at St. Bartholomew's Hospital; Mr. A. St. G. J. M'C. Huggett: The investigation of the function of the placenta in relation to the passage of gases and other substances from the mother to the fœtus and the cause of fœtal apnœa, at the Sherrington School of Physiology, St. Thomas's Hospital, and at the Brown Animal Institution at Vauxhall; and Mr. V. D. Allison: The investigation of the nature and properties of a hitherto undescribed substance which has a strong bactericidal, bacteriolytic and bacterio-inhibitory action—named lysozyme, at the Institute of Pathology and Research, St. Mary's Hospital. Fourth year fellowships of the annual value of £400 have been awarded to Dr. D. Keilin: The life-histories of protozoa pathogenic to insects; the life-history, anatomy and physiology of insects, at the Monteno Institute for Research in Parasitology, Cambridge; and Mr. I. de B. Daly: Auriculo-ventricular block, at the Institute of Physiology, University College, London. The trustees of the Beit Scientific Research Fellowships have re-elected Mr. H. L. Riley and Mr. W. A. P. Challenor to fellowships for the year commencing September, 1922, and elected Mr. H. W. Buston to a fellowship for the same period. All the fellows are required to carry out their research at the Imperial College of Science and Technology. Mr. Riley will continue his research on "The Atomic Weight of Silver, and the Dielectric Constants of Dry Gases" in the chemistry department, and Mr. Challenor will continue his work on "Ring Formation in the Aromatic and Aliphatic Series of Organic Chemistry" in the chemistry department, both under the direction of Professor H. B. Baker. Mr. Buston will carry out investigations on "Nitrogenous Metabolism in Plants" in the biochemistry department under the supervision of Professor J. B. Farmer.

THE SECOND NATIONAL HIGHWAY CONFERENCE

PLANS for a second national conference for the study of highway engineering and highway transport education are being prepared by the Highway Education Board, of which Dr. John J. Tigert, U. S. commissioner of education, is chairman. Teachers of highway engineering and highway transport, officials in charge of highway construction programs, members of the automotive industry and kindred fields, together with representatives from other countries, are being invited to attend. The conference will be held in Washington from October 26 to 28 inclusive, and, according to the tentative program, this period will be devoted to the intensive study of highway and engineering problems.

According to a statement of the program committee, the object of the conference is "To review the field of highway engineering and highway transport education in the light of expanding state and federal highway programs and the rapidly increasing social and commercial use of the highways; to discuss general and special courses in undergraduate and graduate curricula; and to exchange views on educational trends arising from these developments in the national transportation system."

Members of the program committee charged with the duty of arranging an adequate program are: Professor T. R. Agg, professor of highway engineering, Iowa State College; Professor Arthur H. Blanchard, professor of civil engineering, University of Michigan; Professor C. J. Tilden, professor of engineering mechanics, Yale University; Professor Lewis W. McIntyre, professor of civil engineering, University of Pittsburgh; H. G. Shirley, chairman of the Virginia State Highway Commission, Richmond, and Dr. Walton C. John, U. S. Bureau of Education, Washington, D. C., chairman.

Seven principal committees will function as the chief activities of the conference, but a program of unusual and exceptional merit, it is said, is being arranged. Tentatively the committees will be assigned to the study of the following problems: (1) Undergraduate and elective courses in highway engineering; (2) Undergraduate and elective courses in highway transport; (3) Graduate work in highway engineering and highway transport; (4) Short courses in highway engineering and highway transport; (5) Introductory general course in highway engineering and highway transport; (6) Vocational training for non-professional highway personnel, and, (7) Highway traffic regulation and safety.

Information with regard to the conference may be obtained from the Highway Education Board, Willard Building, Washington, D. C.

SCIENTIFIC NOTES AND NEWS

At the meeting of the British Association, which begins at Hull on September 6, for the first time, special lectures are being arranged for children in the secondary schools. These will be given by Professor H. H. Turner, on "The telescope and what it tells us"; Professor J. Arthur Thomson, on "Creatures of the sea"; and Mr. F. Debenham, on "The Antarctic."

The ninetieth annual meeting of the British Medical Association was held in Glasgow, Scotland, from July 25 to 28, under the presidency of Dr. David Drummond, of Newcastle-on-Tyne. Sir William Macewen, Glasgow, was elected president for the year 1922-1923. Mr. Charles P. Childe, Southsea, is president-elect for the annual meeting to be held in Portsmouth in 1923.

Sir William Pope has been elected president of the International Union of Pure and Applied Chemistry for the ensuing three years. The next meeting of the union will be held at Cambridge in June, 1923.

The physicists, Professor H. K. Onnes, of Leyden, Professor P. Zeeman, of Amsterdam, and Dr. N. Bohr, of Copenhagen, have been elected corresponding members of the Berlin Academy of Sciences.

H. Le Chatelier, professor of chemistry at the Sorbonne, Paris, has been presented with a gold medal on the completion of his fifty years of teaching and of service to France.

Colonel Arthur S. Dwight, president of the American Institute of Mining and Metallurgical Engineers, and Charles F. Rand, chairman of the Engineering Foundation, have been made Chevaliers of the Legion of Honor.

The honorary degrees conferred by the University of Edinburgh on July 21 included the doctorate of laws on M. Roger, dean of the faculty of medicine in the University of Paris; Sir Charles Scott Sherrington, professor of physiology in the University of Oxford; Mr. John Bretland Farmer, professor of botany at the Imperial College of Science and Technology, London, and William Somerville, professor of rural economy at Oxford.

Dr. Virgil Snyder, professor of mathematics at Cornell University, received, at the seven hundredth anniversary celebration of the University of Padua, the honorary degree of doctor of the University of Padua.

The Rio de Janeiro Academy of Medicine has conferred the Sampaio prize this year on the pharmacist, P. Seabra, for his work on an electric process for producing nitric acid.

Dr. Gerald L. Wendt resigned on July 1 as associate professor of chemistry at the University of Chicago to join the staff of the Standard Oil Company of Indiana in the direction of research.

The Cross of the Legion of Honor has been awarded to Dr. A. E. Kennelly, professor of electrical engineering at Harvard University and the Massachusetts Institute of Technology, for distinguished services as exchange professor in engineering to the French Republic. Dr. Kennelly will be succeeded as American exchange professor by Dean John Frazer of the University of Pennsylvania, now in France. The French representative to the American institutions, Professor J. Cavalier, director of the University of Toulouse, has returned to France and will be succeeded by Dr. M. E. de Margerie, director of the Geological Service of France.

Dr. Frederick Robert Zeit, for more than twenty years professor of pathology at Northwestern University Medical School, at his request has been relieved of active duty in the medical school. He plans to spend next year abroad. The pathological museum of the university will hereafter be known as the Frederick Robert Zeit Museum of Pathology.

James B. Pollock, associate professor of botany in the University of Michigan, goes to the University of Hawaii at Honolulu for the college year 1922-1923, in exchange with Professor H. F. Bergman.

Professor Herbert E. Gregory and Dr. Levi F. Noble are devoting the months of August and September to geological investigations in southern Utah. At the beginning of the academic year Professor Gregory will resume his work at Yale University.

The sixth session of a series of graduate medical lectures given at the University of Washington, Seattle, opened on July 17. Five lectures each were given by Dr. Hobart Amory Hare, professor of therapeutics, Jefferson Medical College, Philadelphia; Dr. John B. Deaver, professor of surgery, University of Pennsylvania, and Dr. Williams McKim Marriott, professor of pediatrics, Washington University, St. Louis. Single lectures were given by Dr. William Englebach, professor of medicine, St. Louis University School of Medicine; Dr. Joseph Colt Bloodgood, professor of surgery, Johns Hopkins University, Baltimore, and Dr. Walter B. Cannon, professor of physiology, Harvard University, Boston.

Dr. George Milbry Gould, known for his work in medical ophthalmology and especially in eyestrain, formerly editor of *American Medicine, Biographic Clinics* and the Gould Medical Dictionary, died on August 8, aged seventy-four years.

The death is announced of Professor W. Hallwachs, of the Dresden Technical School, known for his researches on electricity, particularly on the photo-electric effect, and of Professor Otto Lehmann, of the Karlsruhe Technical school, best known for his work on liquid crystals.

The death is announced from Paris, at the age of forty-one, of Professor Pierre Boutroux, of the Collège de France, formerly professor of mathematics at Princeton University. The son of the philosopher Émile Boutroux and the nephew of Henri Poincaré, himself a mathematician of no little merit, his main work was along the lines of multiform functions and of singularities of differential equations.

Nature says: "Mr. H. G. Wells has accepted the invitation of the labor party of the University of London to offer himself as the candidate of the party at the election for a representative of the university in the House of Commons to be held after the retirement of Sir Philip Magnus at the end of the present session of Parliament. Mr. Wells occupies such a distinguished position in the world of literature and among leaders of thought to-day that his early work in science and education is often overlooked. He was a student at the Royal College of Science, South Kensington, in 1884-87, and was the first president of the Old Students' Association of the College. He took his B.Sc. degree with honors in zoology in 1890, and his first book was a "Text-book of Zoology," written particularly for London University students while he was a teacher of the subject. He is a fellow of the College of Preceptors, and for a short time edited the *Educational Times*. Throughout his career he has been a steadfast supporter of scientific methods in schools and government, and in his books has pleaded the cause of scientific education and research with eloquence and conviction. It is not too much to say that no graduate of the University of London possesses such a rare combination of brilliant literary power and scientific thought or has used these gifts with greater effect than has Mr. Wells in his many and various works."

The Congress of Learned Societies will meet at the Sorbonne, Paris, from April 3 to 7, 1923.

The exhibition which opens in Rio Janeiro on September 7 will include displays representing the New England offshore fisheries, the salmon industry, the sardine industry of Maine and California, the oyster industry, the fresh-water mussel fishery, the fish-canning industry, the by-products of the fisheries, and the bureau's relations with the industries. Because of limited allotments of space and funds the exhibit will of necessity be small. A report on the fisheries of the United States, the organization and functions of the bureau, educational opportunities afforded students of fisheries in the United States, etc., has been prepared for publication in English, Spanish, and Portuguese.

Under the presidency of Lord Ancaster, British deputy minister of fisheries, the Deep Sea Fishing Exhibition was held at the Royal Agricultural Hall, Islington, from July 24 to August 5. Among the exhibits were fish from the Dogger Bank shown alive in tanks of salt water, free fish snacks cooked on the premises, the dressing and curing of fish, wireless broadcasting, Scottish fisher girls at work, a diver operating under water, samples of fish not known on the markets, fish luncheons and dinners, a museum with models of various types of vessels, working exhibits, a picture gallery, and films dealing with deep-sea fishing, life under the surface, whaling and pearl fishing.

The London Natural History Museum Staff Association held their summer scientific reunion in the board room of the museum on July 5. According to the report in *Nature*, among the exhibits were the following: specimen of the supposed gigantic gastropod (*Dinocochlca ingens*) from the freshwater sandstones in the Wadhurst Clay, Hastings; the natural cast of a footprint of an iguanodon from the Wealden Beds. between Bexhill and St. Leonards; opalised mollusca of Cretaceous age from New South Wales and South Australia; skin with scutes of astegosaurian dinosaur from the Upper Cretaceous, Alberta, Canada; specimens from the collection of Swiss minerals bequeathed to the museum by the late Reverend J. M. Gordon; one of the four meteoric stones which fell in the Strathmore district of Perthshire and Forfarshire on December 3, 1917; living specimens of a branchiopod crustacean (*Leptesheria dahalacensis*) hatched from eggs contained in dried mud from Bagdad; ammonites with the operculum preserved and associated fossils from the same bed in the Lias at Charmouth, Dorset; horse chestnut seedlings, illustrating three different methods of replacing the bud of the primary shoot; a very rare British orchid (*Orchis hircina*) recently found near Lewes; examples of the remarkably different, smooth and partly rough, skinned fruits borne on the same tree of the Khatta orange, North India; model of Commerson's dolphin (*Cephalorhynchus Commersoni*) from Port Stanley, Falkland Islands; and the model, enlarged 740 diameters, of the itch mite (*Sarcoptes Scabiei*) recently made for the museum by Miss Grace Edwards. Messrs. R. and J. Beck exhibited their most recent forms of microscope, and Duroglass Ltd. showed examples of their glass-ware for preserving specimens in spirit and for use in chemical analysis.

The third International Congress of the History of Medicine was opened on July 17, at the Royal Society of Medicine, London. Dr. Charles Singer, lecturer on the history of medicine, London University, presided. The following countries were represented: Belgium, Czecho-Slovakia, Denmark, Egypt, France, Greece, Holland, Italy, Portugal, Rumania, Spain, Switzerland and the United States. Lord Onslow, parliamentary secretary to the Ministry of Health, welcomed the delegates on behalf of the government, after which Dr. Singer addressed the congress. Dr. Laignel-Lavastine acknowledged the welcome on behalf of the foreign delegates. Sir D'Arcy Power, in the absence of Sir Norman Moore, president of honor, said it was a matter of especial gratification that England had been chosen for the third congress. Dr. Tricot-Royer, first president, thought that greater success would result from that conference than from its predecessors. He announced that the next conference would be held at Brussels. At the afternoon meeting of the congress, held at the Royal College of Physicians, Pall Mall, the president of the institution, Sir Humphrey Rolleston, gave an address of welcome, and Dr. Arnold Chaplin, Harveian librarian, described the treasures of the library. The president of the congress and Mrs. Singer gave a reception and conversazione in the evening at the Royal Society of Medicine, when a demonstration on human paleolithic skulls was given by Professor Elliot Smith.

We learn from *Nature* that a summer course in the Austrian Tyrol has been organized by the directors of Leplay House, London. The course is of the nature of a civic and rustic survey, and for this purpose the party is divided into groups each of which takes one particular aspect of the work. Mr. H. J. E. Peake, president-elect of the Anthropological Section of the British Association, has undertaken to direct the group studying the anthropological aspects; Dr. M. Hardy will organize a survey of plant life and agriculture, while other sections will deal with the geology, physiography, history and sociology of the district. Group meetings and gatherings of the whole party will frequently be held for the purpose of discussing and comparing results. The tour commenced on August 4 and will last four weeks, although it is possible to arrange for a shorter course of two weeks.

The *Experiment Station Record* states that the Palestine Zionist executive is opening an institute of agricultural research in Jerusalem. This institute will be in charge of O. Warburg as head and botanist, with I. Wilkansky as director of experimental stations and farm management, F. Bodenheimer in charge of entomology, A. Treidal and M. Winik of chemistry, M. Wilkansky of agronomy, L. Pinner of plant breeding, N. Reichert of plant pathology, E. Pickholz of animal nutrition, and S. Zemach in charge of agricultural publications. Departments of horticulture, animal husbandry, irrigation, and agricultural education will be opened next year. The institute will for the present be under the direction of the Colonization Department of the Palestine Zionist Executive, but is expected to be transferred eventually to the Research Institute of the Jerusalem University. Experimental stations in Ben-Shemen for the Shephela, Merhavia for the Jezreel Valley, and Degania for the Jordan Valley were established during the past year. It is anticipated that a similar station will shortly be opened in Beer-Sheba for the Nogob.

According to the *Journal* of the American Medical Association the International Health Board of the Rockefeller Foundation has entered into a cooperative arrangement with the Health Organization of the League of Nations whereby the board will provide a sum not to exceed $32,840 a year, for a period of five years, for the purpose of maintaining an international epidemiologic intelligence service. The board will also provide a sum not to exceed $60,080 a year for three years to put into effect a scheme for the international exchange of public health personnel, to be conducted under the auspices of the health organization of the league. Since the establishment, in 1921, of the intelligence service of the health organization of the League of Nations, it has conducted an international epidemiologic information service, keeping all governments informed as to the status of epidemics of typhus, intermittent fever and cholera, which have been sweeping westward from the famine regions of Russia. It has also undertaken to promote the international standardization of vaccines and serums. It advises the league in matters affecting health and cooperates with the International Labor Organization in promoting industrial hygiene and sanitary conventions for the control of epidemics. It is expected that, by the end of the five-year period, for which funds have been provided by the International Health Board, the epidemiologic intelligence service will have become so efficient and valuable that the various national governments will regard it as indispensable and provide funds for its further maintenance. Interchange of health officials will be arranged, not only for observation but for definite periods of service, which will result in actual exchange of experience. This system of exchanges will be put into effect first in Europe and may be extended to other countries throughout the world.

The Weather Bureau is conducting a study of the constants of anemometers in general use in this country. With the cooperation of the Bureau of Standards about thirty instruments of various dimensions, proportions and weights have been tested in the wind-tunnels of the latter bureau at velocities ranging from five to sixty meters per second. Since the behavior of these anemometers may be different in the variable natural wind, certain instruments tested in the wind-tunnels have been taken to Mount Washington, New Hampshire, for comparison in the very high winds prevailing there. These free-air comparisons will be completed during August, 1922. Following an analysis of the data an improved standard anemometer, recording true velocities, will be developed and corrections determined for records of velocity already accumulated. Experimental values of the factors or constants of anemometers, throughout the range of velocities occurring in nature, are now available for the first time, and much information useful in the design and construction of these instruments has been obtained. In advance of publication of final results it may be stated that the velocities recorded by the standard Robinson anemometer now in use are about 22 per cent. too high and that the rate of the instrument is more nearly constant than that determined by means of tests on whirling-machines. The three-cup pattern suggested by Dr. Patterson, of the Canadian Meteorological Office, appears to be more satisfactory than the four-cup pattern in general use. This investigation is being conducted by Messrs. S. P. Fergusson and R. N. Covert, of the Instrument Division.

It is stated in *Nature* that a biological expedition has left Antwerp for Brazil. It is under the direction of Professor C. Massart, of the department of botany in the University of Brussels, and there are four other members of the expedition, two of whom are students. For several years before the war the universities of Belgium and Holland organized expeditions to enable students to go into the field under the guidance of their professors, and it is one of these expeditions, to Brazil, which has now been promoted by the University of Brussels. The party will not aim at exploring Brazil; the object is rather to put the young naturalists directly in touch with tropical nature; they will have the opportunity of collecting botanical and zoological material for study and demonstration and of making ethnological observations. Brazil has been chosen on account of its salubrity and also because, some twenty days' journey from the starting-place, the party will be in the virgin forest. The expedition will remain in Brazil from August until January or February next, and visits will be paid to the state of Rio de Janeiro and Bahia, to the Campos de Minas Geraës, a region in the state of Bahia which is almost deserted, and to some of the peaks of the Sierra de Mantiqueira.

The *Eugenical News* states that, under date of June 4, 1922, Dr. A. Govaerts, secretary of the Société Belge d'Eugénique, who spent eight months, from September, 1921, to May, 1922, studying the organization of eugenics in the United States, writes that efforts to establish a governmental eugenics office in Belgium have been successful. The new office will be located in the Institute Solvay in Brussels and will be supported by the government. It has been decided to provide regular courses of lectures in eugenics in the State School of Social Service. This school is an organization which prepares its students to undertake actual social service in connection with societies and institutions devoted to charity, the protection of children, and other welfare activities. Professionally, the students of this school will, in the future, be trained, not only as visiting nurses and social workers, but also as eugenical field workers. Dr. Govaerts will organize and give the courses of lectures in eugenics. In general, the courses will be modeled after the instruction provided for the annual training corps of the Eugenics Record Office. Closest contact will be maintained between the Belgian and the American organizations. In Dr. Govaerts' first course of weekly lectures, the following subjects will be treated: Meaning of eugenics; laws of heredity in plants, animals and man; selective matings; the relation between natality and mortality and the national welfare; the technique of eugenics; the field workers' interviews and questionnaires; charting family pedigrees; tracing the descent and recombination of human traits in actual pedigrees; mental and physical measurements in man.

UNIVERSITY AND EDUCATIONAL NOTES

Princeton University has established a library of industrial relations, the expense of which, $12,000 a year, will be defrayed for the first five years by a gift from Mr. John D. Rockefeller, Jr.

Mission and educational bodies of East China have set in motion a project to build in Shanghai a union medical school at a cost of $500,000. St. John's University of Shanghai, which now has a medical department, is one of the institutions supporting the project.

We learn from the *Journal* of the American Medical Association that two chairs in the University of Cincinnati College of Medicine, honoring John D. Rockefeller and Andrew Carnegie, donors of munificent sums to the medical school, were founded at a meeting of the board of directors on July 19. The professorship in obstetrics will be known as the John D. Rockefeller Chair of Obstetrics and the professorship in biochemistry as the Andrew Carnegie Chair of Biochemistry. Dr. William Gillespie holds the chair of obstetrics, and Albert Prescott Mathews, Ph.D., is professor of biochemistry.

Dr. Stephen Rushmore, associate professor of gynecology, has been appointed dean of the Tufts Medical School. The deanship has been vacant since the resignation of Dr. Charles F. Painter, one year ago. Dr. Rushmore is a graduate and former instructor of the Johns Hopkins Medical School.

Dr. William Moulton Marston has been appointed professor of experimental psychology in the American University at Washington, D. C.

Dr. R. W. Shufeldt, of Washington, has accepted the position of lecturer on art anatomy and zoology on the faculty of the Research University of that city. He will also give a course of lectures at the Catholic University of America on "The Essentials of Natural Science."

Dr. H. F. Pierce, who has been for three and a half years in the department of pathology at the University of Oxford, engaged in research for the British Medical Research Council, has been appointed associate in physiology at the College of Physicians and Surgeons, Columbia University.

M. Pruvost has been appointed to the chair of geology and mineralogy newly established at the University of Lille.

M. Hesse has been appointed professor of zoology at the University of Dijon.

In the University of London, Dr. J. C. Drummond has been appointed to the university chair of biochemistry tenable at University College, and Professor Adrian Stokes to the Sir William Dunn chair of pathology tenable at Guy's Hospital Medical School.

DISCUSSION AND CORRESPONDENCE

PASTEUR ON SCIENCE AND THE APPLICATIONS OF SCIENCE

In his address as president of the American Association for the Advancement of Science, Science, 54: 650, 1921, Dr. L. O. Howard makes the following quotation from the address of Edwin Linton at the Baird Memorial meeting in Washington in 1916:

> As I look over the titles of theses for doctorate degrees in biology, however, knowing that they must, in some fashion, reflect the activities of our biological leaders, I am led to wonder if the failure of science to influence legislation in the interests of the people is not to be charged to the propensity on the part of these leaders to shun the practical. Is there a hierarchy in science that frowns upon independence of thought and action in her sanctuary? That can hardly be. Let the heads of departments of biological research in our universities then take heart, and not be afraid to follow the lead of Pasteur, who surely committed no violence upon science by undertaking the solution of practical problems.

This reminds me that, about fifty-one years ago, Pasteur had some pretty definite things to say about this matter. In the preface to the fourth edition of "Fragments of Science," December, 1871, Tyndall says:

My friend M. Pasteur, of the Institute of France, sent me some time ago, among other important books and papers, a short essay entitled "Quelques Réflexions sur la Science en France." It consists of three articles, the first published in January, 1868; the second unpublished, though laid before the Emperor Napoleon at the Tuileries in March, 1868; and the third communicated to a public journal last March. All three articles are conceived in the same spirit, and directed to the same end. The last of them, entitled "Pourquoi le France n'a pas trouvé d'hommes supérieurs au moment du peril," contains many remarks which may wisely be laid to heart in England. In our eager pursuit of "practical" results, the high preparatory studies contended for by M. Pasteur as essential are only too likely to be underrated or overlooked.

The bearing of his views on the question of technical education, now so much spoken of in England, will be apparent to every reader of the following translation of a portion of the article referred to. Its introduction in this place would be incongruous were it not that the main object of the various essays published in this book was to create a public interest in science as a source of knowledge, and as a means of culture, without present regard to its material results. But the issues of studies animated by this spirit are incalculable; for, though undertaken with no practical intent, they are really the prime movers of all practice. If the purely scientific discoverer die out, practical applications cannot long survive him.

The following three quotations are selected from Pasteur's article:

Few persons comprehend the real origin of the marvels of industry and the wealth of nations. I need no other proof of this than the employment more and more frequent in lectures and speeches, in official language, and in writings of all sorts, of the erroneous expression *applied science.* The abandonment of scientific careers by men capable of pursuing them with distinction was recently complained of in presence of a minister of the greatest talent. This statesman endeavored to show that we ought not to be surprised at this result, *because in our day the reign of theoretic science yielded place to that of applied science.* Nothing could be more erroneous than this opinion; nothing, I venture to say, more dangerous even to practical life, than the consequences which might flow from these words. They have rested in my memory as a proof of the imperious necessity of reform in our superior education. No, a thousand times no! There exists no category of sciences to which the name of applied science could be given. *We have science and the applications of science,* which are united to each other as the fruit and the tree on which it grew.

At one time the majority of the foremost disciples of the École Polytechnique followed the career of mathematical and physical science, and of the higher studies generally. In our day this fact is only a rare exception. It is not that the pupils of this great school are less numerous than formerly, or less capable than their predecessors, the Maluses, the Poissons, the Fresnels, to render their country illustrious by fruitful discoveries, but the course of events invites them to carry the fruit of their studies into the operations of industry, such as the working of mines, the construction of railways, etc.

The German nation has understood that there exists no applied science, but only the applications of science, and that these latter are only rendered valuable by the discoveries which nourish them; while the constant preoccupation of our statesmen regarding public instruction during fifty years has had principally for object primary and secondary education. They have forsaken the higher studies, particularly that of science, to the impulse they had received from the renovation of science in the eighteenth century.

Finally Tyndall says:

The opinions of so eminent a man regarding the relation of science to its applications, and to the general culture of the nation, merits our gravest attention.

Charles Robertson

Carlinville, Illinois

CULTIVATION AND EVAPORATION

To the Editor of Science: Dr. L. S. Frierson (in Science, March 24, 1922, p. 317) shows by his remarks the danger of confounding facts with their explanation. What "all practical farmers from the days of King Hamurabi to date" agree upon is the *fact* that cultivation helps plants in dry weather. But Dr. Frierson and I have differed as to the *explanation* of this fact—he believes that cultivation "stops evaporation, and thus conserves the store of soil water," whereas my view was that "a greater total surface is exposed to evaporation, and evaporation is therefore facilitated."

The remarks of Dr. H. A. Noyes (in Science, June 9, 1922, p. 610) throw further light on the subject. He believes that "cultivation lets air down in the soil, thereby increasing bacterial activities which in turn cause the plants to get more food and grow larger on less moisture." In the *Journal of Industrial and Engineering Chemistry* for March, 1922, Dr. Noyes reported experiments where "fertilization has decreased the water requirements of plants over one half, when expressed as the amount of water necessary to produce one unit weight of plant." "It appears that if the soil solution is weak, the plant transpires more water in its attempt to make a normal growth."

The observations of Dr. Noyes seem to confirm my application of Bechhold's "capillary phenomenon" in agriculture (SCIENCE, July 22, 1921), because increased evaporation at the surface of the ground in the immediate neighborhood of the plant would mean a richer soil solution within reach of the plant roots; so that even if some water is lost, the plant can get its food requirements with less water. The uncultivated soil near the plant may even be robbed of its food and moisture by sidewise diffusion streams. As W. Kraus showed, the movement of salts in the Bechhold "phenomenon" is dependent upon evaporation at the exposed surfaces (*Kolloid Zeitschrift*, 28, 161, 1921).

Another important factor is the *rate* at which the soil water reaches the plant roots. This must at least equal the speed at which moisture is evaporated by the leaf system, otherwise the *wilting coefficient* is reached and the plant droops. In this connection Sir E. J. Russell, director of the Rothamsted Experimental Station, pointed out that the availability of nutrients should properly be measured by the *rate* at which they reach the roots which absorb them. (*J. Agri. Sci.*, 1, 327).

According to the Bechhold phenomenon, cultivation of the soil immediately above the roots (which is where cultivation takes place) increases evaporation there and the accelerated *upward* and *sidewise* diffusion streams carry the essential water and food with sufficient rapidity to favor plant growth. Russell says (*Trans. Faraday Soc.*, February, 1922) that a crop of wheat weighing with its straw about four tons per acre, transpires during its lifetime about 1,000 tons of water per acre, the actual strength of the soil solution varying from 0.0001 to 0.006 per cent. according to treatment.

Dry weather usually comes when the plant's leaves are well developed; and in any event it means a period of rapid evaporation from the leaves. Especially *then* has cultivation been found a life saver, and often an actual aid to growth.

The remarks of Dr. Cyril Hopkins (quoted by Dr. Frierson to support his view) that the soil is "stirred after each rain to prevent evaporation, and thus store up sufficient moisture in the soil to give the crop a good start," do not militate against my view; for Dr. Noyes' experiments show that cultivation, by allowing the plant to grow with less moisture early in the season, enables it to enter the drought period "with an accumulative reserve of soil moisture." This is a most important conclusion. It seems to me, however, that the Bechhold phenomenon of salt concentration or movement also explains why a plant may thrive on less water; for this lesser amount of water, enriched by diffusion, has the essential plant foods.

JEROME ALEXANDER
RIDGEFIELD, CONN.

REPOSITORIES FOR SCIENTIFIC PUBLICATIONS

TO THE EDITOR OF SCIENCE: Recent discussion in SCIENCE as well as in other places is indicative of the increasing interest in efforts to extend limited funds so as to cover rapidly expanding scientific writings or to curtail such writings so as to bring them within the limits of the funds.

This interest is considerably augmented by the realization of workers in certain lines that there is also a problem of storage space for multitudinous papers and a kindred problem of finding time and energy for reading such as come to hand.

In the course of recent discussions with representatives of the University of California Press and the University of California committee on research I have been impressed with the need for adoption of a general policy with regard to certain features (at least) of scientific publications.

It is my understanding that the University of California officials are about ready to adopt for their publication material of all departments the settled policy of curtailing or excluding generally explanatory discussion which is plainly redundant or needlessly explicit, and of curtailing or excluding tabular, statistical or other exhibitive matter which is likely to receive little or no attention from most readers. But, in order that such exhibitive material shall not be lost to permanent record (where its value may be far superior to mere textual discussion) it is expected that limited numbers of copies of such matter will be mimeographed or otherwise duplicated and placed in certain repositories designated because of their accessibility to those persons most likely to need such records.

Such a plan seems to offer the best possibilities for meeting the adverse conditions mentioned, but since it is probable that in many or most cases the individuals or organizations concerned will be expected to arrange matter for deposit there is danger of much confusion in the process of accumulation at points of deposit.

Possibly the National Research Council can give early assistance in the matter by obtaining the consent of available institutions to act as repositories and also by classifying them according to local interests if that should seem desirable. For example, an institution in Indiana would not be very favorable as a place of deposit for most marine material.

Provision should also be made for putting deposited documents in fairly uniform packages. In the case of statistical tables such as my own the ordinary typewriter sheets (8 x 11 inches) would probably be most satisfactory. It would then be an easy matter for the institution of deposit to tie them up or put them in clip binders for convenient and economical storage.

If definite plans can be made for some such dispersal they will surely greatly expedite the issuance of papers using large volumes of quantitative and statistical records. Such papers may then get into print and into use while still comparatively fresh. Furthermore the worker in such lines will not have so much reason to be discouraged by long delay in publication, following the monotony (and sometimes dreary drudgery) of making, accumulating and interpreting the records.

W. E. Allen

Scripps Institution for
Biological Research,
University of California

ALFRED GOLDSBOROUGH MAYOR

To the Editor of Science: When I saw the name "Alfred Goldsborough Mayor" at the head of Dr. Woodward's most interesting and appreciative notice of his late associate I suspected a typographical error, but when I saw the same name "Mayor" throughout the article and found it the same in "Who's Who" and in the list of members of the National Academy of Sciences, I realized that a change, which had escaped my notice, in the spelling of this well-known name had been made by the son of my old friend, Professor Alfred M. Mayer, the charming and accomplished professor of physics who for so many years was the head of that department at the Stevens Institute of Technology.

One would like to know the reason for this, which may have been due to the not infrequent pronunciation of the original spelling as if it were "Myer," but this seems an insufficient excuse for abandoning a form so long and so well known in the world of science and art.

Besides the distinguished father of the late biologist, his uncle, Frank Blackwell Mayer, was an eminent artist who studied in Paris, exhibited in the French salon, won a prize for his paintings at the Centennial exhibition in Philadelphia and made special studies of Indian types in the west.

His father's uncle, Brantz Mayer, was a distinguished historian and archeologist, the author of numerous volumes and the founder of the Maryland Historical Society.

Alfred M. Mayer also studied in Paris and always exhibited a fondness for and even a prejudice in favor of French men, methods and books, and I had always assumed that the family was of French origin, a hypothesis which received some confirmation in the fact that one "Constant Mayer," a French artist, came to this country about the middle of the last century and rose to distinction in his profession, though I have no evidence of his being closely related to the Maryland Mayers.

By all of the latter, except the subject of Dr. Woodward's sketch, the name was invariably spelled with an "e" in the last syllable. The future student of heredity is very likely to be misled by this change, which seems unfortunate unless there existed some sufficient reason, not apparent at this moment.

T. C. MENDENHALL

RAVENNA, OHIO

SCIENTIFIC BOOKS

Terrestrial and Celestial Globes, their history and construction including a consideration of their value as aids in the study of geography and astronomy. By EDWARD LUTHER STEVENSON, New Haven, Yale University Press, published for the Hispanic Society of America, 1921, Volume I, xxvi + 218 pp., 95 plates; Volume II, xii + 292 pp., 72 plates.

These magnificent volumes present in a most interesting way the development of globes from earliest times up to the nineteenth century. The first volume treats terrestrial globes in antiquity, celestial in antiquity, globes of the Arabs, globes of the Christian middle ages, those constructed in the period of the great discoveries, and in four further chapters globes of each quarter of the sixteenth century. The second volume discusses globes of the seventeenth and eighteenth centuries in two chapters each, with a final chapter on the technic of globe construction, including materials and methods particularly of making the gores.

A bibliographical list, which makes no pretense of being exhaustive, gives approximately 600 titles; an "Index of Globes and Globe Makers" occupies 25 pages; and finally a "General Index" follows, occupying 16 pages. For use as an ordinary index the inclusion of items of the bibliographical list and names given in the index of globes and globe makers would have been highly desirable. As it is all three indices must be consulted to determine whether given items are mentioned in the work.

The section devoted to Arabic globes and the section relating to globes in antiquity are based upon material of thirty years ago and longer. There is more recent material, and the use of modern works would have improved these chapters. In particular no mention is made of Suter's great work on the mathematicians and astronomers of the Arabs[1] which includes the references of the Fihrist. Suter mentions as writers on the use of the armillary sphere, or on the planisphere or astrolabe, Al-Sufi and Al-Fazari (p. 3) of the eighth century, Al-Nairizi of the tenth (p. 45) and also Al-Biruni, Al-Zarkali of the eleventh, and Ibi- al-Bannah, whose activity extended into the fourteenth century. Al-Zarkali's instruments were famous and one of his works discussing instruments was published in Latin translation by Johann Schoner at Nürnberg in 1534.

With reference to the Greek conception of a globular earth the works of both T. L. Heath[2] and of the late Pierre Duhem[3] contain the latest and best information by the highest authorities on these matters. It may be of interest to note that Theon of Smyrna C. 150 A.D. (ed. J. Dupuis, Paris, 1892, p. 287) states that the Babylonians "explained celestial phenomena" and were able "to predict celestial phenomena to come, the Chaldeans by the aid of arithmetical methods, the Egyptians by graphical methods."

The bibliography could easily have been extended to give more adequate conception of the wide interest in globes, and the large amount of literature bearing directly upon globes in works of the sixteenth to nineteenth centuries.

Probably the most notable omission is that of any reference to one of the earliest works in the English language containing an extensive discussion of both celestial and terrestrial globes. Robert Recorde, an English physician,

[1] Suter: "Die Mathematiker und Astronomen der Araber," *Abhandl. zur Geschichte der Math. Wissenschaften,* Vol. 10, 1900.

[2] T. L. Heath: "Aristarchus of Samos, . . . A History of Greek Astronomy to Aristarchus, etc.," Oxford, 1913; "A History of Greek Mathematics," Oxford, 1921, 2 vols. In Vol. II, pp. 17-18, Heath states that Archimedes wrote a work on *Sphere-making* which is lost.

[3] "Le Système du Monde," 5 vols., Paris, 1913-1917.

wrote in English treatises on Arithmetic, Algebra, Geometry and Astronomy which were the most widely used of sixteenth century English text-books on mathematics. The titles were intended to be attractive: The Grounde of Artes, the Whetstone of Witte, The Pathwaie to Knowledge, and The Castle of Knowledge. The last mentioned is the astronomical work, published in London in 1556, and contains a section on pages 35-60, "The Seconde treatise of the Castle of Knowledge wherein is taughte the makinge of the materiall sphere, as well in sounde or massy forme, as also in ryng forme with hoopes." Recorde discusses the mounting of such spheres as well as the use of them.

An earlier Englishman who deserves passing mention is William Batecombe or Badecumbe who is reputed to have written about 1420 two works evidently on spheres: De Sphæra Solida and De Sphæra Concava fabrica et usu. The former of these works is reported by Bale to have been in the library of Robert Recorde.

Another sixteenth century writer who deserves mention is Fr. Baroccius whose Cosmografia published at Venice in 1585 contains material on globes and a passage (p. 227-228) "vsi sumus globo terrestri, quem Gaspar Vopelius Mathematicus anno 1553 ab ortu Christi construxit." No globe of this date by Vopel is known; while Stevenson, following Fiorini, ascribes an armillary sphere to one Giovanni Maria Baroccius, it might equally well be due to this astronomer.

The bibliographical list is unsatisfactory in several points. The items are not included in the final index; many items relate to works not cited in the text, and the title as given frequently does not indicate why the work should be included; many treatises and discussions of globes widely used and easily accessible in New York are not included.

As an illustration of a title which does not indicate the reason for its inclusion, take the Cosmografia of Peter Smit. The 1720 edition which is available to me here includes in the title the phrase "Als mede het maken van de Hemelsche en Aardsche Globe," but this is left out in the bibliography.

A work on the globe which went through three editions by 1661 is Pierre Bourdin's Traité de l'usage du globe terrestre, included in his Le Cours de Mathématique (Bibl. Chem. Math., 2 vols. 1921). Such a work should be included.

Of English discussions of globes Sotheran's recent catalogue mentions two that are anonymous: The antiquity and excellency of globes, 26 pp., 1652, and Treatise of the Descriptive Use of both Globes, 1718. I have an anonymous treatise in German, Einleitung zur Erkent. und Gebrauch der Erd und Himmels-Kugeln, Nürnberg, 1767, which mentions Lowiz and also a Professor Hasen in Wittenberg as designers of the Homann globes.

In view of the distinguished author's connection with the Hispanic Society the references to Spanish works treating globes are surprisingly limited in number. Among Spanish treatises on the subject which apparently enjoyed wide popularity in the eighteenth century may be mentioned Thomas Vicente Tosca's discussion. This appeared in the eighth volume (out of nine volumes) in the third edition of Tosca's Compendio Mathematico published at Valencia in 1757; it is in the geography, Libro IV, pp. 157-184, under the title, "De la fabrica y uso del Globo Geographico, y de todo genero de Mapas." The writer treats the making both of gores and of moulds.

A similar and contemporary German work which went through numerous editions was Johann Christian Wolff's Elem. Math. Universæ. The edition published in five folio volumes in Verona, 1746-1751, contains De Globi terrestri artificialis constructione et usu, in Vol. IV and De Globo coelesti artific, in Vol. III, with discussion of gores.

No uncertainty need be entertained as to the date when Lalande made his celestial globe (II, p. 182), as in his Astronomie, Paris, 1792, Vol. I, p. 247, Lalande says: "J'ai publié un nouveau globe celeste en 1775." On pages 616-617 of Vol. III Lalande discusses the manufacture of globes. But more interesting is the price list of globes in 1791 which he gives in Vol. I, pp. lx-lxiii. The celestial and terrestrial mounted, etc., of Robert of Vaugandy, the two for 300 livres in size 17½ ponces; the one foot size, corrected by Messier, the two for 80 livres; 10 inch at 15 livres each. The then more recent globes of Bonne and Lelande were sold in the one foot size at 100 livres the pair; 10 inch at 18 livres; 8 inch at 10 livres; 6 inch at 7 livres. The prices are more than double those quoted by Stevenson (II, 136) from Moxon, a century earlier.

Lalande cites among the enormous globes one at Cambridge and one at Lyon by Picpus de la Guillotiere. Lalande further states that the finest of the large terrestrial globes is that made in 1787 by D. Bergerin. The Cambridge celestial globe was made, according to the *Encyclopedia Britannica* (IX edition, Vol. X, Globes, p. 683) about 1764 by Dr. Roger Long, professor of astronomy and master of Pembroke College. This globe was 18 feet in diameter, lined with tin. No one of these three men is mentioned by Stevenson.

Nowhere does the author touch upon early appearances of globes in America, North or South. One would expect to find the earliest references in Mexico or Peru; certainly in North America globes must have been imported in the eighteenth century and possibly even constructed here. In the geography by John Payne, revised by James Hardie, that appeared in New York in 1798, there is a figure of an artificial sphere and pages xxxi-xxxviii are devoted to the use of the globe; other references could doubtless be found.

These additions have been made to indicate the wide appeal which globes have made in the past as instruments of instruction. Stevenson's work may well stimulate a revival of interest in globes for instruction purposes.

The two volumes constitute an enduring monument of American scholarship. The press work and the plates are up to the highest standards of the finest presses of Europe. It is to be hoped that students of astronomy and geography in American colleges will make the appearance of a second edition of more than 1,000 copies necessary. The author is to be congratulated upon having added new laurels to his crown in a field closely related to cartography wherein the name of Edward Luther Stevenson has so long stood first in America and almost alone.

L. C. Karpinski

University of Michigan

SPECIAL ARTICLES

THE EFFECT OF ABSORBED HYDROGEN ON THE THERMOELECTRIC PROPERTIES OF PALLADIUM

It is well known that palladium will absorb relatively large quantities of hydrogen under the proper conditions. Palladium black absorbs the gas more readily and in larger quantities than the solid metal but the latter will contain several hundred times its own volume.[1] The purpose of the work here described was to determine the effect of the absorbed gas on the thermoelectric properties of the metal.

The palladium used was in the form of a strip 0.01 × 0.125 × 10 cm. It was first annealed in a vacuum at a temperature of 1,000° C., and then used in a thermo couple with a strip of platinum as the other metal. The cold junction was kept at 0° C. and the hot junction could be heated to various temperatures up to 300° C. This strip of platinum was used as a reference metal throughout all of the determinations.

After the thermoelectric power was obtained, the palladium strip was heated to a temperature of about 700° C., in vacuo, and then allowed to cool slowly in an atmosphere of hydrogen. It is well known that palladium will absorb hydrogen under these circumstances. The thermoelectric power obtained with the gas filled metal against platinum was less than with gas free metal, amounting in one case, at 0° C., for instance, to 73 per cent. of the gas free value. The palladium was then heated in vacuo to a temperature of about 700° C., to remove the hydrogen, and another determination showed the thermoelectric power to have returned to its gas free value. This process was repeated several times, the gas filled palladium having its thermoelectric power against platinum lowered each time hydrogen was absorbed, and restored again to its original value after the hydrogen had been removed.

A much greater decrease in the thermoelectric power of palladium against platinum as a reference metal was obtained when the palladium was filled with hydrogen by the electrolytic method. The palladium strip was used as the cathode in the electrolysis of water from a very dilute solution of sulphuric acid. The nascent hydrogen obtained in this way is very active in penetrating the palladium. At 0° C., the thermoelectric power of the palladium, after being exposed to nascent hydrogen, was in one case only 28 per cent. of the value for the gas free metal. The process of filling with hydrogen by the electrolytic method and then removing the gas by heating in vacuo to about 700° C. was repeated several times and each time the thermoelectric power was lowered by about the same amount as a result of the absorption of the gas and restored to the original gas free value upon removal of the hydrogen.

To obtain the largest effects it was necessary to use the palladium soon after it had been exposed to the hydrogen as the gas slowly diffused away from the metal over a period of several days. Also if the region containing the temperature gradient of the gas filled strip were heated during a determination of thermo e m f, the result was a removal of the hydrogen and a restoration to the original gas free value of thermoelectric power. During a determination of thermo e m f the conduction of heat from the hot junction along the palladium strip caused the evolution of some of the gas and for the higher temperatures of the hot junction the thermoelectric power approached that for the gas free metal.

These results show that a monometallic circuit consisting of gas free and gas filled palladium will give rise to a thermo e m f when the junctions are at different temperatures. Since palladium is negative at the cold junction of a palladium-platinum couple, and since the absorption of hydrogen causes a reduction in thermoelectric power, it follows that gas filled palladium is positive to the gas free metal at the cold junction. Data obtained for one case in which the palladium was electrolytically filled give the value of the thermo e m f in such a monometallic circuit as: $E = 0.12\theta - 0.00023\theta^2$, where θ is the temperature of the hot junction, the cold junction being to 0°C. The constants will depend upon how completely the palladium is filled with hydrogen.

According to the electron theory of thermoelectricity the thermoelectric power (e) of a couple is given by the expression: $e = K \log\frac{n_a}{n_b}$, where K is a constant, n_a and n_b are the effective electron densities in the two materials forming the circuit. When n_a is larger than n_b the current flows from material a to material b at the cold junction. The effect of absorbed hydrogen, then, is to increase the effective electron density in palladium.

R. M. Holmes

Department of Physics,
Cornell University,
June 10, 1922

THE EFFECT OF SPERM BOILED IN OXALATED SEA-WATER IN INITIATING DEVELOPMENT

In connection with certain experiments (the results of which have not yet been published) that were made in an attempt to analyze the rôle of calcium in the fertilization of the egg of *Nereis,* the following results were obtained: (1) *Nereis* sperm that have been treated with oxalated sea-water are capable of fertilizing normal *Nereis* eggs; (2) *Nereis* eggs treated with oxalated sea-water are capable of fertilization with normal *Nereis* sperm; (3) Eggs of *Nereis* are capable of fertilization in oxalated sea-water. Such eggs form jelly, maturate, cleave and give rise to swimming larvæ in the oxalated sea-water. These larvæ show a varying per cent. of abnormalities; (4) Uninseminated *Nereis* eggs treated with oxalated sea-water (0.5 per cent. and above of sodium or potassium oxalate in sea-water) form swimming larvæ which show differentiation without cleavage; (5) Sperm of *Nereis* boiled in 0.1 per cent. to 0.25 per cent. sodium or potassium oxalate in sea-water are capable of initiating development in the egg of *Nereis.* This last result may be briefly considered.

Uninseminated eggs of *Nereis* obtained by cutting a dry female are exposed to each of three boiled sperm suspensions. These boiled sperm suspensions are made up as follows: one drop of dry sperm in 5 cc of sea-water; one drop of dry sperm in 5 cc of 0.53 M NaCl; and one drop of dry sperm in 5 cc of 0.1 to 0.25 per cent. sodium or potassium oxalate in sea-water. In each case the drop of sperm is carefully placed in the bottom of a test tube and the solution added. The test tube is then quickly brought to the boiling point over a flame and the suspension is kept at the boiling point for three minutes. To avoid any possibility of living sperm being present, the wall of the tubes are thoroughly flamed. The tubes, together with one containing normal sea-water kept at the boiling point for three minutes, are then set aside to be used after from two to twenty-four hours. For an experiment ten drops of each suspension and ten drops of the boiled sea-water are placed in dishes each containing one drop of dry eggs. Two minutes later to each dish are added ten cc of sea-water. A control, uninseminated eggs in normal sea-water, was always kept. If the control showed jelly formation the experiment was discarded.

Uninseminated eggs of *Nereis* exposed to these boiled sperm suspensions and to boiled sea-water in this way give the following results: boiled sea-water, no development; sperm boiled in sea-water, no effect beyond small per cent. of jelly formation, maturation and differentiation without cleavage; sperm boiled in oxalated sea-water, higher per cent. of differentiation without cleavage. The highest per cent. of swimming larvæ (differentiation without cleavage) ever obtained with the NaCl boiled sperm was about 10 per cent.; the highest with oxalated sperm was 32 per cent. And this proportion usually holds.

The first experiment of this kind was made early in June, 1914. At Dr. F. R. Lillie's suggestion these experiments were repeated directly under his supervision in his laboratory at the Marine Biological Laboratory, Woods Hole, Mass., during each *Nereis* "run" of 1915. It gives me great pleasure to acknowledge my indebtedness to him for many helpful suggestions in this work.

Every possible precaution was taken against contamination; every variation in procedure to be thought of was tried; and throughout one season, whenever *Nereis* eggs were to be had, the experiments were studiously repeated. Despite the precautions and the laborious repetitions, both during 1915 and subsequent seasons, it is impossible to reduce the results to any seeming order. Even after the elimination of certain sources of error the results are inconstant. The sources of error may be mentioned:

1. Failure to use perfectly fresh eggs of high cortical sensitivity. In 1915 I had great difficulty in keeping the worms from shedding their eggs when kept in the laboratory over night. I therefore adopted the plan of keeping the animals in the refrigerator. But this only made matters worse, for the females shed very quickly on removal from the low temperature. Such eggs were of little value. Moreover, if transfer from the cold sea-water to that at room temperature be suddenly made not only are the eggs shed but they are induced to form jelly and maturate. Moreover, eggs from animals that have been kept at low temperature are not best for study of cortical changes. Such eggs are apt to be polyspermic and in other ways give evidence of change in the cortical reaction. I have found that keeping *Cumingia* (dry) in the refrigerator markedly changes the normal cortical reactions. The eggs of both forms kept in this way give good cleavage and swimmers, but they do not give the best cortical reactions. For the work with sperm boiled in oxalated sea-water, then, one must have fresh eggs taken from *dry* females.

2. The oxalated sea-water should not be more than twenty-four hours old when used. It is best not to use stock solutions. Various experiments were made with different molecular solutions of the oxalates in distilled water plus the addition of double sea-water to correct the hypotony. But the distilled water solutions seem to deteriorate. It was found best to add from 0.1 to 0.25 grams of the oxalate to 100 cc of sea-water which was filtered before use. But even with fresh eggs and the optimum oxalated sea-water the results are far from uniform.

Since hypertonic sea-water alone initiates development in the egg of *Nereis,* we might think that boiling the sea-water is alone responsible for the results. But boiled sea-water alone has no effect. Since oxalate in sea-water initiates development, we might argue that it is the oxalate in the sea-water rather than the dead sperm that initiates development. However, oxalate alone to call forth development must be present in greater amount than in the suspension of sperm boiled in oxalated sea-water.

My first thought in making these experiments was that calcium is necessary for fertilization on the assumption that in some way it holds intact a substance loosely bound to the sperm head which makes possible the reaction of the sperm with the egg. Calcium free sea-water, then, would bring about the loss of this substance and thus render fertilization impossible. If, however, fertilization takes place in oxalated sea-water, this assumption is untenable.

On the basis of Robertson's work, which indicates that "fertilizing" substance can not be extracted in presence of calcium, we might conclude that the *Nereis* experiments here cited show that the effect of boiling sperm in oxalated sea-water is to extract a fertilizing substance from the sperm. This I do not believe and for several considerations.

Though hypertonicity is not responsible for the results here reported, nevertheless, boiling must certainly increase the salt content of the oxalated sea-water. Again, any amount of oxalate present above that necessary to remove calcium must increase on boiling. Moreover, in the sea-water itself chemical changes ensue through boiling. And finally, on boiling, the sperm perhaps lose specificity—they act as any foreign colloid which may induce development.

The results here reported might thus be due to the total of these several factors each of which alone is incapable of calling forth development. I conclude, therefore, that the results here reported do not indicate that they are due to a fertilizing substance extracted from the sperm.

E. E. Just

Marine Biological Laboratory,
Woods Hole, Mass.

THE WESTERN SOCIETY OF NATURALISTS

The annual meeting of the Western Society of Naturalists was held in Salt Lake City, Utah, June 22-23, 1922, during the convocation of the Pacific Division, American Association for the Advancement of Science. Presiding officers were Dr. F. B. Sumner, *president*, and Dr. J. F. McClendon, *secretary pro tem.*

The following officers were chosen at the annual election: H. S. Reed, *president;* Chester Stock, *vice-president,* and C. O. Esterly, *secretary.*

The program presented was as follows:

June 22

PHYSIOLOGICAL PAPERS

The occurrence of essential oils in desert plants: Maxwell Adams.

The influence of temperature upon the germination of orange seed: H. S. Fawcett.

Influence of gravity on the development of new growth on horizontal shoots: F. F. Halma.

Mitosis in rhizopods and flagellates: C. A. Kofoid.

Longevity of Artemia in natural and artificial brines: E. G. Martin.

Some quantitative aspects of growth: H. S. Reed.

Dendograph record of the redwood (with lantern slides): D. T. MacDougal.

The occurrence of goitre in relation to the distribution of iodine: J. F. McClendon.

HEREDITY AND EVOLUTION

The two chromosomes of Clarkia: L. L. Burlingame.

Inheritance of flower color in Clarkia: L. L. Burlingame.

The law of geminate species: D. S. Jordan.

Theories as to the mode of evolution: J. P. Lotsy.

The origin and inheritance of specific characters: F. B. Sumner.

Darwinism—an analysis by observation and experiment: W. L. Tower.

June 23

PAPERS READ IN JOINT SESSION WITH THE ECOLOGICAL SOCIETY OF AMERICA

The original grasslands of California: F. E. Clements.

Why not conserve the marine mammals of the Pacific? B. W. Evermann.

Factors limiting the distribution of Teredo navalis in San Francisco Bay: C. A. Kofoid.

Climate of the Inland Empire in relation to silviculture and forest fires: J. A. Larsen.

Food and game fishes of the Snake River, Great Basin: S. B. Locke.

Wild bird life of the rookeries on the islands of Great Salt Lake (with motion pictures): C. G. Plummer.

A bog forest near Victoria: G. B. Rigg.

Chester Stock,
Secretary

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THE RECORD OF SCIENCE[1]

One learns by adversity—at least such is the popular belief, although the press dispatches from Europe during the past few months would seem to give the lie to this old adage. It used to be my fate to encounter at frequent intervals a genial friend of great distinction in the field of physics and astronomy, long engaged in high administrative functions, an alumnus of this university—altogether a man of great weight and substance, who endeavored each time we met to overwhelm my cherished ambitions by bringing forth with great gusto this aphorism, "Bibliography is the platitude of research!" So much did this phrase please him that he paraded it on many occasions, and I confess I used to dodge around the corner to avoid its rotund and sonorous condemnation of my own ways and works. I hope to show you that bibliography is the *foundation* of research, and that however level and flat that foundation may be, however dull may be the task of laying it deep and strong, no lasting and lofty superstructure may safely be reared, save on the secure footing of a knowledge of previous work done by others, a knowledge resting necessarily even in the field of science on the much despised labor of the bibliographer.

There is prevalent on every university campus, I suppose, an impression—not among students alone—that the various branches of human knowledge are for practical purposes divided into two groups, the laboratory sciences and the book sciences. This is an extremely convenient and easy grouping—and it has certain elements of truth in its facile cleavage of the field of inquiry. But it is essentially inaccurate in that it ignores a fundamental factor common alike to research with the microscope

[1] Address at the annual meeting of the Michigan Chapter of Sigma Xi.

or the blow-pipe and research with the written word or philosophic logic as its instrument. That factor is the *record* of what has been known and spread abroad by previous inquirers. The processes of human inquiry depend fundamentally on memory—and in the case of the pursuit of knowledge in our own day on the *record in print* of what the race has done or thought or attempted. It makes little difference whether the inquiry be into the morphology of the early Italic dialects of the Latin tongue, or into the function of the ductless glands of guinea pigs—the essential processes are alike these: observation and the gathering of data by experiment or by compilation; a study of the previous work done in the same field with a critical examination both of processes and results; a synthesis from one's own observations and from the recorded observation of others; and finally such reflection (or theorizing) on the results as may lead to correlation of this piece of investigation with the sum of human knowledge, perhaps (occasionally) in a way to affect human activity. The so-called "book sciences" employ methods in no way essentially different from those long approved in the so-called "natural sciences." All of them alike depend on careful study of previous work as an initial step and on the publication of results as a final process. No facile popular division can separate "book-knowledge" from "experimental research." Experiment without "book- knowledge" is generally not research in the true sense, even though it occasionally leads an Edison into discoveries of untold value to the world.

There is, notwithstanding, a justification for this distinction popular among college students. The manner of teaching the natural sciences has been completely revolutionized in the last forty years. Every one knows that subjects formerly taught from text-books are now taught chiefly in laboratories. Emphasis is now laid on accurate observation, correct inference from observation, ability to report the sum of observation succinctly and truthfully. An equipment elaborate in itself, impressive in amount and cost, is properly thought needful to the task of teaching the natural sciences. Each student is considered (I suppose) an embryo Pasteur or Rowland, and is laboriously inducted into scientific methods by requiring him to develop manual dexterity in the use of instruments, and training him to produce neat and correct note-books. Naturally the mass of students is found in the elementary courses. It is only the smaller number resulting from a process of natural (or at least academic) selection which ever gets to the "journal club" stage, and becomes personally aware of the existence of the enormous and multifarious record of scientific knowledge. That the method of teaching should of itself influence the student's conception of the subject-matter of instruction is both natural and inevitable. That undue weight should be given by their elders to manner and form of presentation is quite another matter. It is, however, impossible to escape the conclusion that many a scientist thinks that he is freed by the very nature of his work from a supposed taint of bookishness. He gives thanks that he is not as other men, as these historians and philologians—or even this librarian.

There is a real danger lurking in this attitude; and we are not without evidence that (whether from this source or more subtle workings of the laws of auto-suggestion) this tendency to pride himself on being strictly a scientific and not a book man has bred a habitual attitude of neglect of the record side of scientific inquiry which has already been disastrous in too many instances. The conviction that apparatus and laboratories are essential—a perfectly sound and indeed a fundamental thesis—has somehow led to the notion that they and they alone constitute the requirements not only of instruction, but of research as well. This tendency—and I do not exaggerate it in the least—has made too many folk unmindful of the long history of science, has bred an attitude which can best be described as almost wholly lacking in the historic sense. And without a sense of the historic setting of his work, a man is almost as hopeless as is the man who lacks a sense of humor! You can not argue with one or the other! In fact I dare go farther and affirm that only by the combinations of the historical and the experimental methods can any work of first-rate importance be produced in any field of knowledge.

By this time, I fear you may be saying to yourselves that whatever the platitude of research may mean as applied to bibliography the bibliographer is in truth indulging in platitudes! No one need set up a man of straw for the pleasure of knocking him over. There is no point to my contention, if it be true that students of the natural sciences in America have rigorously employed both the historical and the experimental method. The great leaders have unquestionably done just that. But how many *great* leaders have we produced in America? May not one reason for our surpassing excellence in the practical arts and our rather scant array of great names in pure science lie exactly in the absence of the historical record of science from American institutions in the past century? It is difficult, perhaps one may say it is impossible, to get a correct historical perspective without a really good and strong library to furnish the means of study. No amount of second-hand information will ever take the place, for the real student, of the original documents. This is just as true in the pure and applied sciences as it is in history, economics or letters. Imagine an astronomer trying to carry on intelligent research in the observational field alone, without the great publications of the nineteenth century at his hand for previous study and occasional consultation. Yet that is precisely what scores of astronomers have done in this land, and are doing to-day. The example might be multiplied ten-fold. Really good libraries of scientific books are scarce enough in America to-day. Before 1870 they did not exist, save perhaps at Cambridge in Massachusetts. No one of them is yet fully equipped to meet all the reasonable demands of scientists for a record of the progress of knowledge. I say this from my own experience. For eight years I labored—too often in vain—to serve the scientists in the various bureaus in Washington with books they needed. My work was in the third largest library in the world. This fact is significant. May I enlarge upon it?

America is not a nation alone—it is a continent. Distances are enormous. Because Mr. Henry E. Huntington has in San Gabriel in California a very rare early English book on American fishes or plants, it does not follow that it is of much use to a Harvard student who requires the exact language of the original description of a particular species. The extraordinary collection of early botanical works in the library of Notre Dame University is not easily helpful to the botanists of the Bureau of Plant Industry. These are but two concrete examples of the physical size of this land. You know what it means to journey to Washington in the hot weather of summer—yet you must make the trip in vacation to consult some volume found in America only in the Library of Congress and too rare or too fragile to permit its loan. The situation is quite different in Europe. No university in the British Isles is as far from the British Museum as Ann Arbor is from New York or Washington. Even from Aberystwyth or remoter Aberdeen the trip is less in time consumed than from here to Albany. No French university professor is so far in time from the Bibliothèque Nationale as we from our national library, and we (be it remembered) are much nearer than our colleagues to the west and south. In Germany the Prussian State Library and in Austria the great libraries at Vienna are relatively near the universities. If one goes to London, it is but eight hours to Paris. Between the two largest libraries in the world a scholar can usually find *all* he needs in the way of books. I need not point out the contrast in this country and in Canada. These distances from great library centers have not been without influence on American scholarship.

In fact we may safely say that up to about 1900 there were very few strong scientific libraries in America, libraries in which the record of science could be traced with precision. There has been an almost startling change since the opening of this century. We have much yet to do. We can overcome the obstacles of distance and youth only by further heroic efforts. But we have most surely made progress. We have now a round dozen libraries really strong from an absolute standard. And they are growing stronger every day. We have many special libraries in various fields of science which have been highly developed in their own line—of these the most conspicuous is probably the great medical library of the Surgeon General's Office in Washington. We have developed library technique and library service far beyond those of Europe. But we have not developed to the point where the historic sense is necessarily fostered and the historic instinct adequately satisfied. That will come with time. Meantime we may perhaps expect that instruction will take cognizance of this changed situation and will by its pressure aid to improve further the resources in the way of books.

For, of course, instruction in historic method and in the use of books as tools is utterly impossible without really good libraries. It is folly to expect students—even advanced students of high promise—to acquire a proper attitude toward their predecessors and their contemporaries without the publications of both at hand in full numbers. It is useless—or nearly so—to teach exact methods of ascertaining the present state of knowledge about any particular problem, when you know it is being worked on in New Zealand and South Africa—and your library lacks the New Zealand and South African transactions and journals. I need not dwell on this painful fact. You know more about it than I do. I suggest, therefore, that the production of truly strong men in your various lines of study depends to a very considerable degree on a sufficient provision of books in our libraries here on this campus. That provision depends on many factors—of which money is by no means the only one, as I hope to show you in the course of these remarks.

For the publication of the results of observation in the field of science has taken many (and frequently strange) forms. We ordinarily think of books as just books—perhaps unconsciously influenced by the manufacture or the perusal of text-books. Ordinary monographs of the text-book type do, it is true, make the staple contents of book-sellers' stocks and ordinary library shelves. But they are perhaps the least important element in the complicated record of science. They are too generally compilations—not the results of original research. And their tendency to accumulate on those very shelves has perhaps had no small part in that neglect of the historic aspect of scientific inquiry to which allusion has just been made. The large and imposing monograph is the exception. True, it generally remains valuable and "well-spoken-of" long after the smaller books have passed to the limbo of things with a "merely historical" interest. Moreover, the hugh monographs which have appeared in some scientific fields—such things as Audubon's *Birds of North America*, for example, or the monumental publications of von Humboldt—have been so costly that save to a favored few they have been merely names and names alone. I am inclined to consider this costliness in relation to our American libraries (until a recent date) a very real factor in the neglect of the older literature. It has simply cost too much to be known by the average student.

Perhaps the most extremely particularized form of monograph is the doctoral thesis. Most folk whom I have met have lost interest in theses within a few years after their own have been promptly forgotten by their colleagues. It is hard to get any money for a lot of dissertations—particularly for the thin German products. The more extended French dissertations usually masquerade as real books. But historically theses for the doctorate have a great value—particularly those printed before 1800. Few people recall the pleasing habit of the earlier centuries which practically compelled the candidate *respondens* to pay for the publication of the work of his *præses* under the guise of a doctoral dissertation. A few years since a committee on botanical nomenclature—or rather, members of it resident in Washington—began to torment me for the dissertations of the pupils of Linnæus, which, they averred, contained some of the great master's best work. It was an interesting quest which became exciting when I discovered a bundle of these much desired little Upsala dissertations carefully tied up and labeled among a group of several thousand Smithsonian exchanges from Sweden. By the liberal use of the photostat, reproducing copies from the Harvard Library and the Torrey Botanical Club the series was made, I believe, complete, and the committee supplied with those original descriptions so essential in determining nomenclature.

One of the extremely important groups which has been too often denied our budding scientists is that formed by the publication of museums the world over. The catalogs and series, the monographs and bulletins published by important museums are in a very real sense the foundation stones in many branches of science. And it is not only the great museums such as the British Museum, the Berlin group, the National Museum at Washington, the Peabody Museum at Cambridge, which have issued vitally important publications. The local and the special museums have issued publications both serial and monographic which become of vital importance the minute a piece of work done here demands them. You can never foretell when one of these will seem to some professor exactly the one book in the world whose absence from our shelves is fairly blocking his studies. He could not tell you himself a week before his need suddenly arises that he would ever care for such a report or catalog. But he can make his wants known without any difficulty when the demand comes, I assure you. What has seemed a fairly good library up to this morning instantly changes to a very mediocre establishment in the afternoon after a consultation of the catalog! It is a great pleasure to be able to report to you that for five years past the income of the Octavia Bates Bequest has been chiefly devoted to the purchase of museum publications, beginning with those of the British Museum. We could use a permanent fund twice as large to very good purpose in supplementing this work, which up to this time has only begun.

Museum publications are generally issued in limited numbers and at high prices. It is a serious task to secure them. But it is easy compared to the job of getting the publications of expeditions. There is a peculiar fate which attaches to the printing and editing of the scientific results of expeditions of all sorts, Usually some member publishes a popular narrative which frequently sells rather well, particularly if any notoriety or celebrity attaches to the expedition. This very quickly gets into the libraries, as witness the host of popular accounts of polar expeditions which you doubtless all know by name. Far different is the fate of the publication of the scientific results. They are inevitably the work of different men. The labor of preparation requires vastly more time for some subjects than for others. Parts of volumes appear from time to time—members of the expedition go off on other expeditions with their first work half-done or half-published. Editors change, or die. A fire in a store-room or a residence destroys another's notes—or even the specimens themselves. Years pass and the expedition's publications are still unfinished—perhaps they are never finished. Volumes remain unbound because of a missing part never issued, but still hoped for. Publishers fail and the stock is sold for paper. Governments grow weary and withdraw subventions—then vote them again. Heaven blesses a few scientific expeditions with capable members, vigilant editors, a government's purse and completion of publication within a few years. But they are few. I could tell you tale after tale of heart-breaking delays, inconsistencies, changes of forms, failures, deaths—and all involving untold trouble for the librarian who must first *get* these things and then take care of them. Altogether a difficult and perhaps a useless job, you might say.

But then—remember the momentous results of some expeditions and voyages;—yes even of some which have never been completely published! One need only recall a few names, La Perouse, The Challanger, the Beagle, —need we go on? Take but one example—The Wilkes Exploring Expedition. You recall its history, the famous controversy over the Antarctic Continent, the numerous narratives, the slow appearance of the stately folios containing the scientific results. This was the first scientific publication on a large scale of the government of these United States, and an entire evening could be spent in a most interesting way in detailing its vicissitudes. I need mention only one volume to show its importance—Dana's great work on the Zoophytes, a book so important that seventy years after its appearance it is still regarded as fundamental. But how few libraries own a copy of the origiual text and plates! Printed in only 200 copies, never sold, distributed solely by resolution of Congress, what chance has there been for the newer libraries to secure a copy for their clientèle? To be sure, not all expeditions encounter such a series of accidents in publication as this of Wilkes—but as a class they present a most difficult problem. They are alike hard to get when issued, slow to appear, slower to be finished, costly and even (occasionally) not sold at all, but only given to a select few. Later, years later, the task is much harder. If I were given a round sum and told to get in three years all the important scientific expedition publications of the past hundred years—I should decline to promise success in that time—perhaps even in five years. But I can think of but few efforts so well worth attempting.

If expeditions present difficulties alike to the librarian and the scientist, what shall we say of international congresses? That they mark the progress of research in many lines is a truism. They are absolutely needed—but they too are very hard to get. In the first place, there is no good list of them—even the brief list issued about a year ago is most incomplete. Then, the congresses seldom have permanent offices and officers. They are held at irregular intervals, generally in a different place each time they meet. If one attend, he generally gets the proceedings. But very seldom does any library get a notice of the meeting in advance. Usually the papers and proceedings are published in the place where the congress meets—at Madrid one year, three years later at Washington or Moscow or Stockholm, or where you please. The publisher of course varies with each move of the congress. An attempt to place an order for subsequent issues usually fails of execution. Three or five years is a long time for any secretary to carry an order. So if some professor from Michigan goes to the geological congress at Brussels this summer, we *may* get on the mailing list—but otherwise we probably shan't—despite our efforts. The difficulty is vastly increased by the habit of European governments of giving subvention to private publishers to aid in printing reports of congresses instead of issuing them through the governmental printing office. So they may appear in the publisher's list as his own publications—or they may never be listed anywhere. It can not be denied that the hunting down of international congresses adds zest to the librarian's life—but when you are held accountable by science for the results of your hunting it ceases to be sport. Then, too, local societies and savants have a pleasing habit of offering volumes *to* the congress as a sort of testimony alike of their interest and of their own activities. These are almost never to be confused with the Report of the Congress itself—except in the minds of booksellers who manage to introduce no end of confusion into orders as a consequence. You may imagine, therefore, that international congresses are a bug-bear to library folk—a sore topic. You may also imagine my own delight in securing over one hundred and fifty reports of various international congresses on my book-buying trip last fall. Few acquisitions have given me more solid satisfaction. And yet, I suppose I have simply created more trouble for myself—every department will now demand that these reports be made absolutely complete! In the language of the street, "I can see *my* finish!" Partial success always brings its own penalty.

Who originated the idea of the "Academy"? Whoever he was, whether Plato in the groves of Academe, or some Renaissance imitator, or even the gentleman who conceived the Royal Society, he let loose on mankind an institution making for publication—if we appraise it in no higher terms. And particularly in the nineteenth century did the academy flourish in print. Here again Europe has an advantage over America, and advantage more of age than of enterprise, of geographical smallness as contrasted with continental sweep and range. Most scientists in Europe have easy access to files of academic publications, files which have been slowly accumulated with the passing years. Here we have had to work hard in the past two decades to establish half a dozen centers in which fairly complete series may be found, a process still going on and proving increasingly costly each year. But we must continue and complete it. The interests of American scholarship simply require it of us. The greater academies are now well represented at Michigan, with here and there a gap, it is true, but still with full ranks for the most part. What to do about the minor academies and societies from the whole world? That is a vexing question to which I may refer again in a few moments. I pause merely to remark that a minor academy is minor only so long as you do not want its transactions in your own work.

And last in this array of forms of scientific publication comes the largest group of all, newest and most insistently demanded, the journals. To me the rise of the special periodical devoted to the interest of a special group is one of the most significant social phenomena of the past fifty years. Let no one here think that this tendency to periodical publication is confined to science or to the more learned groups. By no means—the brick-layer, the barber, the banker, the baker, the builder, the book-binder (to keep to one letter only) all have their journals fully as much as the biologist, the botanist, the biochemist, or even the bibliographer. And they all have to be ordered, entered, paid for, cataloged, bound, and stored. Periodical publication is the one modern form for telling the world what everybody has done and what other people think about it. We take in over twenty-two hundred journals in the University Library. A goodly number—do you say? Well, it is just about half what other libraries of our size subscribe for, and about a quarter of what the Library of Congress receives each year. Perhaps the medical faculty is satisfied with its four hundred and sixty-six journals received. But I fear no other group really has enough. Certainly that great department loosely known as the social sciences does not have at hand here anything like an adequate supply. I see no end to this modern form of publication. Every quarter I read with sadly disappointed hope the record of "Births and Deaths in the Periodical World" appearing in the *Bulletin of Bibliography*. The births always outnumber the deaths and the marriages of journals. My one consolation is my firm conviction that wood-pulp paper has a very definite limit of stability. But then I reflect that some chemist is sure to discover some process of preserving this wood-pulp mass for an indefinite period. There is no way out. Journals and transactions, reviews and proceedings we have ever with us in ever increasing numbers. These the investigator simply must have. Can he have them all at hand currently and in bound form? Obviously not, unless we multiply our library budgets about ten-fold, and our storage quarters five-fold.

This leads us very naturally to consider this problem of supplying the full record of science to our men of science. It is not a local problem merely. It is also a national problem. The difficulties in the way are partly those of finance, partly those of time, partly competition, not alone among American libraries, but with those of Japan and China, of South America and South Africa, of New Zealand and Australia. Very much of the material required by this group before me was published in but a small edition, running from a couple of hundred in the case of certain very costly books, to a thousand or more for certain journals. In their beginnings journals and transactions are frequently issued in only sufficient numbers to meet the actual number of subscribers. You all know how the waste-basket yawns for odd numbers, and what chances of destruction stray copies must run, between careless or absent-minded owners, house-maids, janitors, the frugal house-wife and the rag-man. Wars and disasters intervene to reduce the numbers of copies in existence. I have no hesitation in saying that the possibility of securing sets of certain very much valued books and journals is diminishing even to the vanishing point with each year that goes by. The world war was destructive of reserves, caused restriction in the number of copies printed, and increased enormously the cost of printed matter of all sorts. In some cases known to me no copies were printed beyond the actual home demand, totally ignoring foreign or enemy subscribers. I know of one American journal which actually printed last December one hundred and fifty copies less than its regular subscription list, because paper took a sudden jump in price and only the stock on hand was used. This sort of thing makes the task of securing sets anything but easy. The chief source of supply is the libraries of deceased professors as they come on the market—and professors who own and bind long files of journals and transactions are becoming rarer with the high cost of living and the decreasing amount of shelf space in modern houses and apartments. The necessity of quick action can not be stressed unduly in view of the present circumstances. It is not a question any longer of waiting for a favorable opportunity. Rather are we faced with the necessity of getting what we need whenever the chance comes up. The competition from the newer countries and the newer libraries is keener every year. Thirty years ago there was no large scientific library west of us—not one. Now we may mention the Universities of Chicago, Illinois, Wisconsin, Minnesota, Iowa, Nebraska, California, Leland Stanford, Washington, and the John Crerar Library, without even exhausting the list of institutions of the first rank—for special libraries in a small field are equally dangerous competitors for the valuable books and sets in their own line. In those same thirty years South America, South Africa, Japan, Australia, and Canada have come into the field eager to provide their scientists with the record of science. McGill University bought just before me last fall very many sets of journals long on our list of desiderata. I found Japanese buyers had been everywhere with the government purse to draw on. The fact is that we must both hasten our own purchases and combine with our neighbors if American learning is to be kept on an equality with that of Europe.

The need of cooperation and of a policy looking to the elimination of certain forms of competition is brought home to me more keenly each year. We should be able, it would seem, to agree on certain fields which we can cultivate intensively, securing everything of moment in them, as far as we can raise the funds. Certain general works, general society transactions, journals of a wide appeal we must *all* have. But must we—to take a concrete case—*all* try to buy the publications of the smaller and less important societies? May not half a dozen sets spread over the country suffice with the development of the interlibrary loan and of photo-duplicating machines? Can we not agree with Chicago, Urbana, Cleveland, Columbus, Pittsburgh, and Ithaca on a limit in purchasing such local society publications? Thus we might *all* save money, keep down prices, gain in the total number of sets available, and lend freely between ourselves. This matter seems to me highly important—even vital to our success. It has been much discussed among librarians. There would be small difficulty in arriving at a policy, if it were a matter to be decided by librarians alone. But it concerns far more deeply the faculties of the various universities and their governing boards. We librarians can not, for example, get together and agree on a limitation of our several fields of specialization. We must first gain adherents to a policy of limitation, then form an agreement through some joint committee of professors, and finally secure the consent of boards of regents and trustees. The facts are most clear and patent. We simply can not all have everything. There isn't enough to go 'round, nor money enough to buy everything. What we must do, then, in common sense is to stop trying to get everything in each library, and go for the things we can reasonably expect to secure in cooperation with our neighbors. If any one doubts the success of this plan, I refer him to the results of the agreement between the Chicago libraries made in 1895 and carried out since to the lasting benefit of scholarship. There is every reason why we should enter into a similar pact with neighboring libraries.

For what is our position now? We have no near neighbors among universities. We stand half-way between Cornell and Buffalo on the east and Chicago and Northwestern on the west. Western Reserve, Ohio State and Oberlin to the south are in a manner comparable with our collections—but as yet hardly formidable rivals. There is practically nothing north of us—(Remember that I am speaking now of libraries whose chief interest is the furthering of scholarship). We have two large public libraries fairly near—Detroit and Cleveland, both owning certain valuable special collections, and both likely to specialize in technology and in the applied sciences. There are a few specialized libraries of distinction, such as that of the Western Reserve Historical Society at Cleveland, which owns what is probably the best collection on our Civil War in existence. We may safely say, then, that we have fewer neighbors on whose aid we may rely than have the eastern universities or those in the northern Mississippi Valley. But there is no reason that I can see why we should attempt to duplicate and surpass, for example, the White Collection of Folk-lore in the Cleveland Public Library, or the Burton Collection of local history and genealogy in the Detroit Public Library. Nor should we fail to agree with the Chicago libraries and those of Ohio (and even perhaps of western New York and Ontario) as to certain fields of learning which they will leave to us, and others in which we shall not aim at more than general works. I should like to see the Association of University Professors, or some other body representing various universities, take up this problem in a practical fashion. The inter-library loan and the photostat put the resources of each library at the disposal of its neighbors. Why neglect so obvious a step as conference and agreement on subjects of specialization? But, of course, when it comes to self-denying ordinances, only the men concerned may pass them. It is not for me to say what any group of professors shall forego. It is "up to" them in the interest of science as a whole and of its progress in our land. I can merely point out one very obvious step to be taken—and perhaps push a little towards that step.

Our present situation here at Michigan is better than it was, but it is far from satisfactory. We have a goodly list, for example, of journals and society transactions—but we have far too many gaps in the sets, gaps that are very hard to fill. We have a fair lot of expedition publications—likewise badly defective. We have a few of the great monumental publications, and very incomplete sets of congresses and museum publications. I have already indicated that our collections of monographs are reasonably large. But we are distinctly worse off in the pure sciences and the applied sciences than we are in literature or American history. We are far worse off as regards economics or philosophy than in scientific fields. We have a faculty and a student body probably third in size in America. But the library ranks about eighth among universities in number of volumes. We have, therefore, very much to add before our book collections correspond to our size in students and faculties. Harvard, for instance, has more than four times as many books as we have, Yale three times as many, and Columbia and Chicago about twice our holdings. This is a situation not to be remedied in a day—even were adequate funds in hand, as I have tried to show. All the more reason, therefore, why we should think clearly and plan wisely, and should cooperate with our neighbors.

The country as a whole is in about the same relative state as regards the record of scientific work the world over as is the University of Michigan. That is to say, by diligent effort we can find the obscure and the rare, and without too much trouble can secure the obvious and ordinary run of books. But taken as a whole, the country is decidedly worse off than most European lands. Our scientists are at a distinct disadvantage when it comes to books as compared with those of Great Britain, France or Germany, or even Italy. We can only overcome this handicap—which is very real—by the most careful bibliographic work and by lending freely.

This brings me to that aspect of our topic which was probably most in my friend's mind when he spoke so disparagingly of bibliography. Most people ignore the practical and administrative side of the bibliographer's labors. They think of him merely as one who records what other men have done and said. That he is also the gatherer of material, and to a large extent its interpreter they forget. But the major function of the scientific bibliographer is that of indexing the record of science, after he has got it together. This is a highly technical job and has been very well done in certain fields, and very poorly done in others. Perhaps medicine has the best indexes. The great catalog of the library of the Surgeon-General's Office in Washington forms one of the most remarkable pieces of index work ever attempted. The *Index Medicus* is a wonderful clue to the currently appearing work of the world of medicine. Both have proven frightfully expensive. Both are due to the energy of one man, John Shaw Billings, and the extraordinary skill and devoted patience of his associate and biographer, Fielding H. Garrison. Neither has ever paid expenses and both have had a hard struggle to survive, despite government aid and the purse of great foundations. Even now we are threatened with a curtailment, if not the ending, of the catalog. Such books are very costly, but without them, science must perforce halt its progress.

The pure sciences have had no such American record as these two in medicine. The Royal Society's *Catalogue of Scientific Papers*, appearing years after their publication, is the most conspicuous British effort. And then, after years of incubation, came the great international undertaking known as the *International Catalog of Scientific Literature*, bearing the Royal Society's imprint and prepared by regional bureaus under an international council. This was to begin with the twentieth century and to be the final word in all branches of pure science. Now unhappily the world war has brought it to a standstill, probably to an end. But it was already breaking down of its own weight before the war. The plain speaking of the few librarians who were given any chance to be heard between 1895 and 1900 was utterly disregarded. They insisted, if I remember correctly, that without some provision for cumulation of entries at intervals of about five years the scheme would defeat its own ends. And their prophecy was amply justified before the war brought a halt to the already huge series of annual volumes. The set remains a monument to the difficulties of the task of an adequate index to the published work of scientists.

A few attempts at overcoming this difficulty by card bibliographies have been made. Of these the most conspicuous is the work of the Concilium Bibliographicum in the field of zoology, paleontology and anatomy—an undertaking which is likewise due to an American, the late H. H. Field. This is, as you doubtless know, a classified bibliography printed on cards, arranged in very minute sub-divisions of the decimal classification. When you once learn how to use it, it is most valuable. It usually takes us about a year to train a girl to file the cards, and how long it may take a zoologist or an anatomist to learn how to use them to full advantage, I can not say. This bibliography was also stopped by the war, but will soon be resumed with money supplied by the Rockefeller Foundation. I know of no other current card subject bibliography on a similar scale.

The tendency has been, on the whole, to develop special annual reviews in rather minute sub-divisions of the general field. Of these by far the most conspicuous have been the *Jahresberichte* appearing in Germany. There was formerly no end to these special bibliographies—often accompanied by critical notes on the scope or value of the works listed. They, too, were mostly stopped or curtailed by the war, and various efforts have been made to revive them or produce new ones. You each know your own favorite bibliographical review—but do you know the difficulties under which they have labored and which are well-nigh fatal at the present day? The chaotic condition of the world from an economic or political viewpoint is well matched as regards the record of science. Publication of results is still slow and defective—indexing of publications is more so. The obligation rests on America to provide both the means of publication and the proper clue to recorded work. I can hardly stress this too strongly, as I necessarily am forced to take a broad and general view of the whole situation. If the needed indexing of scientific (and indeed all learned) literature is to be done at all—it must be financed in this country. I can think of nothing more important for the attention of the American Association for the Advancement of Science than this very problem of adequate successors to those special and general indexes which have been so useful and which are now either suspended or definitely dead.

. . . .

May I, as a layman, venture a suggestion to you who are experts? I feel that most of you tend to ignore in the organization of your work of instruction any presentation of two things which help to mark a scientist of real distinction. The first of these is a knowledge of how to use to the full the various bibliographic tools provided. It seems to me that such instruction in their use is a real necessity—perhaps not for elementary classes, but certainly for any study of an advanced character.

The loss which comes from an ignorance of what has been done on any given problem is pathetic—loss of time, unnecessary labor, discouragement. It is a loss which can be avoided by very simple means. The gain which comes with full knowledge of previously published results is uncounted. It marks the successful from the halting start on any task. The complexity of the bibliographic indexing in most fields is so great that there is real need for formal instruction in handling bibliographic tools. No one of you ignores instruction in laboratory method. Should he overlook the need of instruction in bibliographic method? The second of my two marks of distinction is a broad, general view of the history, methods and scope of his subject, what in my youth the Germans used to call "Encyclopædie." Few men are willing to take the time from their own particular researches to lecture on a general introduction to their subjects. But I venture to point out that precisely such a broad, sweeping view of the whole topic is what the younger men need most. It can be given only by one whose reading has been wide, whose grasp of the whole subject is firm, whose judgment is matured, and whose experience entitles him to speak with authority. What in a master makes disciples? What qualities in some men enable them to found a real school? Is it not precisely that grasp of method, that sense of relations of parts to the whole, that historic view and that prophetic insight which comes from a deliberate attempt to survey the whole of one's subject, to weigh its importance, to contemplate not alone its past but its present and future? My suggestion is that students should not be left to pick up either bibliographic method or a general view of their subject from incidental allusion or chance comment. The need of both is too great and too serious to warrant the indifference or neglect which they now seem to encounter.

To sum up, then, this attempt at some reflection on the record of scientific inquiry, particularly as it concerns us at the present hour and in this university: We have made a fair beginning at providing our men and women with the printed record of the more immediate past. We have at least the rudiments of a good collection of the important work of the remoter periods. We know rather precisely the direction which our efforts in buying should take, and more than a little as to the difficulties in our path. We are ready to do our part (I take it) in any cooperative scheme for furnishing to this Great Lakes region a fuller measure of books and journals. We know the imperfections of our bibliographic tools. (We have most of them in constant use!) And we stand ready to contribute in this field also our own share of cooperative labor. In other words—we know our defects and we are trying to overcome them, and all we need is time and money—and perhaps wisdom!

What of the future? What may we hope for in twenty years, supposing no great disaster checks our labors?

We may, I believe, expect to find here (available to a large region) the major academic and society publications in absolute completeness. We may further expect at least double the present amount of journals, both current numbers and bound files. We shall be part of a regional group of libraries, owning our share of the minor society publications and journals, with a fairly complete whole ready for rapid use, distributed by air-mail in response to wireless telephone requests, every few hours. It ought not to take a man here in 1930 any longer to get a book from Columbus or Chicago than it now takes him in many European libraries—that is, six to twenty-four hours. We shall have a completed printed list, kept up to date, of all the periodicals and transactions (and perhaps all the books) available both in the libraries of our region and the whole United States. (This is almost in sight now! With two hundred thousand dollars it could be done in two years' time!) We should have also a bibliographic equipment which will furnish with the minimum of effort a practically complete list of all articles and books on any topic, arranged in inverse chronological order, the latest to appear coming first. This is solely a matter of organization and money. It represents merely the marshalling of a sufficient number of trained people to supplement work already begun on methods already worked out. It means applying the method of storing linotype bars and using them as needed, for example, in the cumulation decade by decade of the Royal Society's International Catalog. This work could be organized for the future in three years and printing of the first two decades of the twentieth century finished in five or less. I am less sure that it will come than I am confident of the future provision in the way of books. But if and when the key to the record does exist, then no budding scientist may fail of confidence in his start, of the help in his labors as they go on year by year which comes from knowing what has been done and what is being done by his fellows. We shall have them ready at hand—not alone the record in print of human efforts to comprehend the universe, but also such an effective and useful key to that record that we may reverse the old saying, and affirm he who reads may run.

Wm. Warner Bishop

May 26, 1922

THE DEPLETION OF SOILS BY CHEMICAL DENUDATION

The rate of chemical denudation of soil and rock material has been of vital interest to geologists and soil scientists. The geologist has been interested in an attempt to establish a unit of time for estimating the age of the ocean, the time periods of geologic processes and incidently the time periods of the life of man, animals and other forms of life on the globe. He has been ably assisted by hydrographers and oceanographers. The soil scientist has been interested in relation to time measurements of soil productivity and of methods to be taken to prolong the life and the endurance of the soil for the agricultural needs of the people.

Unfortunately the vast amount of information that has been collected has been based mainly upon the translocation of material in true solution, disregarding all material in colloidal solution. The results of the methods used have shown surprisingly little silica, alumina and iron lost from the soil in comparison, for instance, with the amount of potash lost. In fact, the soil scientists have assumed that the three first named elements, which form by far the larger proportion of the soil, remain in the soil because of their slight solubility. There has been a lack of evidence of any considerable loss of these through solution.

The hydrographers have determined, from the average composition of the soluble salts carried to the sea, that SiO_2 constitutes 8.60 per cent., Al_2O_3 and Fe_2O_3 together constitute 0.64 per cent. and K_2O 2.13 per cent. This gives a ratio of one part of potash to 4.4 parts of silica, alumina and iron. As the ratio of potash to silica, alumina and iron in igneous and in shale rocks is about 1 : 25, there is an apparent selective loss of potash; that is, the loss of potash is relatively much greater than the loss of the main soil constituents. From this fact, together with the fact that plants appear to have the same selective power of absorption of potash in much greater proportion than of the original proportion of the main soil constituents, soil scientists have taken a very pessimistic view of the length of time the soil will remain fit for agricultural use.

Opinions have been advanced by some that our most productive soils will only last for one hundred and fifty years or so without replacement, because of this selective loss of plant food material due to their greater solubility and assuming further that the silica, alumina and iron are removed in very small proportions from the soil because of their relative insolubility. Such is briefly an outline of the situation up to a short time ago.

If silica, alumina and iron are removed from the soil in proportion to the loss of the so-called more soluble salts the losses could not be determined by chemical analysis any more than the removal of a cartload of soil would affect the chemical composition of the material that remains. Recent investigations of the soil colloids by this bureau suggest that this may be actually what takes place. It would appear that, in the breaking down of the silicates to a point where the potash goes into solution, silica, alumina and iron also go into solution in the same proportion as they bear to the potash content in the original material. There is, however, this very important difference which has not heretofore been recognized or properly appreciated and that is that the solution of silica, alumina and iron is a colloidal solution as distinguished from the true solution of the so-called soluble elements.

The methods devised for separating colloids from soils for analysis and study, and the methods for the determination of the amount of colloids in soils have apparently opened up a new and vast field of research, the results of which will undoubtedly throw a broader light upon the subject of chemical denudation.

In my paper on "The Origin of Soil Colloids and Reason for the Existence of This State of Matter," published in Science, December 30, 1921, I called attention to the fact that in the mechanical analysis of soils under microscopical control practically the smallest particle of matter is .0001 mm. I advanced the opinion that complex silicates of such small diameters contain relatively so few molecules that when brought into contact with water the bombardment of the water molecules shatters the mineral particles, the electrolytes going into true solution and the silica, alumina and iron going into colloidal solution, the colloids thus formed reabsorbing much or all of the electrolytes, which puts these electrolytes themselves in large part into a colloidal state.

It is difficult to conceive how the electrolytes can be dissolved out of silicates at ordinary temperatures and pressures without conceiving that the whole thing breaks down into a dissolved mass. In fact, direct evidence of this is to be found in the dry grinding of silicates in the ball mill. If this fine ground material is brought into contact with water, soluble salts go into solution as determined by conductivity or chemical test, and at the same time there is released a relatively large amount of colloidal material. What the exact ratio is between the potash, for example, which has been released from the silicate rock, and the silica, alumina and iron in the resulting colloids formed has not been determined.

Soil colloids in suspension of a gram to the liter give the appearance under the ultra microscope of minute droplets immiscible with the surrounding water capable of indefinite suspension. In larger concentrations the droplets appear to coalesce, forming a jelly-like mass which settles to the bottom of the vessel. These soil colloids have a distribution equilibrium, however, between the colloid and the surrounding water, involving silica, potash and other electrolytes to a notable extent, but affecting the iron and alumina only to an inconsiderable extent.

We have a general idea of this distribution equivalent in the case of analyses which have been made of the truly soluble material that passes through the Pasteur-Chamberlain filter in comparison with the colloidal material which remains on the outside of the filter tubes. The colloidal material of the Miami silty clay loam soil collected on the outside of the tubes on a strictly water-free basis carries 54.15 per cent. SiO_2, 28.03 per cent. Al_2O_3 and 13.39 per cent. Fe_2O_3. These together add up 95.57 per cent. of colloidal material. The content of K_2O is 2.89 per cent., giving a ratio of potash to silica, alumina and iron of 1 : 33. In the dissolved salts which have passed through the filter tube there is 10.4 per cent. SiO_2, 2.9 per cent. Al_2O_3 and Fe_2O_3, making 13.3 per cent., while the K_2O content is 8.1 per cent., giving a ratio of 1 : 1.6. The salts of the river waters of the United States contain on the average 8.60 per cent. of SiO_2, .64 per cent. of Al_2O_3 and Fe_2O_3, making a total of 9.24 per cent., while the K_2O content is 2.13 per cent., giving a ratio of 1 : 4.4.

The average analysis of igneous rocks as given by Washington on a strictly water-free basis shows 60.14 per cent. of SiO_2, 16.32 per cent. of Al_2O_3 and 7.84 per cent. of Fe_2O_3 and FeO calculated to Fe_2O_3. This makes 84.30 per cent., while the K_2O content is 3.27 per cent. This gives a ratio of potash to silica, alumina and iron of 1 : 25.8, as compared with the ratio of 1 : 33 in the case of the Miami soil colloid as above. The composition and ratio of potash to silica, alumina and iron in shale rocks is nearly identical with the igneous rocks.

The average composition of deep marine sediments ("red clay") on a water-free basis, excluding sea salts and shells, shows according to Steiger 54.48 per cent. SiO_2, 17.15 per cent. Al_2O_3 and 10.36 per cent. of Fe_2O_3 and FeO calculated to Fe_2O_3. This makes a total of 81.99 per cent., while the K_2O content is 3.07

per cent. This gives a ratio of potash to silica, alumina and iron of 1 : 26.7 or very nearly the ratio in the igneous rocks. The "terrigenous clay" of the deep marine sediments has a rather larger content of SiO_2 and a somewhat smaller content of K_2O, giving a ratio of 1 : 36.4.

The average composition of the soil colloids shows somewhat less SiO_2 than is contained in igneous rocks but considerably more Al_2O_3 and Fe_2O_3, indicating probably that much of the quartz from the disintegrating rock remains as such in the soil. On the other hand, it is seen that the marine sediments have gained in SiO_2 over the soil colloid for which we can offer at present no explanation.

An examination of the Miami silty clay loam soil shows the following very interesting figures. If we assume a weight of 3,500,000 pounds per acre foot, the composition on a water-free basis with 81.11 per cent. of SiO_2 shows 2,838,850 pounds of SiO_2 per acre; Al_2O_3 at 10.46 per cent. gives 366,100 pounds per acre; Fe_2O_3 at 2.80 per cent. gives 98,000 pounds per acre, while K_2O at 2.27 per cent. gives 79,450 pounds per acre. The amount of soil colloid at 19.3 per cent. gives 675,500 pounds of colloid per acre foot. The SiO_2 content of this colloid amounts to 365,780 pounds, the Al_2O_3 189,340 pounds, and the Fe_2O_3 90,449 pounds, while the K_2O content of the colloid is 19,522 pounds per acre.

The total soluble salts of the Miami silty clay loam soil collected after passing through the Pasteur-Chamberlain filter, after treatment of one part of soil to five parts of water, amounts to 60 parts per million of the soil. The SiO_2 in soluble form in this soil collected under these conditions is therefore 22.43 pounds per acre and the Al_2O_3 and Fe_2O_3 6.16 pounds, while the K_2O is 27.16 pounds per acre.

This bureau has determined from observation of river waters the presence of colloidal material but has made no analysis to determine the amount or composition of this colloid. Unfortunately, in all of the river analyses that have been made the amount of silica, alumina and iron in colloidal solution owing to the lack of methods has not been determined and has not been included in the evidence presented of chemical denudation. It seems likely that the colloids carried by the rivers approximate in composition the soil colloid and arguing from the figures above given pertaining to the Miami silty clay loam soil the 2.13 per cent. of K_2O and the 9.24 per cent. of silica, alumina and iron as reported for the average river water gives only one part of the story. If the ratio of 1 : 1.6 of potash to silica, alumina and iron of the soluble salts is changed to the ratio of 1 : 33 as in the colloidal solution, then in addition to the soluble potash, silica, alumina and iron as reported in the river water analyses, we will have a colloidal solution carrying, in its dry parts, 2.89 per cent. of potash, 54.15 per cent. SiO_2, 28.03 per cent. Al_2O_3 and 13.39 per cent. Fe_2O_3.

The total additional amount of potash in the colloidal matter carried by the rivers, as compared with the total amount of potash in true solution, and the total amounts of SiO_2, Al_2O_3 and Fe_2O_3 carried in this colloidal matter, as compared with the amounts carried in true solution, can not be determined without further investigations and further determinations of the material carried by the river water. If we knew the amount of soluble material in the river water, the amount of colloidally dissolved material and the amount of unaltered rock fragments there would still be one item which would make comparison difficult and would be seemingly difficult to evaluate, and that is the amount of CO_2 that enters from the air and from decomposing organic matter, which would combine with some of the constituents noticeably with lime, either in the soil or in the river water. It seems likely, however, from the consideration of the facts given that this would be a small factor.

Until we evaluate all these factors and particularly until we determine the actual loss through chemical denudation of silica, alumina, iron, potash and other electrolytes in the colloidal state carried by the rivers, we are in no position to even speculate as to whether chemical erosion is a selective process which might change the chemical composition of the soil or whether materials leave the soil in about their original ratios which would not change materially the chemical composition of the soil upon which water has acted.

MILTON WHITNEY

BUREAU OF SOILS,
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SCIENTIFIC EVENTS

THE PITTSBURGH MEETING OF THE AMERICAN CHEMICAL SOCIETY

(American Chemical Society News Service)

FROM an industrial standpoint the meeting of the American Chemical Society in Pittsburgh from September 4 to 8 will be one of the most important scientific gatherings ever held in this country. It will be of particular interest and value to the automobile industry. Among the important inventions which will be publicly described for the first time is a new zinc oxide, much smaller in particle size than any zinc oxide heretofore made, the work of Frank G. Breyer, chief of research for a New Jersey zinc concern. This pigment used in the tread of automobile tires gives almost twice the wear of tires containing ordinary zinc oxide.

Dr. Thomas Midgley, Jr., and T. A. Boyd, of Dayton, Ohio, will give a demonstration in Carnegie Hall of how various fuels detonate and explain how "knocking" may be reduced by the use of various compounds. Their work is of great importance, inasmuch as it probably will be the basis, in the future, of building automobiles of much greater power and increased efficiency in the use of fuel.

Nearly all the sixty-four local sections of the society, located in nearly all the states, will be represented at the meeting. From 1,500 to 2,000 chemists are expected to attend.

Dr. Charles L. Parsons, secretary of the society, who has just returned from Europe, where he attended the International Conference of Pure and Applied Chemistry, held at Lyons, France, the last week in June, says that European scientists are watching American research work with great interest, but that very few, if any, will attend the Pittsburgh meeting, as economic conditions, particularly on the continent, make it almost impossible for European chemists to travel. They, however, are keeping in close touch with Americal chemical progress through the literature of the society.

As an instance of the respect of European chemists for American procedure and methods, Dr. Parsons pointed out that the Commission on Nomenclature of Mineral Chemicals decided that the "Formula Index" printed in *Chemical Abstracts,* one of the publications of the American Chemical Society, be the standard for scientific purposes the world over. Likewise, the abbreviations used in *Chemical Abstracts* were adopted as the standard by the Commission on Chemical Periodicals.

The chief address of the Pittsburgh meeting will be by Dr. Edwin E. Slosson, author of "Creative Chemistry," on "The constructive chemist." Dr. Slosson, who was for many years literary editor of *The Independent,* is now editor of *Science Service,* Washington.

Information received by the American Chemical Society indicates a tremendous increase, since the war, of interest in chemistry as a result of the work being done to explain in "every-day" language some of the achievements of this science. These results seem to be directly due to efforts of Dr. Edgar F. Smith, president of the society, to get American chemists to speak before clubs of men and women, social and business, throughout the country, and through the writings of such men as Dr. Slosson, Ellwood Hendrick, of New York, and others.

At the Pittsburgh meeting further steps to advance improved methods of teaching chemistry, from the high schools up, will be taken by the Section of Chemical Education, of which Dr. Smith is chairman.

EXHIBIT OF OPTICAL INSTRUMENTS

ARRANGEMENTS are now being completed for the exhibit of optical instruments and apparatus to be held at the National Bureau of Standards, Washington, in connection with the annual meeting of the Optical Society of America, October 26 to 28, 1922.

The leading manufacturers of optical equipment have already signified their intention of participating. However, the exhibit will not be limited to standard commercial types. Individuals and research laboratories are also invited to exhibit special research apparatus. Brief descriptions of instruments and their purposes supplied by the exhibitors will be printed in the program and published later in the minutes of the meeting in the *Journal* of the Optical Society. The exhibit of new apparatus will thus constitute just as definite a contribution to science as a paper communicated to the meeting. The authors of papers communicated at this meeting are urged to supplement their papers by an exhibit of apparatus in case such an exhibit is suitable and practicable.

Exhibitors are urged to prepare their exhibits and descriptions so as to give them the maximum educational value.

Exhibits must be listed with the committee at the Bureau of Standards not later than September 20. Blank entry forms for this purpose may be obtained from Professor C. A. Skinner, chairman, Exhibit Committee, O. S. A., Bureau of Standards, Washington, D. C. Exhibits may be installed from October 24 to 25 and installation should be completed not later than noon, October 26.

Irwin G. Priest,
Secretary

VENTILATING CODE OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

The code for the ventilation of public and semi-public buildings adopted by the American Society of Heating and Ventilating Engineers in 1915 has been submitted to the American Engineering Standards Committee for approval as the American standard.

This code was prepared by a committee of the American Society of Heating and Ventilating Engineers in response to requests from state commissions, legislative bodies, public health agencies and other organizations for suggestions to be used in the preparation of legislation and regulations regarding the heating and ventilation of buildings. The committee endeavored in this code to cover the general features most essential to the public health, in such a manner as to protect the public with the least possible expenditure for equipment and without unnecessarily limiting the methods of obtaining the desired results.

Section 1 of the code relates to general matters pertaining to all classes of buildings; the remaining three sections relate to schools and colleges, factories, and theaters, respectively.

Among the states that have utilized parts of the code in their regulations are: Illinois, Indiana, Kansas, Massachusetts, Minnesota, New Jersey, New York, Ohio, Pennsylvania, Utah, Virginia and Wisconsin. A thoroughly representative special committee, including all the important organizations interested in the subject, has been appointed by the American Engineering Standards Committee to investigate the status of the code in the industry and the desirability of approving it. Sidney J. Williams, chief engineer of the National Safety Council, is chairman of this special committee.

The American Engineering Standards Committee would be glad to learn from those interested of the extent to which they make use of this code, and to receive any other information regarding the code in meeting the needs of the industry.

THE AQUARIUM OF THE ZOOLOGICAL SOCIETY OF LONDON

We learn from *Nature* that the Council of the Zoological Society of London has approved a scheme for the establishment of an aquarium at the Zoological Gardens in Regent's Park. The aquarium is to be built under the Mappin Terraces, but so installed as to be invisible from the front, and will not interfere with the panorama of the terraces. It will consist of a crescentic gallery, 400 feet long, lined with tanks on both sides. Those on the outer curve will have both daylight and electric illumination, while those on the inner curve will be lighted by electricity only, a method used at the Berlin Aquarium with complete success. The gallery will be divided into three parts—fresh water, marine, and tropical aquaria—with special ponds for seals, diving birds, and trout. The tanks are to be constructed with the bottoms, sides and backs of slate, and the fronts of polished plate glass set in a framework of white marble. They will be provided with rock-work arranged to suit the needs of their inhabitants. The water will be kept constantly circulating, flowing into the tanks from high-level reservoirs and thence through a series of underground filter-beds, on the plan of those in use at the New York Aquarium, to low-level reservoirs, from which it will be pumped by electric pumps to the high-level reservoirs again. Special arrangements are to be installed for heating the tanks and for regulating the temperature of the water in the different aquaria. The plans for the gallery have been prepared by Messrs. Belcher and Joass, and the circulation, electric plant, and the heating, lighting and ventilating systems have been designed by Sir Alexander Gibb. The scheme will cost about £50,000, and should provide London with the best-equipped and most carefully arranged aquarium in Europe.

SCIENTIFIC NOTES AND NEWS

At the forty-first annual meeting of the Society of Chemical Industry, held in Glasgow in July, Professor R. F. Ruttan, of McGill University, presided, and made an address on "Some aspects of industrial and scientific research." Professor H. E. Armstrong, of London, gave the first of the Messel Memorial lectures.

Mr. Calvin W. Rice, secretary of the American Society of Mechanical Engineers, sailed from New York on August 23, to represent the engineers of the United States at the Engineering Congress to be held in connection with the International Exposition at Rio de Janeiro. A dinner in his honor was given at the Engineers Club on the evening of August 21.

Dr. Henry S. Drinker, formerly president of Lehigh University, has been appointed the successor of the late Joseph T. Rothrock as a commissioner of forestry in Pennsylvania.

Mr. C. A. Sussmilch, principal of the Newcastle Technical College (N. S. W.), and formerly lecturer in charge of the department of geology and mining, Sydney Technical College, has been elected president of the Royal Society of New South Wales.

The Royal Dutch Institute of Engineers has appointed as honorary members Sir Charles Parsons, inventor of the Parsons steam turbine, Mr. J. H. Tudsbery, secretary of the Institution of Civil Engineers, London, and Mr. Charles le Maistre, secretary of the International Electro-Technical Commission in London.

The seventieth birthday of Dr. S. Goldflam, the Polish neurologist and alienist, has been celebrated, a special volume of "Neurologie polonaise" being dedicated to him.

Dr. Reid Hunt, of the Harvard Medical School, Boston, has been elected on the editorial board of *Physiological Reviews* for 1922.

At the recent meeting of the International Union of Pure and Applied Chemistry, as has already been noted, Sir William J. Pope was elected president of the union, and it was decided that the next meeting should be held in Cambridge, England, on June 17, 1923. Dr. Wilder D. Bancroft, professor of physical chemistry at Cornell University, was elected vice-president for America, succeeding Dr. Charles L. Parsons, secretary of the American Chemical Society, whose three-year term of office has just closed.

On May 24, a Hawaiian Section of the American Chemical Society was organized with the following officers: C. C. James, *chairman;* S. S. Peck, *vice chairman;* R. Q. Smith, *secretary;* Guy R. Stewart, *treasurer;* Frank T. Dillingham, *councilor.*

At the convention of the Western Psychological Association held at Stanford University on August 4 and 5, the following officers were elected: *President,* Edward C. Tolman, of the University of California; *vice-president,* J. Edgar Coover, of Stanford University; *secretary,* Edmund S. Conklin, of the University of Oregon.

Dr. Elwood Mead, professor of rural institutions, University of California, has been made an honorary member of the American Society of Agricultural Engineers. Dr. Mead recently returned from the Hawaiian Islands, where he went on the invitation of the Hawaiian Home Commission to investigate conditions on the islands.

Dr. W. W. Coblentz, physicist of the National Bureau of Standards, spent part of the month of June at the Lowell Observatory extending his radiometric investigations of last year at Flagstaff, on the stars and the planets. The observing conditions were favorable and progress was made both in the accumulation of new observational data and in tests of new apparatus. The observations were carried out with the 40-inch reflector.

Dr. Wm. F. Prouty, of the department of geology of the University of North Carolina, has accepted a part time engagement as paleontologist for the West Virginia Geological Survey, in the study and description of the fossil faunas of the Devonian, Silurian, Ordovician and older beds of that state. Dr. Prouty is spending the summer vacations in the field making collections and stratigraphic studies. For the present year his work will be in Mercer, Monroe and Summers counties in connection with Mr. David B. Reger, assistant geologist, in the latter's studies of the geology of this area. Dr. John L. Tilton's paleontologic work for the West Virginia Geological Survey will be confined principally to the study of the fossil fauna and flora of the Monongahela and Dunkard beds of the state.

M. T. Jenkins, of the U. S. Department of Agriculture, has been detailed to the Agricultural Experiment Station of Iowa State College for cereal breeding experiments on the relative value of the pure line theory of selecting new varieties of corn.

Under the direction of Professor Clifford H. Farr, of the botany department of the University of Iowa, the city officials and residents have cooperated in a campaign to rid the city of ragweed for the eradication of hay-fever.

Dr. Donald D. Van Slyke, of the Rockefeller Institute, is on his way to China, where he will participate in teaching, for six months, at the Medical School at Pekin.

Dr. Louis A. Bauer gave a lecture on the "Earth's magnetism and electricity" before the Royal Society of Western Australia, at Perth on June 21, as also before the Philosophical Society at Wellington, New Zealand, on July 5. During an inspection trip to the Carnegie Institution Magnetic Observatory at Watheroo, Western Australia, he completed arrangements for continuous earth-current observations. This observatory will be the only one completely equipped in the southern hemisphere for investigations relating to the earth's magnetism, atmospheric electricity, and the earth's electric currents. While in Australia he furthermore made arrangements for special magnetic and electric observations at various stations during the solar eclipse of September 21, 1922. At Wellington Dr. Bauer attended a specially-called meeting on July 4 and 5 of the Samoa Observatory Honorary Board of Advice. Arrangements were perfected for further cooperation in the maintenance of the Samoa Observatory at Apia by New Zealand, the British Admiralty and the Carnegie Institution of Washington. Dr. Bauer returned to Washington the middle of August.

As has been noted here, Professor Santiago Ramón y Cajal, having reached the age limit, has retired as incumbent of the chair of normal histology and pathology of the Madrid Medical School. The *Journal* of the American Medical Association says: "The whole country has rendered tribute to the great scientist, bestowing on him every distinction and honor, the greatest, perhaps, being the award of the Echegaray medal. This was presented to him in the Royal Academy of Sciences by the king, who delivered a speech overflowing with respect and love for the illustrious Spaniard, who has brought so much prestige to his country. A number of cities have designated Ramón y Cajal as their adopted son; many others have named streets after him, and prizes have been established in his name. The government performed an act of greater importance in introducing a bill for the construction of a building for the Cajal Institute, which was organized February 20, 1920. The bill carries an appropriation of a million pesetas ($155,400), divided into four sums which will be spent annually from 1922 to 1925 on the building designated as Cajal's Biologic Institute. An appropriation of 50,000 pesetas ($7,770) a year is made for maintenance, including the 10,000 pesetas ($1,540) now provided for Cajal's laboratory. The work of the institute will be directed by a board of trustees presided over by Cajal."

Professor H. J. Hamburger, the distinguished physiologist of the University of Groningen, Holland, will give the first series of Charles E. Dohme Memorial lectures at the Johns Hopkins Medical School on October 10, 11 and 12. This lectureship has recently been established by Mrs. Charles E. Dohme as a memorial to her husband, the late Charles E.

Dohme, a well-known manufacturer of pharmaceutical products. It is the purpose of the donor to have presented in these lectures discoveries which intimately concern the fields of chemistry, pharmacy and medicine. Professor Hamburger has chosen for the title of his lectures, "The increasing significance of permeability problems in physiology and pathology."

PROFESSOR ALBERT PERRY BRIGHAM, of Colgate University, gave a course of lectures on "The American Domain and the American People" before the Oxford University School of Geography from August 10 to 16.

ROLLIN D. SALISBURY, since 1892 professor of geographical geology and since 1897 dean of the Ogden School of Science at the University of Chicago, died on August 15, aged sixty-four years.

EDWARD M. EIDHEER, formerly expert in the department of agriculture, bureau of chemistry, Austria, member of the Academy of Science of Vienna, died on July 24, aged sixty years.

STEPHENSON PERCY SMITH, known for his work on Polynesian ethnology, has died at New Plymouth, New Zealand, at the age of seventy-two years.

ACCORDING to the regulations of the "Van't Hoff Fund" founded in 1913, the foundation in Amsterdam under the supervision of the Royal Academy of Sciences appropriates annually allotments to investigators in the field of pure and applied chemistry. The amount available for 1923 is about twelve hundred Dutch florins. The committee in charge consists of A. F. Holleman, *president;* S. Hoogewerff, A. Smits and J. P. Wibant, *secretary.*

THE seventh summer meeting of the Mathematical Association of America will be held at the University of Rochester, Rochester, New York, on Wednesday and Thursday morning, September 6 and 7. The American Mathematical Society will meet in Rochester on Thursday afternoon and Friday, September 7 and 8. A joint dinner will be held on Thursday evening at the Oak Hill Country Club, the future site of the university. Professor R. C. Archibald, the president of the association, has been invited to give a report at this time on European conditions, based on his six months' traveling in Europe. The sessions of the association on Wednesday will be held in the Eastman Building, at 10 A.M. and 2 P.M. The session on Thursday morning will be held at 9:30 A.M. at the Research Laboratory of the Eastman Kodak Company. A short chamber concert will be given for the members of the association and the society in Kilbourn Hall, of the New Eastman School of Music, at 4:30 P.M. on Wednesday. An automobile ride on Thursday afternoon will precede the joint dinner.

THE autumn meeting of the British Iron and Steel Institute will be held at York on September 5 to 8, when it is expected that ten papers will be submitted for discussion. In addition to an excursion to Rievaulx Abbey and Castle Howard, visits have been arranged, with special trains, to the works of the Staveley Coal and Iron Company, near Chesterfield, and of the Parkgate Iron and Steel Company at Rotherham.

IN connection with the National Colonial Exhibition to be held in September at Marseilles, a "Semaine Internationale" has been organized for the purpose of bringing together geographers, explorers, ethnologists and naturalists, whether French or of other nations, who are in sympathy with French colonial achievements. The program will include visits under suitable guidance to the exhibition galleries, public lectures and technical meetings, social functions and geographical excursions, and the congress, which is presided over by Prince Bonaparte, will last from the twenty-second to the twenty-eighth of September. The charge for tickets of membership is 25 francs, and those attending will be able to travel for half-fares on the system of the Paris-Lyon-Mediterranean Railway.

THE Imperial Department of Agriculture for the West Indies has been amalgamated with the West Indian Agricultural College, and the head office of the department has been transferred from Barbados to Trinidad.

THE London Chemical Society has agreed to supply copies of the *Annual Reports on the*

Progress of Chemistry, Vol. XIX, to members of the American Chemical Society at a reduced rate. Any member can obtain a copy of the 1922 *Annual Reports* by sending his order, accompanied by a remittance of seven shillings, to S. E. Carr, assistant secretary, Chemical Society, Burlington House, Piccadilly, London, W. 1, England. All orders must be in by January 1, 1923, as it is necessary for the society to know the number of copies desired in advance of publication. Each applicant should make known the fact that he is a member of the American Chemical Society.

We learn from the *Experiment Station Record* that a scientific commission has been appointed by the French government to study the agricultural possibilities of French Nigeria, especially that portion lying between Bamoko and Timbuctoo. The construction of a huge dam in this vicinity is contemplated for the irrigation of the Upper Niger Valley. A general agricultural reconnaissance will be made by the commission, with special emphasis on cotton, covering a period of from twelve to eighteen months. Dr. R. H. Forbes, formerly of the Arizona University and Station and who has just concluded his engagement with the Société Sultanienne d'Agriculture of Egypt, has accepted an appointment as agronomist on this commission.

An additional appropriation of $15,000, with legislation to guarantee its effective expenditure, will be asked of the next legislature by the Minnesota State Board of Health, for the supervision of the state tourist camps. The importance of extreme care in sanitation matters among tourists is shown in a report covering the period from 1913 to 1921, showing that 365 cases of typhoid fever in Minnesota were contracted outside the state while the victims were on vacation trips.

The valuable collection of books on forestry, photographs, slides and papers gathered by the late Dr. Joseph T. Rothrock, the "Father of Pennsylvania Forestry," has been given to the State Department of Forestry, in accordance with a wish expressed by the former commissioner. The collection was turned over to Dr. Joseph S. Illick, chief of the research division, who worked under Dr. Rothrock, and he is arranging them to be placed in the departmental library. Among the books is a copy of Gray's Botany, which Dr. Rothrock carried with him during his service in the Civil War. Some of the photographs in the collection were among the first taken by Dr. Rothrock when he was arousing public interest in conservation and bringing about the organization of the Department of Forestry.

The state legislature of South Carolina has appropriated $50,000 for experimental work, about half to be expended at the college and the remainder at the substations and for cooperative experimental work on different soil types in the state.

The University of California announces that its students have won two of the four prizes offered by the Glass Containers' Association in a national competition for the most valuable paper on canning or any feature relating to canning or preserving. The first prize was won by Lal Singh, a Hindu student who graduated from the College of Agriculture with the class of 1921. His paper on "Factors concerned in manufacturing fruit products" is said to be a distinct contribution to the knowledge of jams and jellies. The paper is to be published as a series of articles in the trade magazine, *Canning Age*. J. R. Herman, a graduate student in the College of Agriculture, won the third prize in the national competition with a paper on "The utilization of grape products." The second and fourth prizes went to students in eastern universities.

We learn from *Nature* that the Ramsay Memorial Fellowship trustees have made the following awards: Ramsay Fellowship of the value of £300 tenable for one year, but renewable for a second year, to Dr. R. W. Lunt, of the University of Liverpool, and of University College, London, for the continuation of his work at University College, London, on chemical effects of electromagnetic waves over the frequency range, 10^5-10^8 cycles; Glasgow Ramsay Fellowship of £300 to Mr. J. A. Mair, of the University of Glasgow, who will continue his research on the chemistry of the terpenes; a special fellowship of £300 for one year to Mr. W. Davies, who has already held a Ramsay Fellowship for two sessions and whose work, especially that on the preparation of synthetic reagents from the toluic acids, shows special promise; Danish Ramsay Fellowship to Mr. Kristian Höejendahl, of the University of Copenhagen, who will pursue his research in the University of Liverpool; two Swedish Ramsay Fellowships, to Dr. J. O. G. Luhlin and Mr. A. W. Bernton; and two Norwegian Ramsay Fellowships to Mr. Dag Nickelson, who will work at the Imperial College of Science and Technology, and Miss Milda Prytz, who will work at University College, London. A special Ramsay Fellowship of the value of £350, which was placed at the disposal of the National Research Council of the United States of America, has been awarded to Dr. C. S. Piggot, of Baltimore, who will begin work at University College, London, in October.

UNIVERSITY AND EDUCATIONAL NOTES

At the University of Missouri plans have been practically completed for the new agricultural building for which $200,000 was appropriated by the last legislature. The building will constitute the center of the agricultural group, including the present agricultural and horticultural buildings, and will serve as the administration headquarters of the college of agriculture.

Professor M. Jules Tissot, of the Paris Museum of Natural History, and Mme. Tissot have given 844,483 francs to the museum to endow the chair of physiology.

Dr. Charles C. Bass has been elected dean of the school of medicine of Tulane University.

Dr. H. H. Lane, for fourteen years professor of zoology at Oklahoma University, has been appointed head of the department of zoology at the University of Kansas. He succeeded Dr. B. M. Allen, who has gone to the Southern Branch of the University of California.

Dr. Waldo Shumway, assistant professor of biology at Dartmouth College, has been appointed associate professor of zoology at the University of Illinois.

Dr. M. Kharasch, who has held a National Research fellowship at the University of Chicago for the past three years, has been appointed associate professor of organic chemistry at the University of Maryland.

W. T. Chambers, graduate student in the department of geography of the University of Chicago, has been appointed to a newly established instructorship in geography at the University of Tennessee.

Miss Marion Bell has been appointed biochemist in pediatrics and child welfare research at the University of Iowa.

Professor D. Thoday, of the University of Cape Town, has been appointed to the chair of botany, in succession to Professor R. W. Phillips, who retires after thirty-eight years' service.

J. A. S. Watson has been promoted to the chair of agriculture and rural economy at Edinborough, in succession to Professor Robert Wallace, retired. Professor Watson was demonstrator in botany under Sir Isaac Bayley Balfour, afterwards continuing his studies in Germany, America, and Canada.

DISCUSSION AND CORRESPONDENCE

THE FOOD HABITS OF SWORDFISH

The recent note of Mr. C. H. Townsend ("Swordfish Taken on Trawl Lines," Science, Vol. 56, p. 18) brings up the question of whether these fishes descend to considerable depths for food. On this point I have some evidence which may be worthy of record.

The late Captain John Toothaker of South Harpswell, Maine, was always very helpful to the Harpswell Laboratory, and would bring in from his trips any of the peculiar animals he found while sword fishing. Some years ago he turned over to me a couple of deep sea fishes which he had taken in a swordfish stomach. I have forgotten the genus and species, but both belonged to the Scopelidæ, and as I recall looking the matter up, the species had never been taken in less than 800 fathoms. The specimens were quite fresh and the digestive juices had hardly affected the integument, and the phosphorescent organs along the sides were in good condition. One of the specimens was given to the Boston Society of Natural History as a member of the New England fauna; the other was presented to the Museum of Comparative Zoology at Harvard. The swordfish was taken on the eastern border of the Georges Banks, a little inside the 500 fathom line. From this it would appear that the swordfish do descend to considerable depths for their meals, and, from the good condition of the specimens, it would appear that they make a rapid transition from the feeding grounds to the surface for the after-dinner siesta.

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EXPERIMENTAL TRANSFORMATION OF THE SMOOTH-BLADDER OF THE DOG

The essential difference between the pale smooth muscle of the bladder and the red involuntary striated muscle of the heart is dependent upon the differential intensity of the hydro-dynamic pressure to which the vesicular and cardiac mesenchymal cells have been subjected, respectively. By experimentally varying the velocity of application and the intensity of the intra-vesicular pressure, which causes tension of the smooth bladder muscle, during a period of eight weeks, to a point comparable with that found in the heart the non-striated bladder muscle is transformed histologically into cross-striated muscle, and physiologically into an organ manifesting rhythmicity as long as the hydro-dynamic pressure stimulus is applied.

From the dynamic or functional, embryological viewpoint the various muscles, smooth, cardiac and skeletal represent differences in the amount of *work* that has been done upon them by the differential growing parts of the embryo during the active periods of growth.[1] The essential difference then physiologically between the various muscles is their capacity for work which in turn is dependent upon the amount of work that has been expended in their production. The reason for the different degrees of energy possessed by the types of muscle is purely an embryological bio-mechanical problem and corresponds to the differential amount of optimum tension which these muscles have experienced during their formative period because of a dominant energetic zone extrinsic to the region of myogenesis. The evidence presented by these experiments warrants the conclusion that as regards cross-striated muscle, function determines structure and not the reverse.

The writer wishes to thank Dr. Charles R. Bardeen, University of Wisconsin, for rechecking the evidence leading to the above conclusions.

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AN ALBINO MUTATION OF THE DEMATIACEOUS FUNGUS BRACHYSPORIUM TRIFOLII

This fungus has been under study in culture since October, 1919, when it was first isolated from clover plants. A description was published in *Phytopathology*, October, 1920, and an intensive culture study of the fungus has been continued since that time. The cultures were started from a single spore and have been kept going as a pure strain ever since.

The normal fungus is of the dematiaceous type, with dark brown hyphæ, forming in culture a very dense black mat on and in the medium.

On one of a series of cultures made early in November 1921 there appeared, starting from the point of inoculation, a sector of growth which completely lacked the black-brown color of the normal mat. A microscopic examination showed that the mycelium and conidia of this light-colored area were morphologically identical with those of the normal growth of the fungus, except for the lack of the dark brown color.

Isolation cultures were made of this albino material by the isolation of sclerotia-like

[1] Carey, E. J., 1919-20, *Journ. of Gen. Physiol.*, (*a*) ii, 357; (*b*) iii, 61; (*c*) *Anat. Record*, 1920, xix, 199.

bodies which are formed abundantly on certain media. From these pure cultures were made and subcultures have been carried on through sixteen consecutive non-sexual generations, both by the single spore method and by ordinary transfers from one tube to another, without any variation in the appearance or nature of this strain. The mycelium in mass is a true albino or may at times take on a light flesh color.

Throughout an intensive study in culture covering thirty months' time, and employing every variation in condition that could be thought of as an influencing factor, there has been no ascus or sexual stage developed either in the normal or albino strain. With these facts in mind, it would seem that the phenomenon here reported can only be referred to some sudden change which occurred in the mycelium or conidia of the normal strain; and in any case has no connection with any sexual process.

The abruptness of this change, and the continual difference shown by contrasting cultures of the albino and the normal strain, is very striking. This change does not seem to fall into that class of somatic mutations so far reported in fungi which are usually described as a dwarfing or reduction of the development of the normal form, but it is a complete loss of the dark-color character which is typical for the normal original strain.

LEE BONAR.

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A DAMP CHAMBER FOR MICROSCOPES

In the study of cultures of mycelia of fungi it is desirable that they be observed under the 4 mm. objective of the microscope without disturbing the hyphæ by transferring them to a microscopic slide and making a fresh mount in the usual fashion. The type of damp chamber described below has been found especially adaptable to this purpose. It affords a chamber of considerable volume, with a humidity which is constantly near the saturation point, and of such a proportion that the greater part of the enclosed space may be observed through the 4 mm. objective.

This damp chamber is a modification of the one used by Blaauw in his recent work on the growth and phototropism of roots. It is made by using a large-sized microscopic slide, 2 x 3 inches, and a large-sized No. 2 coverglass, 45 x 72 mm., such as are used for making mounts of brain sections. These two pieces of glass are separated by several layers of filter paper, the central portions of which have been cut out, so that the filter paper is in the form of a frame about 5 mm. in width. Slits in this frame may be made for the purpose of ventilating the chamber, if such is desired.

The mount is made by placing the filter paper frame on the slide, then dropping a bit of nutrient agar just on the inner edge of the frame and inoculating it with the fungus to be studied. The large-sized coverglass is then placed over the filter paper and the mount is bound together with white linen thread and placed erect in a tumbler containing a little water. It is desirable that the mount be kept in a place which is slightly cooler than the room in which it is to be examined in order that the condensation of water on the inner surface of the coverglass may not interfere with observations.

This damp chamber has been found by the writer to be an excellent means of preparing mycelia of fungi for use in general courses in botany. Mounts so constructed can be used repeatedly in successive sections of the same or different classes. For this purpose only the low-power, 16 mm., objective is necessary and therefore the coverglass referred to above may be replaced by another large-sized slide, making the damp chambers much less expensive. The details of the structure of the hyphæ are well shown, the normal position in which they develop, and the streaming of the protoplasm in the hyphæ of Rhizopus, for example, are very distinct. Also the general form and arrangement of the fruiting bodies may be studied here.

By making a slit in the filter paper frame at one end, this damp chamber may be advantageously used for the study of roots and root-hairs. A seedling with a radicle a centimeter or more in length may be inserted in the slit and development allowed to proceed. This method of the study of root-hairs even under low power is found to be far superior to the fresh mounts commonly used. The writer has found this damp chamber especially well adapted to the study of the relationship of fungous hyphæ to roots, both in the study of tropisms and in the actual observation of root-hair infections.

Clifford H. Farr
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THE COST OF GERMAN PUBLICATIONS

To the Editor of Science: Apropos of the cost of German publications to Americans, it may be interesting to note the cost of membership in the Deutsche Chemische Gesellschaft (including subscription to the *Berichte* and *Zentralblatt*) to Germans and to others. The figures are computed on to-day's exchange rate:

United States			$23.00
England	115	shillings	25.56
France	305	francs	25.28
Belgium	316	francs	24.74
Italy	536	lira	24.55
Norway	176	kroner	28.09
Sweden	104	kroner	27.14
Denmark	124	kroner	26.60
Holland	69	gulden	26.71
Switzerland	91	francs	17.47
Germany	370	marks	.81

It will be noted that Americans fare better than any other nationals except the Swiss. It might be added that in 1921 the subscription for Americans was $16.00.

But do the Germans expect us to believe that the disparity between the cost to themselves and to others is, as was stated by the president of the Gesellschaft, due to the low value of exchange?

Jas. Lewis Howe
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QUOTATIONS

SCIENCE AND THE TROPICS

From the late Mr. Chamberlain onwards, successive colonial secretaries have shown a far-sighted appreciation of what science may do for the tropics. The London School of Tropical Medicine, inaugurated and fostered by the Colonial Office, is now a world-center of research and education in the diseases prevalent in warm climates and the measures for resisting them. In another column Sir Arthur Shipley, now happily restored to economic zoology from his arduous and successful tenure of the vice-chancellorship of Cambridge, describes the work of the Imperial Bureau of Entomology, a product of a research committee appointed by the Marquess of Crewe when colonial secretary, and firmly established by the late Viscount Harcourt and Viscount Milner. Its local habitation is rightly placed at the Natural History Museum, which contains the finest collection of insects in the world. It is in close touch with every part of the empire, receives, examines, and identifies specimens sent to it, and acts as a general headquarters in the war against insects, whose successful prosecution is almost a condition of human existence. A third very practical application of science to the needs of the empire, due to the initiation of Viscount Milner when colonial secretary, applies specially to the tropics. A College for the Study of Tropical Agriculture is to open its first session at St. Augustine, Trinidad, this autumn. Last year we were able to welcome the constitution of a governing body to carry out the details of the scheme. Sir Arthur Shipley, chairman of the governors, and his distinguished colleagues have selected a competent staff and devised practical courses extending over three years for a diploma, and shorter periods for training in special subjects or for postgraduate research. The island of Trinidad has provided the site and a handsome grant towards the erection of the buildings, which are now complete. Private persons and commercial companies interested in tropical produce have made benefactions, and other West Indian islands are to contribute towards maintenance. But the benefits of the college in Trinidad will radiate far beyond the Antilles. The conditions of soil and climate which favor the luxuriant growth of tropical fruits, vegetable oils, rubber, and woods also favor the growth of animal and vegetable pests. Insects and moulds which no more than maintained existence in the jungle proliferate under the conditions of cultivation. Much can be done towards identifying and studying these in the museums and laboratories at home, and something also towards the devising of treatment.

But the detection of the early stages, discrimination between methods of treatment, and determination of the most suitable times and modes of applying these can be adequately pursued only in the field. The work of the professors of entomology and of mycology will be eagerly watched in many parts of the empire, and the men they train will have no difficulty in finding useful spheres when the demands of the West Indian islands have been satisfied.—The London *Times*.

SCIENTIFIC BOOKS

Mathematical Philosophy. A study of fate and freedom. Lectures for educated laymen. By Cassius J. Keyser. Pp. xiv + 466. New York: E. P. Dutton and Company.

The common saying, "What man would be a philosopher who might be a mathematician" does not seem to apply to the author of this book, who tells us in the preface that for more than two score years he has "meditated upon the nature of mathematics, upon its significance in thought, and upon its bearing on human life." The book is in the form of twenty-one lectures designed primarily for students whose major interest is in philosophy but it aims to appeal to a much wider circle of readers, including professional mathematicians and the "growing class of those natural-science students who are interested in the logical structure and the distinctive method of mathematics regarded not only as a powerful instrument for natural science but also and especially as the prototype which every branch of science approximates in proportion as its basal assumptions and concepts become clearly defined."

The last lecture of the book is on science and engineering. In this lecture the author considers various definitions of engineering and then proposes the following: *The science and art of directing the time-binding energies of mankind—the civilizing energies of the world,—to the advancement of the welfare of man.* The language of this definition portrays the type of language used throughout the volume. The reader may at times feel that the language is too flowery to convey much real information, but he will generally find that the words are far from empty. Even in the more mathematical parts of the book, where the author speaks of the infinite abelian group of angel flights and discusses the question whether mind is a group, will frequently disclose much careful thought in what might at first appear to be superficial statements.

Professor Keyser has for a long time been preeminent among American mathematicians as regards a certain type of popularization and the present volume is perhaps, up to the present time, his most successful effort along this line. The scientist who wishes to acquire a knowledge of the nature and bearing of some of the fundamental mathematical concepts without going deeply into the subject will find here a unique opportunity. It is true that this knowledge is here presented in a sugar-coated form and that there is a danger that some of the readers may not get within this coating, but it is to be hoped that many others will become really interested in the subject matter and will give it sufficient thought to derive a lasting benefit therefrom. Teachers of mathematics will probably find here attractive features of their own subject which had escaped their attention. In fact, the present writer found the lecture devoted to the group concept worthy of a second reading although he had given much thought to this particular concept before reading this lecture.

The book under review occupies a unique and useful place in the mathematical literature of to-day. It deals with a considerable number of fundamental mathematical concepts, including those of transformation, invariance, infinity, hyperspace, group, variable and limit. Considerable attention is given to systems of postulates and the properties which are essential to a genuine system. In particular, it is noted that the Hilbert system of postulates for geometry is not intrinsically superior to others. On page 43 our author refers to the system of postulates "devised by the late Professor Hilbert and found in his famous 'Foundations of Geometry,'" which would naturally be construed to mean that Hilbert died before the publication of this book. This is fortunately not the case.

In the preface to his "Easy Mathematics," 1906, Sir Oliver Lodge stated that "the mathematical ignorance of the average educated person has always been complete and shameless." One cause of this ignorance has been the lack of popular and reliable books dealing with serious mathematical subjects. By the publication of the present volume Professor Keyser has rendered a very notable service towards the supply of such popular books. He has introduced into the book at various places somewhat serious doses of mathematics but these places are probably sufficiently separated by non-mathematical material to hold the reader who would not be interested in a book restricted to real mathematics.

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SPECIAL ARTICLES

THE "WINTER CYCLE" IN THE FOWL

THE idea of the superimposition of a Mendelian factor or factors determining the egg production of the "winter cycle" upon the factors determining the egg production of the normal or "reproductive cycle" has become widely familiar as an explanation of the phenomenon of the inheritance of fecundity in the domestic fowl.

In recent years there has been much skepticism among geneticists concerning the validity of this hypothesis. Crucial evidence for or against it is difficult to obtain.

Some light may be thrown upon the problem by the determination of the correlations between the egg records of the various "cycles" in the first and second laying year. If the birds of a flock differ fundamentally among themselves by reason of the presence in or absence from the zygotes from which they developed of Mendelian genes or factors determining their winter egg production, it would be logical to expect that the highest inter-annual correlation[1] would be that of the winter period. This must be considered true under the theory stated unless the further assumption be made that genes of factors which determine egg production during the "winter cycle" of the first laying year have no influence in determining production during the "winter cycle" of the second laying year.

We have, therefore, determined all possible correlations between the total egg records of the "cycles" of the first and of the second year for a series of 443 White Leghorn birds, for which complete records for the first two laying years are available.[2]

The correlations appear in the accompanying table. These show that for all four periods considered there is a higher correlation between the records of homologous periods than be-

[1] Harris, J. Arthur: "The Value of Inter-annual Correlations," *Amer. Nat.*, Vol. 49, 707-712, 1915.

[2] An exhaustive series of correlations for the egg records of the individual months of the first and second year was determined some months ago and is now in press in *Genetics*. The correlations for the total productions of the "cycles" have been only recently determined, because of the difficulty of dealing with the moments of such large numbers without grouping.

BIRD'S FIRST YEAR

BIRD'S SECOND YEAR	Winter[3]	Spring[3]	Summer[3]	Autumn[3]	Annual
Winter	$+.3225 \pm .0301$ 10.71[4]	$+.0680 \pm .0335$ 2.02	$+.1269 \pm .0331$ 3.83	$+.3142 \pm .0303$ 10.36	$+.2955 \pm .0307$ 9.62
Spring	$+.1177 \pm .0332$ 3.54	$+.3293 \pm .0300$ 10.97	$+.2060 \pm .0322$ 6.39	$+.1874 \pm .0325$ 5.76	$+.2782 \pm .0310$ 8.97
Summer	$+.0976 \pm .0333$ 2.93	$+.3047 \pm .0305$ 9.99	$+.4272 \pm .0275$ 15.53	$+.2904 \pm .0308$ 9.42	$+.4026 \pm .0282$ 14.27
Autumn	$+.2535 \pm .0315$ 8.04	$+.0369 \pm .0336$ 1.09	$+.2679 \pm .0312$ 8.58	$+.5545 \pm .0233$ 23.79	$+.4115 \pm .0279$ 14.74
Annual	$+.3255 \pm .0301$ 10.81	$+.2352 \pm .0318$ 7.39	$+.3641 \pm .0292$ 12.46	$+.5127 \pm .0248$ 20.67	$+.5134 \pm .0248$ 20.70

[3] The conventional limits of these "cycles" are as follows: Winter, November to February; spring, March to May; summer, June to August; autumn, September to October.

[4] Ratio of correlation coefficient to its probable error.

tween those which are not homologous. They show, furthermore, that the correlation between the winter periods of the first and second year is the lowest of any of the four correlations between the productions of homologous periods. The difference between the winter-winter correlation and the spring-spring correlation is not large, but the differences between the winter-winter correlation and the summer-summer and the autumn-autumn coefficients are more substantial, the two latter being 2.57 and 6.10 times as large as their probable error.

In so far as this type of evidence is pertinent to the problem, it indicates that in the White Leghorn at least there is no evidence of special factors which distinguish the "winter cycle" from any other period of the year.

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THE EFFECT OF X RAYS ON CHEMICAL REACTIONS

While investigating with Dr. E. Dershem absorption coefficients for X rays, a brass cell with aluminum windows containing cyclohexanol was subjected to the X rays and afterwards opened. The contents showed very striking and unexpected consequences due to this exposure. The colorless hexanol had turned to greenish-blue, and later analysis showed that about 0.1 of a gram of copper had gone into solution.

The intensity of the X rays was so small, coming as a nearly monochromatic beam from a crystal grating, that the amount of chemical action produced was most surprising. The geometry of our apparatus and the power used by the X ray bulb enabled us to calculate the maximum energy which could be involved. Assuming the target and the crystal grating to be 100 per cent. efficient, and taking one hour as the maximum time exposure, the energy received by the cell could not be greater than 3×10^6 ergs, or less than 0.1 of a calorie.

Using the quantum theory, we may calculate from the wave length, approximately 0.2 Å, the number of quanta entering the cell. The energy per quantum is 1×10^{-7} ergs. Therefore the number of quanta received could not be greater than 3×10^{13}. Since about 0.1 gram of copper went into solution each quantum must have caused at least 3.3×10^7 atoms of copper to react.

The small amount of energy involved, and the small number of quanta relative to the number of atoms reacting, indicate that the reaction is an exothermal one. The quantum voltage producing the X rays was approximately 10^5 volts. Since each quantum caused 3.3×10^7 atoms to react, not more than 3×10^{-3} volts could be expended on each atom if the reaction were endothermal. This value is only one five-hundredth of the smallest known resonance potential, that for cæsium as determined by Foote, Rognley and Mohler,[2] being 1.48 volts.

We therefore must conclude that the X rays produced some sort of trigger action of the type studied by Bodenstein and Taylor[3] and by Jorissen and Ringer[4] in their work on the formation of hydrochloric acid from hydrogen and chlorine by means of alpha particles. An excellent discussion of this work will be found in a monograph by Lind.[5]

Mesitylene showed a behavior similar to that of cyclohexanol, but in this case the color was a yellowish green. This difference in color may be due to concentration effects.

On account of the large effect produced by relatively small amounts of energy, it seems that the use of X rays may acquire great importance in the production of organic compounds, especially if substances are produced in this manner which can not be obtained by other means.

A. R. Olson
National Research Fellow in Chemistry
University of California,

[2] Foote, Rognley and Mohler, *Phys. Rev.*, 61 (1919).

[3] (M. Bodenstein) and H. S. Taylor, *J. Am. Chem. Soc.*, 37: 24 (1915).

[4] Jorissen and Ringer, Ber., 39: 2095 (1906).

[5] S. C. Lind, *The Chemical Effects of Alpha Particles and Electrons*, Chemical Catalog Co., New York (1921).

THE FIFTEENTH ANNUAL CONFERENCE ON WEIGHTS AND MEASURES

THE Fifteenth Annual Conference on Weights and Measures was held at the Bureau of Standards on May 23 to 26 inclusive. In many respects, it was the most successful conference which has so far taken place.

At the opening session, the absence of Major Louis A. Fischer, formerly chief of the Weights and Measures Division, who died somewhat less than a year ago, was felt by practically all those in attendance, and it, therefore, seemed especially appropriate to devote this session to memorial addresses given by men who had been closely associated with him. The first of these was delivered by Dr. Stratton, director of the bureau, the second by Dr. C. W. Waggoner, of the State Department of Weights and Measures of West Virginia, and the last by Mr. D. J. Moynihan, who spoke on behalf of the manufacturers of weighing and measuring devices. A special committee presented resolutions memorializing Major Fischer.

Following these addresses and resolutions, the regular program of the conference was taken up, and reports were made by the delegates from the various state departments, approximately two hundred delegates from thirty states being present.

On the second day, an interesting paper was delivered by William F. Cluett, chief deputy inspector of weights and measures of Chicago, on the "Enforcement of sales by weight legislation and the elimination of the dry measure."

The feature of the afternoon session was an address by the Honorable Herbert Hoover, secretary of commerce, in which he emphasized the need for unity of action through organized conferences and established methods, and the importance, not only of the "prevention of crookedness and the catching of crooks" but also the protection of the honest producer and distributor.

The program included addresses by Mr. John N. Mackall, chairman of the Maryland State Roads Commission; Mr. Charles H. Ferris, of the National Bottle Manufacturers' Association; George Warner, chief inspector of weights and measures of the State of Wisconsin; F. S. Holbrook, of the Bureau of Standards; W. T. White, director of the Bureau of Weights and Measures of the State of New York; A. H. Vestal, chairman of the committee on coinage, weights and measures of the House of Representatives; Mr. W. B. McGrady, chief of the Bureau of Standards of the State of Pennsylvania; Mr. P. C. Brooks, president of the Scale and Balance Manufacturers' Association; Mr. J. J. Holwell, commissioner of the Mayor's Bureau of the City of New York; Mr. John M. Mote, Ohio state inspector of weights and measures; Ralph W. Smith, of the Bureau of Standards; and W. L. Egy and L. W. Higbee, of W. and L. E. Gurley.

Resolutions and thanks were tendered to the Honorable Herbert Hoover, Dr. S. W. Stratton and the Honorable A. H. Vestal, for their courtesy in addressing the conference.

A motion to the effect that the entire question of standardization and simplification, as applied to all phases of weights and measures activities, containers, standards, laws, methods of procedure, etc., be given special consideration at the next conference, was passed without a dissenting vote. The executive committee was directed by this motion to give special thought to this subject and arrange for a thorough presentation of the various factors involved so that the matter might be presented to the next conference in its entirety.

It was also voted that the second day of next year's conference should be devoted to the papers by and the activities of the city and county sealers of weights and measures.

The following officers were elected:

President: Dr. S. W. Stratton, director of the Bureau of Standards.

First vice-president: Mr. A. H. Webster, commissioner of weights and measures of the State of New Hampshire.

Second vice-president: Mr. W. B. McGrady, chief of the Bureau of Standards, State of Pennsylvania.

Secretary: Mr. F. S. Holbrook, Bureau of Standards.

Treasurer: Mr. J. Harry Foley, superintendent of weights and measures, State of New Jersey.

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CONTENTS

THE GEOLOGICAL SURVEY OF CHINA

In the process of reconstruction, and adaptation to modern conditions, which China is at present undergoing, the introduction of scientific research and, concurrently, the establishment of scientific government organs is absolutely essential to the success of the movement. To a narrow circle of interested mining men and scientists, it has long been known that the Geological Survey of China, established in 1916, has been making steady progress, both in the way of supporting the mining industry with expert advice, and in accumulating scientific data and material to such an extent that it has been recognized abroad as a factor in inaugural ceremonies by and in the presence ploration of the earth.

But the work of the Geological Survey has been carried on in quite an unostentatious way, and little has transpired about its activities outside of professional circles, until July seventeenth, when the institution was officially thrown open to the public, with appropriate inaugural ceremonies by and in the presence of H. R. President Li Yuan Hung.

Before giving an account of these exercises, it may be well briefly to review the development of the survey and its achievement up to the present time.

Geological Government Surveys have been established during the last half century in all civilized states. The principal aims of those institutions are threefold: namely, (1) to promote the knowledge of the mineral resources of the country, (2) to carry on a general geologic survey of the whole country upon a uniform scale, and (3) to undertake scientific geological research.

In the first of these fields the Geological Survey of China can already point to a creditable series of achievements, such as the discovery and survey of a large number of iron-ore deposits, which will soon be described in a monographic report, and the examination of numerous coal-fields, as well as metalliferous deposits. Among the latter are the antimony and mercury deposits, which have already been described in the bulletins issued by the survey.

The general geological survey of the country has so far been restricted to the province of Chihli, Shantung, Shansi, Bonan, and Kiangsu, the larger part of those provinces being already mapped. It is the intention of the survey to publish sheet maps of the whole of China upon the scale of one to one million, and four such sheets are now in preparation.

The scientific work of the survey has been confined principally to the study and description of the fossil remains occurring in the various geological systems, and to the determination of stratigraphic horizons. The survey has had the advantage of the cooperation of a famous paleontologist, Dr. A. W. Grabau, formerly professor of paleontology at Columbia University, who has made great progress in describing the invertebrate fossils.

A number of Swedish scientists, acting as associate paleontologists to the survey, have, with the Swedish fund, made extensive collections of fossil plants, fossil mammals and the remains of prehistoric man, and these are now being studied by them. The results of these studies, together with Dr. Grabau's investigations on the invertebrate fossils, will be published in "the Paleontologic Sinica," a series of monographs, which is intended to comprise, as far as possible, descriptions and illustrations of all the fossils of China.

Early in the history of the survey, the collections brought together by the field geologists, were arranged to form a small museum. This has grown constantly, until now it comprises 3,250 specimens of ores, minerals, rocks and fossils, properly labeled and exhibited under glass, in the compound of the Survey west city, Fong Shong Hutung, No. 3.

In order to bring together an up-to-date geological library, the director of the survey, Dr. V. K. Ting, approached private individuals as well as mining companies, requesting them to contribute to a library fund. Through their generous response, forty thousand dollars were collected, and with this fund Dr. Ting has been able to erect a modern library building and bring together a collection of geological literature comprising at present 8,873 volumes. President Li Yuan Hung has taken a leading rôle among the individual donators, while among the mining companies the Kailan Mining Administration stands foremost through the generosity of its donation.

It has been considered by the minister of agriculture and commerce, and by the director of the Geological Survey, that this institution has now reached such a stage of development that it is appropriate to throw the museum and the library open to the public. The opening ceremony took place on the seventeenth instant at four o'clock in the afternoon, in the lecture hall of the survey, and in the presence of a distinguished gathering of Chinese officials, headed by President Li Yuan Hung, who, himself a leading donor to the library fund, gave, by his presence, renewed evidence of his scientific interest and democratic spirit. Among other notable guests, we may specially mention the minister and vice-minister of agriculture and commerce, Their Excellencies Chang Kuo Kan and Chiang Tion To; the chiefs of the different departments of the ministry of agriculture and commerce; and delegates from other government museums in Peking, as well as many of the donators and other representatives of the mining industry.

The guests were welcomed by the director of the survey, Dr. Ting, in the following words:

"H. E. the President, Their Excellencies, the Minister and the Vice-Minister, our honored guests and my colleagues: It is my great privilege and pleasure to welcome you most heartily on behalf of the Geological Survey. First of all, I must thank the president, not only because he condescends to come to this ceremony, but also because he is one of the contributors to our building fund. In foreign countries it is not uncommon for the official head of the state to be present at the opening of a similar scientific institution, but, as far as I know, this is the first time in China that the President of the Republic honors such an occasion by his presence. This indicates the scientific interest as well as the democratic spirit of our president, for which we are sincerely grateful.

"Secondly, I must thank the donors to our building fund. Without their generous help we would be still without a library. Furthermore they have come here to-day in spite of this very hot weather, so that we may have an opportunity to thank them publicly, and to show them what we have done with their money. It proves the real interest they take in our institution. I may add that this is also the first time that private generosity has helped a scientific institution belonging to the government.

"Thirdly, I must thank my official superiors in the ministry of agriculture and commerce. In spite of the political changes that have taken place, they have always given us their support. They have not only provided us with sufficient funds in the time of great financial stringency, but they have also left to their responsible subordinate a great deal of freedom in administration, and in the appointment of the staff. Thus, with the exception of three men in charge of the business part of the institution, practically all the members are technical men. Again there is not a single extra man appointed beside the regular members, whose number is determined by the rules of the organization. Whatever result we have been able to achieve is entirely due to the confidence and guidance of our superiors.

"Fourthly, I take this occasion to thank the members of my staff for their loyal cooperation. Because of the smallness of the staff, we are not able to put men solely in charge of the library and the museum. Practically every member has done his part, in order to render this opening possible. During this summer all have worked, through all the day, instead of only half a day, as in most of the government bureaus, and recently they have even worked on the national holidays and on Sundays. I therefore tender to both my foreign and Chinese colleagues my personal gratitude, and desire to tell our guests frankly that the results of the survey, such as they are, have been the work, not of one or two men, but of all the members of the organization.

"For a summary of the history and the functions of the Geological Survey I refer you to the printed pamphlets. I wish only to tender to you once more our sincere thanks, before I respectfully request the President to deliver his address."

Following Dr. Ting's welcoming remarks, H. E. the President of China declared the Geological Survey Library and Museum opened to the public in the following words:

Geology is by no means a new science in China; indeed, it originated here in very ancient times. In the book of Yu, the nature and color of soils were carefully discriminated. In the Chow Dynasty, a mining and geographical staff formed an important branch of the government organization. The book of Kweitzu touches even on the principles of ore deposition and the manner of locating ore deposits. Since the Dynasty of Han and Wei, trained specialists on copper and silver were constantly employed by the government. Though their knowledge was fragmentary, and their results frequently inconsistent with modern ideas, we can not help thinking that the achievements of those pioneer workers entitles them to be considered as forerunners of the great army of investigators in the modern science of geology. It is only because of the lack of system in the methods of study of the ancient Chinese, that we are at present far behind other countries in this branch of science. As a result of this neglect in the development of this important branch of knowledge, our people remain poor and miserable, because we are not equipped with the necessary knowledge to develop our vast resources, which are at present almost untouched.

As is well known, geology is most intimately related to mining, while mining is the foundation of a nation's prosperity. Important and fundamental though they are, our government has paid no attention to such investigations until very recently.

The Geological Survey of China was organized in 1913, two years after the revolution. Having spared no efforts to overcome the many and serious obstacles in its path, this survey has now reached its present enviable position. This is due entirely to the efficient administration of its officers, and the ambitious labors of all its members. Under almost all kinds of difficult conditions, the members of the survey have willingly and earnestly enlisted to perform their duty—the work of collecting facts and materials, the mapping of many districts, and the study of the various problems connected with the mining industry. Recently the survey has purchased a large number of books in Europe, America and Japan, to serve the needs of its ever growing activities. In 1920 the new museum and library were established, this being made possible by contributions from outside sources. With these facilities, the survey is now able to arrange, in systematic manner, all the minerals, ores, rocks, fossils and books collected from time to time.

To-day is the opening day for the public exhibition of the newly established museum and library, and I have the great honor to be present on this occasion. I found in the library books on diverse phases of the science of geology and its kindred subjects, well classified and arranged, and in the museum, specimens of almost all the varieties of minerals, rocks and fossils of this country, accompanied by descriptive matter and illustrative maps and sections. It is really a wonderful and marvelous exhibit. I am very sure that both the industrial and the scientific world will be greatly benefitted by the existence of such an organization as this. May I congratulate you, my dear members of the survey, on the success of your work, and the opportunity you have for the future development, in this country, of science and industry—for those are the foundations of our nation's prosperity.

The next speaker was H. E., Chang Kou Kan, the minister of agriculture and commerce, who spoke as follows:

Geological investigation of the country is a technical and scientific subject, as well a necessary branch in the government organization. In order to lay the foundation for industries depending on natural resources, and to point the way for their development, such investigation is absolutely essential. When I myself served as the head of the ministry in former times, I tried hard to promote this kind of investigation. Owing to the lack of funds, however, this organization was not able to expand as it should have. Now the President has taken the lead, followed by many of our mining people, in contributing towards the building of the library, and the expansion of the museum. All signs indicate that the nation as a whole places great hopes in the Geological Survey. It is to be expected that the survey will expand its work, and to complete the geological atlas, and the geological maps of the important mining regions, so that both the industrial and the scientific world will be profited. Thus we shall be able to realize what the president has so earnestly hoped for. Great credit is also to be given to those who have made contributions towards the realization of this aim. Such cooperation between private individuals or companies and the government is perhaps the first of its kind ever practiced in this country.

The next address was delivered by the vice-minister of agriculture and commerce, H. E., Chiang Tien To, who expressed himself as follows:

The main duty of our ministry is to develop our natural resources, thereby making our country a prosperous one. There are many ways that lead to this desired end, but the survey of the geology of the country is one of the most important. In the study of geology we must pay attention not only to field work, but we must also carry on scientific research work. It is for this reason that the geological surveys of other countries are all equipped with modern libraries and museums. The museum of this survey has been established for many years and I have personally visited it several times. I found in it specimens of ores and rocks from all parts of China, furnishing a very good foundation for research. Owing to lack of funds, the survey has not been able previously to build a library. Now the president has taken the lead, together with many gentlemen prominent in the industrial and mining circles of this country, in contributing to this survey the funds which have made possible the erection and equipment of this building. From now on the members of the survey, besides doing field work, will also be able to carry on accurate research work under adequate conditions. I am sure that the results thus obtainable will be profitable to both the industrial and the scientific world. It is hoped, therefore, that the members of the survey will work with renewed enthusiasm, and give of their best, so that the high hopes of the president and the minister may be realized to their fullest extent.

Mr. C. Y. Yen, the industrial commissioner of Chihli, spoke next and expressed his admiration of the work already accomplished by the Geological Survey, not only in building up a very efficient organization but also in contributing actively to the industrial development of Chihli province.

Mr. E. J. Nathan, the representative of the Kailan Mining Administration, the largest donator among the mining companies, expressed his deep satisfaction with the well arranged museum and considerable library which the survey had already been able to bring together. He was convinced that the Geological Survey of China, which had already done so much for the discovery and survey of mineral deposits, will in the future prove a powerful factor in the development of China's mineral industry.

General Yen Chang, formerly minister of war, explained in an eloquent address the importance of the systematic examination and development of the rich treasures which are hidden in the rocky ground of China. The effective organization of the Geological Survey gives good hope that the public will have excellent scientific help in the promotion of the national mineral industry.

After the opening ceremony the president, followed by the other guests, made a tour of inspection of the library and of the museum.

H. T. Chang,
Acting Director

Peking,
July 17, 1922

AGGLUTINATION AND TISSUE FORMATION

For a considerable number of years the principle underlying our analysis of tissue formation—undertaken with the view of contributing to a physiology of tissues in contradistinction to a physiology of organs[1]—was the suggestion that primarily agglutination is the factor which makes isolated cells join into a tissue, and that this agglutination depends on a certain consistency of the outer layer of the cell protoplasm[2]. In an analysis of tissue formation it was thus necessary to determine the factors on which this consistency depends and we showed that it is a quantitatively variable factor, that this variability is a prerequisite in amœboid movement and that the same agglutinability which determines tissue formation is the cause of what we have called stereotropism of tissue cells, their tendency to move in contact with solid surfaces.[2] Tissue formation, stereotropism and amœboid movement are therefore related phenomena, all depending on a certain variability and regulation in the consistency of the outer layer of the protoplasm. As a step in this investigation we prepared an experimental amœbocyte tissue which consists of motile bloodcells of invertebrates and which readily admits of an experimental analysis of all these associated factors.[3] The basic laws of tissue formation must apply equally to the various kinds of growth, embryonic, regenerative, correlative and tumor growth.[4]

Tissues are primarily aggregates of agglutinated cells. Secondarily certain differentiations may occur which concern the individual cells as well as the connections between these cells. Elementary tissues and even structures resembling particular tissues in certain respects, can be produced from isolated amœbocytes under conditions which we have described in detail elsewhere. Under the influence of environmental changes the consistency of the outer protoplasmic layer of these cells is altered in such a way that it becomes sticky. In this experimental tissue various processes which occur in natural tissues can be imitated. A state of the outer parts of the protoplasm intermediate between liquid and solid is essential for tissue formation, because it insures that degree of adhesiveness necessary for this process. Agglutination is likewise the basic factor, which insures the possibility of the formation of paraplastic structures in which the products of adjoining cells are united into a homogeneous whole.

We showed that the movements of tissue cells take place in contact with surfaces which are solid or approach the solid state, such as fibres. We designated this mode of reaction as stereotropism of tissue cells (1898), and attributed to it a significant part, not only in wound healing, but also in processes taking place normally in the organism whenever movements of tissue cells occur.[5] This stereotropism is apparent not only in normally motile cells, but even in cells which are normally in a fixed condition but which are made to move under conditions which imply a change in environment; it is self-evident that this includes also those environmental changes which take place during embryonal development. We found that this stereotropic reaction can

[1] *Biological Bulletin*, 1903, IV, 1301, Virchow's Archiv. 1903, CLXXIII; 135 Anatomical Record 1912 VI, 109.

[2] Washington University studies 1920, VIII, 3. *American Journ. Physiol.* 1921, LVI, 140. Science 1921, LIII, 261.

[3] Washington University Studies, 1920. VIII. 3 Science 1919 L. 502. *American Journal Physiol.* 1922, LX, 277.

[4] Virchow's Archiv. 1903, CLXXIII, 135. *Journ. Med. Research*, 1917, XXXII, 75, 1920, XLI, 247. *Journ. Cancer Research*, 1920, V, 261. Science, 1922, LV, No. 1410.

[5] Archiv. f. Entwickelungsmech. 1898, VI, 297. 1902, XIII, 487. *Anatomical Record*, 1912, VI, 109. M. S. Fleischer and Leo Loeb. Proc. Soc. Exp. Biol. and Med., 1911, VIII, 133.

be induced and modified experimentally in the amœbocytes and that it depends upon changes in the consistency of the protoplasm, which tend to make it sticky. Stereotropism is therefore an expression of the same factor which leads to the agglutination of isolated cells with each other, which latter results in tissue formation.

The stereotropism of tissue cells depends upon their ability to carry out amœboid movements. On the basis of our observations and experiments we concluded that in amœboid movements, cyclic changes in the consistency of those parts of the protoplasm take place which are concerned in this activity.[6] With these changes there must be associated corresponding changes in the agglutinative power of the tissue cells. The factors underlying amœboid movements are therefore closely related to those determining agglutination and tissue formation; but while in the latter usually the whole surface of the cell is in a viscous state, the cyclic changes in consistency and viscosity of the protoplasm are localized and thus lead to the formation of pseudopods. In modifying this amœboid movement experimentally we have shown that its character varies with the consistency of the protoplasm; only if the latter approaches the liquid state can surface tension play a part in the amœboid movement; but during certain phases of the process the consistency of the protoplasm is so great that the laws of surface tension, as they have been defined for the liquid state of matter, cannot play an essential part in amœboid movement.[7]

Related to amœboid movement but not identical with it, is the spreading out of tissue cells, which occurs under certain conditions, when the cells are in contact with solid surfaces. This process can likewise very conveniently be studied in amœbocytes. Both amœboid movement and spreading out depend upon changes in the consistency of the protoplasm. The spreading out in particular depends upon a softening and relaxation of the outer layer of the protoplasm. Usually this spreading out goes hand in hand with amœboid movement; yet both processes can to a certain extent be separated from each other experimentally. As we have shown, it is possible to increase the consistency of the protoplasm in such a way, that the spreading out is prevented or very much delayed, while amœboid movements are still quite active. Addition of definite amounts of acids to the medium in which the amœbocytes are held, may have this effect. However, in influencing the consistency of the outer layer of the protoplasm as a whole, for instance through the addition of acid, we may also influence the character of the pseudopods in a corresponding manner. Addition of slight amounts of alkali favors very much the extension of the cells by softening the consistency generally.[8] Again the consistency of the outer layer of the spreading out cell is such that adhesiveness results; thus an agglutination of the spreading out cells to the base on which they rest is assured. This spreading out is an important factor in tissue formation and during embryonic development the formation of the mesenchyme depends upon such a transformation of the more or less rounded off blastomeres into cells, which not only assume amœboid movement, but at the same time spread out. We have previously called attention to the importance of changes in agglutinative properties of cells during embryonic development, in which a change takes place from agglutinated round cells, which stick to each other with certain parts of their circumference, to cells spreading out in contact with a solid or viscous substratum.[9]

It can be shown that the stickiness and therefore the agglutinability of cells is a variable factor; but the degree of this variability differs very much in different kinds of cells and under different conditions. We have found that this variability is very great in the case of amœbocytes. In the circulating blood they are not sticky; but as soon as the environment is altered they become sticky, show amœboid movements and agglutinate to each other and to other structures. We have every reason to believe that, while these variations in stickiness are less marked in the majority

[6] *Journal Med. Research*, 1902, VII, 145.

[7] Washington University Studies, 1920, VIII, 3.

[8] *American Journal Physiol.* 1922, LX, 277.

[9] Science, 1922, LV, No. 1410.

of cells, great variations occur generally. Thus in the resting stage, the endothelial cells lining blood and lymph vessels present a perfectly smooth surface and other cells pass them freely without adhering to them. But when certain changes in the environment occur, these cells may become amœboid and migrate adhering to surfaces; or they assume phagocytic properties, which likewise presuppose certain changes in the surface consistency. It is very probable that similar changes occur in all epithelial or connective tissue cells, when they change from the resting state to the active state of amœboid migration, adhering to surfaces with which they come in contact. Amœboid movement as such implies, as we have shown, a cyclic, localized change in the consistency of the cell and it can be shown that the stickiness of the pseudopod may be greater than that of the rest of the cell. In the majority of the cells the variation in consistency and stickiness is less marked than in the case of the amœbocytes, because they are already naturally in the state of tissue components, adhering with certain parts of their surface to neighboring cells. This applies already to the blastomeres of the dividing egg, in which some parts of the outer layer have such a degree of viscosity that the segmenting cells remain united. The union of cells in resting tissues may be accomplished by means of secondary differentiations, which lead to the production of special structures. There is reason for believing that when, under the influence of certain stimuli these cells enter into the state of amœboid movement, these differentiations are at least partially lost and this implies a change in the condition of the outer layer of the cell, which exhibits amœboid movement and on which the agglutinability, and therefore stereotropism, depends.

Such changes in environment which lead to amœboid movement, alterations in consistency of protoplasm, stereotropic response, play a great part in pathological conditions, in inflammation, wound healing, and tumor growth, in all of which cellular stereotropic movements are a significant factor. Under natural conditions these movements occur not only during embryonic development in various types of cells, but also in the adult organism, for instance in the ovary during atresia of the follicles, in the endothelial cells of the corpus luteum during the formation of blood vessels and in the lymphocytes migrating through epithelial surfaces.

It is possible further to analyse some of the factors and especially the significance of agglutination in the formation of certain tissue structures. In general, cell division not accompanied by amœboid movements tends to the production of epithelial surfaces. Tissues which show active amœboid and spreading out movements, may produce structures which differ according to the relative degree of agglutinability and energy of amœboid movement present. If the amœboid motility is very marked in proportion to the degree of adhesiveness, we tend to have tissues of a more or less loose character. Thus the fibroblasts are connected with each other through relatively small areas of contact, while they are sending out long pseudopodia and moving freely along solid bodies. In epithelial tissues, or in tissues of similar morphological character, the preponderance of amœboid motility over the adhesiveness of the cells is much less pronounced and these cells are therefore joined together in wider surfaces of contact and may form more or less connected layers. The same differences we find between the growth of sarcoma cells, which behave similarly to fibroblasts, and carcinoma cells which are epithelial in character. Great stickiness may lead to the formation of cell clumps, and if it is associated with a tendency to amœboid movement and spreading out of the adhesive cells, it may lead to the formation of tissue layers, in which strands of spread out cells form a net. This net formation is due to the fact that the cells move away from the cell clumps, which serve as centers, and form thus secondarily strands of spread out cells, which connect with each other.

In the process of tissue formation, such as we observe in tissue growing in culture media in vitro, two phenomena are noticeable in outgrowing cells, (1) the stereotropism, which leads the cells to grow in contact with solid surfaces, (2) the tendency of the cells to grow out in a centrifugal direction away from the piece of tissue implanted; thus a more or less radial and often tree-like branching arrangement of the outgrowing cell strands is produced. We have discussed above the stereotropic response. The centrifugal arrangement can be conveniently studied in amœbocyte tissue. Several years ago we tested experimentally the possible significance of the galvanic current and differences in electric potential in the centrifugal direction of cell migration. Our results were negative, neither did the direction of light rays influence the movements. It is very probable that the centrifugal growth depends upon the following two factors, (1) the tendency of the cells adhering to each other to separate, to send out pseudopodia and to move in such a direction that two or more cells forming a clump become isolated, (2) the tendency of a healthy cell to continue for a certain time to form pseudopods at the same part of the cell at which this process has been induced. These two factors, the existence of which observation of the moving cells verifies, would be sufficient to produce the centrifugal movement, which would thus partly represent a statistical chance phenomenon. Inasmuch as the isolated cells and the cell clumps become less frequent with increasing distance from the central piece, this would insure a centrifugal, more or less net-like growth, or in other cases a tree-like growth, such as we found under various conditions. We may assume that the same factors play a role during the growth within the organism.

Tissue formation depends upon a combination of cell movements and cell divisions. We have seen that contact with a solid base is a prerequisite for the outgrowth of tissues; but in addition we found more recently that in various tissues growing in vitro, a very active mitotic cell division may be induced in favorable liquid culture media supplied with a sufficient amount of oxygen, even under conditions which do not permit an active outgrowth because of the lack of a solid surface along which the cells would be able to migrate.[10]

While it is thus possible to separate experimentally mitotic cell proliferation and migration of cells in tissue cultures, the same stimulus usually tends to produce both of these reactions together. A suitable change in environmental conditions usually brings about alterations in the cells, which lead to both mitotic cell division and migration in tissues, provided they are capable of both of these activities. The difference in actual response on the part of different tissues depends upon the structure of the tissue, which enables certain kinds of cells to migrate very readily and to divide only with difficulty or not at all, and other tissues to divide much more readily than to make amœboid movements.

The stereotropic reaction of tissue cells to an environmental change consists of two component parts, (a) of amœboid movement and (b) of alterations in the consistency of the outer layer of the tissue cells; the latter change may vary very much in different cases. In some cases a previously non-sticky surface may become sticky as the result of the environmental change (as in amœbocytes, the free surface of endothelial cells, perhaps in lymphocytes and certain other cells), while in other cases a certain degree of usually circumscribed adhesiveness pre-existed, but became more general or stronger as the result of the environmental change.

These changes in motility and adhesiveness are responses of a living organism to a stimulus. This is quite apparent in the case of the amœbocytes and in the reactions of the experimental amœbocyte tissue, where a mechanical stimulus leads to that far going alteration in cell consistency, which makes possible both stereotropic reactivity and tissue formation; but in principle, conditions are similar also in the case of other tissues.

Leo Loeb

Washington University

[10] Leo Loeb and Moyer S. Fleisher, *Journ. Med. Research*, 1919, XL, 509.

THE SHENANDOAH CAVERNS

The exhibition of caverns to the traveling public is noted by the United States Geological Survey as a growing industry in the Shenandoah Valley of Virginia. The famous Valley Pike, now a link in the New York to Atlanta highway, is traversed yearly by thousands of automobile tourists, and no one has adequately seen America who has not visited one or more of the caverns in the Shenandoah Valley. Until recently the only caverns that were accessible to the public were the celebrated Luray Caverns, in Page County, and Weyer's Caves, in northern Augusta County, near Grottoes. However, within twelve months, the Endless Caverns, near New Market, in Shenandoah County, have been opened, and on May 31 another cavern near Mount Jackson, also in Shenandoah County, made its first bid for public favor.

The latest-opened caves have been named Shenandoah Caverns. They are about three miles south of Mount Jackson and two miles west of the Valley Pike, with which they are connected by a macadamized road. The visitor descends into these caverns by a concrete stairway and soon sees the first stalactites, which appear as stout daggers of crystallized lime carbonate, hanging like icicles from points where surface water drips from the limestone roof. At the foot of the stairs is the spacious anteroom to a long chain of high-vaulted chambers connected by narrow passageways, forming in general plan a gigantic letter S, all illuminated by cleverly concealed lights. Attractive natural decorations are found in every room. Here the side walls are covered by fluted veneer done in crystal stucco, there in graceful drapery hang creamy lambrequins in ruddy-tinted stripes. From place to place, singly or in groups, are pendent stalactites and uprising stalagmites—the first inverted narrow cones fed by trickling films of lime-bearing water; the second pillars or columns fed by spattering drops of the water. In one room midway down the chain the show piece is a narrow 30-foot cascade of white glittering crystal flanked by twin falls of pale translucent ocher. At the base and to the rear of this diamond cascade, visible by peering between slender columns of oriental alabaster, is the "Fairy's Secret," a tiny pool illuminated in due season by animated torches, presumably carried by a brood of phosphorescent larvæ of some insect, perhaps a small fly that is commonly present in such caverns. At the end of the developed portion of the cavern a chamber of high vaulted roof suddenly gives place to a low-ceiled room containing a lakelet in which are mirrored a multitude of delicate stalactites—a pool of a thousand crystal pendants.

According to A. C. Spencer, of the United States Geological Survey, the caverns of the Shenandoah Valley are far more numerous than the casual visitor would be likely to imagine. The rocks in which the broad trench-like valley has been excavated by water are mainly limestone, and wherever these rocks occur the existence of caverns is indicated by two unfailing signs—the presence of innumerable water sinks and the absence of brooks tributary to the rather regularly spaced creeks. The brookless tracts receive a due share of rainfall and must obviously contribute water to maintain the flow of the creeks and rivers, but their contributions are not delivered by way of the surface drains, but through underground channels that supply copious springs in the deep valleys. The sinks are rude funnels, by means of which surface waters are diverted to the subterranean waterways.

The development of extensive underground waterways in limestone formations like those of the Shenandoah Valley hinges upon the two geologic facts that large masses of rock are always cut by joints and that limestone is dissolved by rainwater, which always contains more or less carbon dioxide. Surface water entering fissures, joint cracks and bedding planes attacks the limestone walls and thus by a process of etching converts close fractures and joints into relatively open crevices. As this process of solution goes on lateral connections will be made from crevice to crevice, and the downward etching of the linked openings will be halted only when the subsurface water channels have become closely adjusted to the water table controlled by surface streams. Thus it is that the caverns of the Shenandoah Valley are formed.

THE SALT LAKE CITY MEETING

The sixth annual meeting of the Pacific Division, American Association for the Advancement of Science, held at Salt Lake City, June 22 to 24, 1922, in conjunction with a summer session of the national association, was perhaps the most successful meeting since the organization of the division and, in the opinion of those who attended at least, thoroughly justified the policy of the Executive Committee, maintained in the face of some opposition, to hold the annual meetings in rotation in widely separated centers of population throughout the Pacific Coast region.

While Salt Lake City is somewhat isolated geographically with respect to the major portion of the membership of the division, and its inaccessibility prevented the attendance of many who would have attended a meeting in a coastal city, nevertheless the number in attendance exceeded the expectations of the committee and comprehended a very good representation of the active scientists of the Pacific Coast. Besides, owing to the cooperation of the National Association which called a summer session at the same time and place, many distinguished men attended from the middle west and eastern points.

The general sessions and the meetings of the affiliated societies were accommodated at the University of Utah, which is beautifully located in the eastern part of Salt Lake City on a plateau commanding a view of the great valley which is geologically famous as Ancient Lake Bonneville.

Eleven affiliated societies united with the Pacific Division in holding meetings upon this occasion as follows:

The American Physical Society.

American Meteorological Society.

American Phythopathological Society, Pacific Division.

Ecological Society of America.

Pacific Coast Entomological Society.

Pacific Slope Branch, American Association of Economic Entomologists.

Pacific Division, Physiological Section, Botanical Society of America.

Seismological Society of America.

The Society of American Foresters.

Utah Academy of Sciences.

Western Society of Naturalists.

Sessions of extraordinary interest were reported in each case and many significant papers were presented which it is hoped will find publication in the various technical journals if not in the organs of the association.

In addition to the regular meetings of the affiliated societies there was a meeting of the agronomists and soil experts which resolved itself into an "Alkali Congress" in which the experience in reclaiming alkali soils in various sections of the west was presented with great mutual benefit. It was determined to organize a permanent association which would affiliate with the Pacific Division and hold regular meetings in future.

The general sessions of the Pacific Division were well attended and of more than usual interest. Dr. John A. Widtsoe addressed the Research Conference, speaking on "The research problems of the Great Basin."

The address of the retiring president, Dr. Barton Warren Evermann, on "The conservation and proper utilization of our natural resources," provoked a warm eulogium from President George Thomas, of the University of Utah, and from Dr. L. O. Howard. A pleasant feature of this session, which came as a surprise to the recipients no less than to the audience, was the conferring of the degree of doctor of laws upon Dr. Barton Warren Evermann, president of the Pacific Division and director of the Museum of the California Academy of Sciences, and Dr. James Harvey Robinson, associate of the New School for Social Research of New York City. With impressive ceremony the degrees were conferred by President George Thomas, of the University of Utah, who stated that the honor had been conferred but six times previously in the history of the university.

Of peculiar interest and significance at this time was the session devoted to the symposium on "The Problems of the Colorado River." The great reclamation project, which contemplates the utilization of the waters of the Colorado River for power and irrigation, involves the more or less conflicting rights of seven states. The thorough discussion of the scientific phases of this subject was of absorbing interest, and will prove to be a direct contribution to the furthering of the project. The papers presented in this symposium will doubtless be published in Science.

A notable feature of the convention was the address by Dr. James Harvey Robinson, which appeared in a recent number of Science.

Announcement was made of the election of Dr. E. C. Franklin, professor of chemistry, Stanford University, as president of the Pacific Division for the ensuing year.

A resolution was unanimously adopted expressing appreciation and gratitude to the University of Utah, the Brigham Young University, the Utah Academy of Sciences and the Utah Agricultural College, who acted as hosts to the convention. The great success of the meeting was largely due to their very efficient handling of the arrangements.

Dr. Robert G. Aitken, astronomer of Lick Observatory, was elected a member of the Executive Committee in place of Dr. W. W. Campbell, whose term expired.

The thoughtful hospitality which marked the reception and entertainment of visiting members reached its climax on the last day of the convention, when automobiles and lunches were provided and the visitors who had previously designated their choice of several all-day excursions were conveyed under the guidance of scientific experts to points of interest in this famous region of geological records and scenic wonders.

An organ recital in the Mormon Tabernacle and a dip in Great Salt Lake in the cool of the evening brought the final day of the convention to a close.

There was a total registration of about 400, of which 110 were members of the association.

The publicity afforded through the local press of Salt Lake City was very gratifying. Each year there is apparent a wider general interest in the proceedings of the annual meeting which promises well for its future usefulness.

W. W. Sargeant

SCIENTIFIC EVENTS

THE INTERNATIONAL RESEARCH COUNCIL

In an article in *Nature* it is stated that a meeting of the International Research Council was held at Brussels on July 25 and the four succeeding days, under the presidency of M. E. Picard, secretary of the Académie des Sciences, Paris. Twenty countries have now joined the International Research Council, the following seventeen being represented at the meeting: Belgium, Canada, Denmark, France, Great Britain, Greece, Holland, Italy, Japan, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United States of America, and Czecho-Slovakia.

The greater part of the business of the meeting was concerned with the organization of international scientific unions additional to the five for Astronomy, Geodesy and Geophysics, Chemistry, Mathematics, and Scientific Radio-Telegraphy, which are already in activity. As a result of the meeting the formation of unions for Pure and Applied Physics and for Geography is said to be assured. The proposed union in Geology awaits the consideration of the Geological Congress, and some advance has been made in connection with the biological sciences.

At a previous meeting of the International Research Council it had been provisionally agreed to unite medical and biological sciences; this decision did not find favor, and the intention now is to separate medicine from physiology, zoology and botany. Proposals will be submitted to the countries belonging to the Research Council, and the ultimate formation of this union will depend on the number of countries willing to join.

Among other matters dealt with, a proposal submitted by the National Research Council of the United States and accepted by the meeting may prove to be an important addition to the responsibilities of the Research Council, which hitherto contented itself with the formation of unions which became practically autonomous as soon as their statutes were approved. As problems in which several unions were concerned ran a danger of being neglected, the proposal was now made by the United States that the Research Council itself should take such problems under its own special protection. Three inquiries were mentioned as likely to fall within this category. One of them had already been considered by the International Astronomical Union, which requested the Research Council to make arrangements for a collaboration of several of the unions in the study of the correlations between solar and terrestrial phenomena. The second referred to the energy supply of the world (fuel, solar energy, etc.), while a third suggestion dealt with the difficult and complicated question of international patents. The risk of overlapping efforts and the possible fear of interference with the special work of the unions is avoided by the provision—now coming into force—that the executive committee of the Research Council, which hitherto consisted of five members, should be enlarged, each union nominating an additional member.

At the concluding meeting the five members of the executive committee appointed by the general assembly were elected as follows: M. E. Picard (president), Mr. G. Lecointe and Professor Vito Volterra (vice-presidents), Dr. G. E. Hale, and Sir Arthur Schuster (general secretary).

THE ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS

The sixteenth annual convention will meet September 11 to 15 at Cleveland, Ohio, at which time there will be presented and discussed subjects dealing particularly with steel mill problems.

The papers have been written with a view of giving to the engineers as much practical data as is possible, feeling that this class of information is far more beneficial than the theoretical side when dealing with steel mill problems.

Some of those who will present and discuss the subjects are Dr. C. P. Steinmetz, Messrs. B. G. Lamme, Wilfred Sykes, A. G. Witting, F. C. Watson, D. M. Petty, L. W. Heller, R. B. Gerhardt, D. B. Rushmore, J. B. Crane, E. R. Fish, H. M. Rush, R. M. Butler, F. Hodson, Professor Edgar Kidwell, F. W. Cramer, A. R. Leavitt, E. T. Moore, R. H. Bauer, F. A. Wiley, L. F. Galbraith and R. S. Shoemaker.

A tentative list of the subjects to be presented are:

Improvement in Efficiency of Electric Power Supply.

A Review of Steel Mill Electrification.

Boiler Practices of 1922.

Education and Safety.

The Gas Engine as a Prime Mover for Power Generation.

Steam Turbines.

Judging Combustion from Gas Analysis.

Electrification of the International Nickel Company's Works for Monel Metal.

Some Considerations in the Electrification of the Steel Plant Railroad Yard.

Power in the Iron and Steel Industry.

Control—Motor—Lighting and Crane Standardization.

Electric Furnaces.

Electrical Developments in 1922.

Investigation of Insulators for Steel Mill Service.

In addition to the technical sessions, there will be an exhibition of apparatus of particular interest to the steel mill engineers. This exhibit will cover approximately 30,000 square feet of floor space and will be held in the same hall as is the technical sessions.

Representatives from practically every steel mill in the United States are expected at this convention for it is planned to interest practically every class of engineer, such as general managers, general superintendents, department superintendents, chief engineers, steam engineers, electrical engineers, electrical superintendents, mechanical engineers, master mechanics, superintendents of power, engineers of tests, safety engineers and department foremen.

THE AMERICAN ELECTROCHEMICAL SOCIETY

The meeting will be opened by President Schluelerberg at Montreal on Thursday, September 21, and the technical program will proceed with the presentation and discussion of papers on electrolysis and electroplating. The recently organized Division on Electrodeposition (G. B. Hogaboom, *chairman;* Wm. Blum, *secretary*) will be well represented and take active part in the discussion of these papers.

One of the papers of the Thursday morning session will deal with the physical properties of electrolytic iron—a product which is being turned out commercially, contrary to all predictions of ten years ago. There will also be papers on zinc, brass and other electrodeposited metals.

On Thursday afternoon and Friday morning a symposium on "Industrial Heating" will be in progress. The Electrothermic Division

(Bradley Stoughton, *chairman;* Colin G. Fink, *secretary*), which held a most successful symposium on "Electric Cast Iron" at the Baltimore meeting, in April last, will again be in charge. Twelve papers especially prepared for this session and dwelling on industrial heating in electric furnaces, other than fusion and melting furnaces, will be placed open to discussion.

There will be papers on:

a. History of industrial heating.

b. Principles of design of furnaces.

c. Comparison of fuel costs in different types of electric furnaces, and with combustion furnaces. (In this connection, electric energy would be estimated as a "fuel cost.")

d. Resistor materials.

e. Specific heats.

f. Electric conductivity of insulating materials at industrial furnace temperatures.

g. Heat emissivity.

h. Heat transfer.

There will be an excursion to Shawinigan Falls, affording members an opportunity to inspect the various industrial plants of one of the most progressive centers on the continent. It is planned to have a special train for this all day trip from Montreal.

A popular lecture on "Progress in physical science" is scheduled for Thursday evening. Section Q will be in charge of an old-fashioned smoker on Friday evening.

The headquarters for this meeting will be the Hotel Windsor. Members and guests are urged to make their hotel reservations immediately.

THE BIOLOGY CLUB OF THE OHIO STATE UNIVERSITY

DURING the academic year of 1921-1922, the Biology Club of the Ohio State University held monthly meetings from October to May inclusive. Considerable interest was manifested in the programs, to which contributed various members of the biological and related departments, and some graduate students doing original research in these departments. The following papers were presented:

October 3: "Experiences in England, with observations on the status of botanical research and interest there," Professor A. E. Waller.

November 7: "The ductless glands," Professor R. G. Hoskins; "The work of the Ohio State Fish Survey," Professor R. C. Osburn.

December 5: "Glaciation of the San Juan Mountains, with notes of paleontological and natural history interest," Dr. R. F. Webb.

January 9: Reports of the zoological and entomological meetings and other sessions and general meetings of the American Association for the Advancement of Science, at Toronto, Professor R. C. Osburn, Professor F. H. Krecker, Professor D. M. DeLong, Professor C. H. Kennedy.

February 13: "The problems of biology from the standpoint of a philosopher," Professor A. E. Avey.

March 6: "The distribution of the dragon flies of the Put-in-Bay region," Professor C. H. Kennedy; "The reactions of house flies to radiant heat," Professor W. M. Barrows.

April 3: "The physiology of the guard cells of *Rumex patientia*," Mr. J. D. Sayre; "The nature of twig abscission in cottonwood, *Populus deltoides*," Miss Lois Lampe.

May 8: "Mushrooms and toadstools," Professor W. G. Stover; "Habits of aphid parasites," Mr. H. Spencer.

The president of the club for the year was Dr. E. P. Durrant, of the department of physiology; the vice-president, Dr. R. C. Baker, of the department of anatomy, and the secretary-treasurer, Mr. W. C. Kraatz, of the department of zoology and entomology.

THE GORGAS MEMORIAL

IN response to a request received from the directors of the Gorgas Memorial Institute of Tropical and Preventive Medicine for the cooperation of the American Medical Association, a committee representing the association was appointed consisting of Dr. Charles W. Richardson, Washington, D. C.; Dr. Fred B. Lund, Boston, and Dr. George E. de Schweinitz, Philadelphia. This committee has presented the following report:

As a result of the stimulating suggestion of President Porras, of Panama, it has been resolved that a fitting memorial shall mark the humanitarian service of the late Major General William C. Gorgas, and the beneficent influence of his life and work on mankind throughout the world. Following the thought of President Porras, it has further been decided that this memorial shall take the form of a scientific institute for the study of tropical diseases and of preventive medicine.

No better place could have been selected than Panama City, the gateway between the Atlantic and the Pacific, where General Gorgas' well-planned and executed work made possible the building of the Panama Canal.

It is hardly necessary to call the attention of the medical profession to the far-reaching effects of General Gorgas' work on the welfare of the people of the whole world, especially in tropical and semitropical climates, and in all places subject to the inroads of infectious disease.

We of the medical profession remember him as our surgeon general during the early part of the World War. We remember his prompt recognition of the necessity of bringing into active service large numbers of physicians and surgeons from civilian life. We remember his genial and kindly nature, his high character, and his steadfast effort directed toward the organization and equipment of the medical corps of the Army. We remember the patriotic response. We remember him as a great sanitary officer, to whom we wish to pay a lasting tribute.

A central committee has been formed, with Admiral Braisted, retired, ex-president of the American Medical Association, as its president. The American Medical Association has appointed a committee of three to work in accord with the central committee, and through its members this appeal is made to the American medical profession.

The plan is to build at Panama an institute for the study of tropical and infectious diseases, with a hospital, laboratories, departments for research and all other facilities required in an institute of this character, erected and administered according to the most progressive, modern ideals. The Panamanian government, owing to the far-sighted, philanthropic vision of President Porras, has donated the great Santo Tomas Hospital, and also the ground on which it is proposed immediately to construct the buildings as they have been described. Dr. Strong has been appointed the scientific director.

In conjunction with this work in Panama, there will be established in Tuscaloosa, Ala., the Gorgas School of Sanitation for the purpose of training country health workers, sanitary engineers and public health nurses, especially educated to deal with the problems peculiar to the southern states.

An endowment of six and one half million dollars will be required to enable the institute to carry on the work according to the plans which have been formed.

The Republic of Panama has demonstrated its sympathetic and practical interest in this enterprise with splendid liberality. The physicians of our country, and especially the members of the American Medical Association, surely will not disregard the memory of a former president, and will seize the opportunity to make in this respect a contribution of which they will be proud.

The campaign for funds is to be international. A large response is expected from North, Central and South America, since the nations of these countries have been the chief beneficiaries of the labors of General Gorgas. It is fitting that his co-workers of the American medical profession should be requested to respond generously to this appeal. It is hoped that every member of the American Medical Association will make as liberal a subscription as possible. Any sum will be gratefully received. Checks should be drawn to the order of the "Gorgas Fund" and should be mailed to the American Medical Association, 535 North Dearborn Street, Chicago.

SCIENTIFIC NOTES AND NEWS

DR. E. T. WHITTAKER, professor of mathematics in the University of Edinburgh, has been elected a foreign member of the Accademia dei Lincei, Rome.

PROFESSOR W. ROUX, of Halle, has been elected honorary member of the Academy of Medicine at Turin. Professor Roux has presented to the Roux Foundation for research on the mechanics of development the 30,000 marks recently sent him by the St. Louis Emergency Relief Committee for German and Austrian Universities.

PROFESSOR A. N. WHITEHEAD, of Cambridge, has been elected president of the Aristotelian Society for the coming session. He will deliver his inaugural address on November 6.

DR. N. BISHOP HARMAN, of London, has been elected a corresponding member of the Cherbourg Scientific Society, in recognition of his researches into the origin of the facial musculature.

WILLIAM SCHAUS, of the Bureau of Entomology, has been elected an honorary member of the Entomological Society of Brazil in recognition of his extensive work on the butterflies and moths of Brazil.

POSTMASTER GENERAL HUBERT WORK, formerly president of the American Medical Association, was the guest of honor at a dinner on July 26, in Washington, given by the chargé d'affaires of the Panama legation, Señor Lefevre, in honor of the committee of the American Medical Association appointed to cooperate with the board of directors of the Gorgas Memorial.

MR. W. H. DINES has retired from the directorship of the Aerological Observatory of the British Meteorological Office at Benson.

DR. F. VON LUSCHAN, professor of anthropology at the University of Berlin, retires this year, having reached the age limit.

G. R. MANSFIELD has been appointed chief of the section of non-metalliferous deposits in the Geologic Branch of the U. S. Geological Survey.

DR. J. S. FLETT, director of the British Geological Survey, will act as one of the delegates of the Geological Society of London at the International Geological Congress at Brussels on August 21 to September 3. The other delegates nominated by this society are Professor E. J. Garwood, vice-president, and Dr. J. W. Evans, F.R.S.

THE Röntgen Society, London, has elected as president Sir Humphry Rolleston, and as vice-presidents Sir W. H. Bragg, Sir Ernest Rutherford and Dr. A. E. Barclay.

PROFESSOR THOMAS F. HOLGATE, of Northwestern University, has returned home after a year's leave of absence in China, during which time, though nominally on a vacation, he assisted in the mathematical and administrative work of the University of Nanking.

ATHERTON SEIDELL, of the Hygienic Laboratory, U. S. Public Health Service, is in Europe to study methods and progress of work on vitamines.

DR. F. W. PENNELL, curator of botany in the Academy of Natural Sciences, Philadelphia, accompanied by Mrs. Pennell and by Mr. E. P. Killip, of the National Museum, have gone to Colombia, where about six months will be spent in botanical exploration in the central and western Cordillera.

IT is announced in *Nature* that Dr. Michael Grabham has gone to Porto Santo, the northern island of the Madeira group, to study the conditions under which the local race of Portuguese inhabitants are said to enjoy complete immunity from dental caries. These people possess huge, ugly, yellow, but sound teeth, and Dr. Grabham proposes to bring specimens to London.

A. E. FATH has taken furlough from the Geological Survey to do private geological work abroad.

WE learn from the *Journal* of the Washington Academy of Sciences that at the call of Secretary Walcott, a meeting of the scientific staff of the Smithsonian Institution and its branches was held on May 23 to discuss the promotion of research. Several research problems which could be advantageously taken up were suggested, together with means for carrying them out. A committee on research was then appointed by the secretary, consisting of Dr. Merrill, *chairman*, Dr. Coville, Dr. Fewkes, Mr. Fowle, Dr. Hough, Mr. Nelson and Dr. Stejneger. The committee will hear reports by individuals on proposed research projects and consider means for taking them up, and it is hoped that by fall a definite plan of action will be formulated.

PARK BENJAMIN, the well-known patent lawyer, formerly editor of *The Scientific American* and of Appleton's "Cyclopædia of Applied Mechanics," died on August 21, in his seventy-fourth year.

DR. ARTHUR RANSOME, F.R.S., known for his contributions to the study of tuberculosis and public health, died on July 25 at the age of ninety-two years.

A COMMITTE has been organized, as has already been reported in SCIENCE, to collect subscriptions for the monument to the memory of Professor Yves Delage which it is proposed to erect near the marine laboratory at Roscoff, Finisterre. Several Americans have worked at this laboratory and all biologists are indebted to Delage not only for his discoveries in marine biology but also for his organization of zoological science, his book on protoplasm and heredity and "L'Année Biologique." Subscriptions to the memorial may be sent direct to Mlle. L. Dehorne, treasurer of the committee, at the Laboratory of Zoology, Sorbonne, 1, rue Victor-Cousin, Paris, 5e, or through any one of the American members of the committee, F. R. Lillie, T. H. Morgan and C. B. Davenport.

We learn from the *Journal* of the American Medical Association that Professor E. Marchiafava, having reached the age of seventy-five, retired, June 5, from the chair of pathological anatomy at the University of Rome after forty-eight years of continuous incumbency. A fund has been endowed in his name by contributions from royalty, the city of Rome, the Italian Red Cross, the public health service, the hospitals and banks, and others, to found scholarships at the University of Rome. A number of addresses were made by delegates from various scientific societies and Marchiafava's numerous contributions to science were enumerated, his initial research on malaria and his leadership in the campaign against malaria in Italy, his discovery of the estivo-autumnal parasite, of the cause of melanemia, and his studies in syphilis, tuberculosis, alcoholism, etc. The city of Rome has always regarded him as the one responsible for having freed it from malaria. One of his latest works was the foundation of the Asilo Antimalarico Communale as a home in Rome for the children of families living in the malaria infested marshy districts in the region. A tablet was placed on this building by the community when it was inaugurated last year, paying tribute to Marchiafava as the originator of the project.

The tariff bill as passed by the Senate provides for the continuation of the policy that scientific instruments and apparatus which are imported by educational institutions and used solely for educational purposes shall be admitted free of tariff duty. The provision was adopted by a vote of 30 to 26.

The *Journal* of the American Medical Association notes that in the final passage of the tariff bill, the Senate reversed its position on the importation of dyes and synthetic medicines, and placed extremely high duties on all such articles. There was read to the Senate a letter from Secretary of War John W. Weeks urging that the American dye industry and synthetic medicine industry be protected in the interest of national defense and public health. While the Senate did not vote that there should be an embargo on these products, the tariff duties are of such nature that they will in effect be a conservative check on the importation of dyes and synthetic medicines derived therefrom. The new duties fix the duty on coal-tar dye intermediates at 10.5 cents a pound and an additional 75 per cent. ad valorem, and on finished dyes and coal-tar products, 90 per cent. ad valorem. In urging the adoption by the Senate of these rates, Senator Wadsworth, of New York, showed that England, France and Italy have placed an embargo against the importation of dyestuffs. He said that as a people we have paid little attention and given small encouragement to scientific research. He asserted that chemical laboratories can not be maintained unless there is a chemical industry, and that research in the laboratory and chemical industry go hand in hand. As a result of the action taken by the Senate on this legislation, it is said that approximately 200 laboratories and plants manufacturing medicinals and coal-tar products which have been built up in this country since the war will be enabled to continue operations.

The American Dietetic Association will hold its fifth annual meeting in Washington, D. C., October 16 to 18, with headquarters at the New Willard Hotel. Speakers of national reputation will discuss recent developments in dietetics, as well as administrative and other practical problems of the dietitian. Trips to Walter Reed Hospital and the scientific laboratories of the government will give opportunities to observe the research work now carried on in Washington. An exhibit of equipment, food materials, charts and other illustrative matter will be a feature of the convention.

Under the auspices of the New England Section of the American Society of Agronomy, and in cooperation with the Maine Agricultural Experiment Station and Aroostook County Farm Bureau, some thirty agronomists, pathologists and others interested in problems of potato production spent three days from August 8 to 10 in Aroostook County, Maine, inspecting potato fields and discussing problems of certification and production. A formal program was rendered.

STEPS were taken recently by the Boston Chamber of Commerce to organize a New England Research Council to study the food supply and marketing problems of the region. President K. L. Butterfield, of the Massachusetts College, was elected chairman of the groups of agricultural colleges and the federal and state departments of agriculture and other agencies interested in the formation of the council.

WE learn from the *Journal* of the American Medical Association that members of the British Medical Association have been asked to contribute five shillings each in answer to the appeal for help from Russian medical men and their families. Up to July 3 $3,500 had been received.

UNIVERSITY AND EDUCATIONAL NOTES

THE will of the late William Sloane makes bequests to public institutions amounting to about $600,000, including Yale University, $100,000; the Presbyterian Hospital, $100,000; New York Public Library, $50,000; Metropolitan Museum of Art, $50,000; American Museum of Natural History, $50,000; Robert College of Constantinople, $10,000, and Yale Foreign Missionary Society for the institution known as "Yale in China" at Changshau, $10,000.

BY the will of the late Rollin D. Salisbury, of the University of Chicago, his estate, amounting to $125,000, is left in trust to his two sisters, on whose death one third goes to the University of Chicago for the endowment of scientific fellowships and $2,500 to Beloit College. Two former associates of Dr. Salisbury in geological research, Dr. Wallace W. Atwood, now president of Clark University, and Dr. Harlan H. Barrows, head of the University of Chicago department of geography, will share in the division of Dr. Salisbury's library.

DR. J. SCHNEIDER, of Milwaukee, has been elected "honorary senator" by the University of Würzburg in recognition of his donation of 3,000,000 marks to the university on the recent anniversary of its foundation, 340 years ago.

DR. R. FITZ, professor of medicine in the Mayo Foundation and chief of a medical section, has become associate professor of medicine at Harvard University and visiting physician at the Peter Bent Brigham Hospital, Boston.

DR. WILLIAM C. ROSE, professor of biological chemistry at the medical school of the University of Texas, has been appointed associate professor of physiological chemistry at the University of Illinois.

DR. WILBUR C. SMITH, since 1916 professor of anatomy in Tulane University, has been appointed director of athletics.

DR. CHARLES B. MCGLUMPHY has been appointed assistant professor of pathology at Northwestern University Medical School. He has been working in Vienna for the past two years.

MR. R. M. WILSON, at present principal of the East Anglian Institute of Agriculture, Chelmsford, has been appointed principal of the South-Eastern Agricultural College, Wye.

DR. J. S. DUNN has been appointed to the Procter chair of pathology and pathological anatomy at Manchester in succession to Professor H. R. Dean.

DISCUSSION AND CORRESPONDENCE

METEORITE HUNTING

TO THE EDITOR OF SCIENCE: The experience of the writer in "meteor chasing" fully corroborates those of Dr. Merrill as related in SCIENCE for June 23. The general inability of the observers to furnish reliable data of the event can scarcely be exaggerated. Despite this, however, the writer has in two instances succeeded in "running to earth" the meteorite and securing a large portion if not all of it.

He also has to announce the recent obtaining of two pieces of meteoric iron (siderites) which were plowed up by a farmer in making a tobacco bed three miles southwest of Glasgow, Barren County, Kentucky. They exhibit on fresh surfaces, even without etching, very coarse Widmanstadt structure. One of them weighs about twenty-five and the other about twenty pounds. They are both very much oxidized on the surface, and had evidently been in the earth a very long time. The smaller piece goes to the National Museum, where doubtless it will be described in full by Dr. Merrill in the near future. We propose for this fall the name "Glasgow siderite." It is the fifteenth meteorite known from Kentucky.

In hunting down the first meteorite the writer secured after he came to Kentucky—the Bath Furnace, which fell November 15, 1902, at 6:45 p.m. central time—he had good success in obtaining from a large number of observations *five* which were so accurately expressed as to angular measurements that they indicated southern Bath County, Kentucky, as the place of the fall. It was here that the first two pieces of the meteorite (an aerolite) were almost immediately recovered, and this was followed five months later by the discovery by a squirrel hunter of the main portion.

It is in the attempt to locate a meteorite which passed over Indiana, Kentucky and West Virginia, early in the evening of May 30 last, 7:30 central time, 8:30 eastern time, that the writer has thus far been baffled by the singular ineptitude of the average man, and even of the man supposed to be above the average in intelligence, to grasp the space relations involved in the problem of a body coming to the earth from without. To his request through the newspapers for observations on this meteor the writer has received prompt replies from a large number of persons. They came from four states—Ohio, Indiana, Kentucky and West Virginia—manifest the greatest eagerness to serve the cause of science, and represent, for the most part, the more intelligent of the various communities from which they come; yet even by a follow-up correspondence it has thus far been almost impossible to obtain from any of them reliable data concerning the main thing desired—namely, the compass direction of the point of disappearance of the meteorite, either by "bursting" or sinking below the horizon, as seen from the place of observation. Another thing desired was information concerning any sounds, as of cannonading, that might have been heard in connection with the "bursting," and if such were heard, what was the interval between the two phenomena.

It is evident from the replies received, that while people about us *formally* subscribe to the doctrine of a spherical earth, surrounded by infinite space, *practically* their conception of the universe when it comes to orienting themselves in it with reference to things terrestrial and things celestial is as primitive as that delineated on the monuments of Egypt, set forth in the writings of the ancient Chaldeans and Hebrews, or promulgated from the pulpit of Voliva of Zion City.

Knowing that few people possess compasses, and that still fewer know how to use them in measuring degrees of azimuth, the writer sent out maps, with the direction to each observer that he return it after he had oriented it with reference to the points of the compass and drawn a line on it from the place of observation toward the point of bursting or disappearance of the meteor. It has been surprising (though we should have been prepared for it by previous experience) to find how few people can locate points correctly on a map, or indeed use a map for any of the purposes for which it has been made. One of the parties, and he a college professor, evidently held the map above his head in an effort to make it represent the sky and tried to show by a curved line on this flat surface, and hence in a different plane, what appeared to him to be the descending path of the meteor. As other evidences of the survival of naïve primitive conceptions as to the relation existing between the "heavens and the earth," all the Indiana observers were sure the meteorite fell in their state, with commendable state pride making the "circle of the heavens" meet that of the earth on their side of the Ohio River. The pot of gold is to be found at the end of the rainbow just over the neighboring hill. Hence also the Ohio observer, who saw it from a moving automobile, was sure that he could conduct the writer to the exact spot where the meteorite fell, which he described as in a ravine four and one half miles southeast of Oxford, Ohio. Hence, also, the size of it was variously estimated as "six inches in diameter," "as large as a dinner plate," "as large as a lard can," "as large as a barrel"; and the path of it on the face of the firmament was described as "descending toward the earth" (really it was passing toward the horizon) "with a moderately descending course," "at an angle of 45 degrees," "at an angle of 65 degrees"—all blissfully unconscious that these estimates mean nothing to any one but the one making it. A doctor described the bright trail left by the meteor as "20 feet long." Two of the observers at different points, neither of them closer to it than 50 miles, despite the fact that sound waves travel with a very low velocity as compared to those of light, were certain that they heard a "swishing" or "hissing" noise accompanying the meteor as it sped across the sky. A number attempted to give the direction of the *path* of the meteor with reference to the points of the compass, not realizing that this was impossible in all cases where it did not pass through the zenith of the observer, because only one of the components of its course—that athwart the line of his vision—could be determined by him.

Let us hope that when our present boy scouts come to maturity, having been trained in a proper knowledge of their relation to their physical environment, which has been so sadly neglected in our schools—is it because the teaching of the boy has been so exclusively delegated to women?—those who then follow "meteor chasing" as a scientific recreation may find their efforts to elicit information concerning things celestial, when they come into relation to things terrestrial, crowned with better success than were those of their predecessors.

Meanwhile the meteorite of May 30, 1922, lies hidden somewhere in the most mountainous portion of West Virginia, probably, according to the advices received from Dr. I. C. White, state geologist of that state, within the area covered by the counties of Fayette, Greenbrier, Raleigh and Summers. What an exasperating way meteorites seem to have of so frequently selecting the wildest and most rugged portions of our earth in which to bury themselves![1]

Arthur M. Miller
The University of Kentucky

THE FOURTH RECORD OF THE OCCURRENCE IN THE ATLANTIC OCEAN OF THE WHALE SHARK, RHINEODON TYPUS

On the early morning of May 19, 1922, while the Munson liner, *American Legion,* Charles H. Zearfoss master, was crossing over the banks which lie northeast of the Abrolhos Light, off the coast of Brazil, in Lat. 17° 57′ S. and Long. 38° 41′ W., a large shark was struck by the stem of the vessel and held doubled around the bow for some hours. It was photographed and an attempt was made to get it aboard, but the weight was too great.

It was struck just behind the gills and, with about eight feet of the head end on one side of the bow and some twenty-two feet of the body and tail on the other, it was so perfectly balanced that the vessel had to be stopped and backed before it could be got rid of.

Photographs sent me by Mr. C. F. Krauss, a passenger on the steamer, and by Captain Zearfoss, show only a part of the body, but they show plainly the spots arranged in vertical rows and separated by vertical bars, the distinctive markings of the whale shark. These photographs leave not the faintest shadow of doubt that the shark was *Rhineodon.*

This then definitely constitutes a fourth record for the Atlantic Ocean of the occurrence of the largest of all the sharks, and of the rarest of all the large sharks. The other

[1] Since writing the above, letters from two persons in West Virginia—W. T. Hill, Eskdale, Kanawha County, and M. W. Venable, who saw the meteor from near the mouth of Glade Creek, Raleigh County—indicate that the meteorite is probably to be looked for in Greenbrier County, that state. The former heard a "rumbling sound" in a due east direction about one minute after the meteor disappeared, and the latter a "tremendous roar similar to a salvo of artillery" simultaneous with the bursting of the meteorite with a "brilliance almost blinding" in a direction a little east of north.

records are as follows: In January, 1902, an 18-foot specimen came ashore at Ormond, Fla. It was described by Mr. B. A. Bean in Science, February 28, 1902. Its skin is now in the U. S. National Museum. A second specimen was taken at Knight's Key, Fla., in May, 1912. It was put on record by me in Science of August 22, 1913, and the fish and its capture were fully described by me in "Zoologica," *Scientific Contributions N. Y. Zool. Soc.*, March, 1915. Its mounted skin is in the possession of Captain Charles Thompson of Miami, Fla. The third, and, except the Abrolhos Light specimen, the only other definite record, is of a fish taken near Cape Sable, Fla., in June, 1919. This I have also put on record in Science for August 27, 1920. The indefinite record in the Atlantic, to which reference has been made, is found in George Bennett's "Wanderings in New South Wales, Batavia, Pedir Coast, Singapore and China," London, 1834. In Vol. II, p. 267, is a notice of a giant shark seen near the Azores in 1831. It was of great size, but too far off for spots and stripes to be seen, and while it was probably a *Rhineodon* it cannot be so stated definitely. Hence the specimen, referred to in the body of this article, constitutes our fourth definite record for the Atlantic Ocean.

E. W. Gudger
American Museum of Natural History

DISCHARGE OF STATIC ELECTRICITY

A splendid example of the discharge of static electricity between two persons was witnessed at one of the games in the gymnasium of Iowa Wesleyan College at Mount Pleasant during the recent southeastern Iowa high school basketball tournament, and is reported by Ben H. Wilson, a member of the Iowa Academy of Science.

While the game was in progress between the Wayland and Ft. Madison teams, Saturday evening, March 11, 1922, two players in pursuit of the ball came together in the southeast corner of the court, after a fast run of almost half way down the length of the floor. A deep yellow spark was discharged between their bodies, the flash of which was plainly visible to spectators in the top row of the balcony in the northwest corner of the gymnasium, over one hundred feet distant. This could be no illusion as it was witnessed by over a dozen persons who made exclamation of the fact almost simultaneously. The spark appeared to be emitted at about knee height. Both players had on rubber-soled athletic shoes which would be non-conductors, and wore woolen shirts and cotton flappers. That this was visible in a well lighted room makes the phenomenon all the more remarkable.

Shocking the cat by rubbing the fur on its back; lighting the gas from a spark emitted from one's knuckle; witnessing sparks while combing one's hair in the dark; and children's shocking each other while playing on woolen carpets, are all quite common experiences, but this is the first time that the writer has heard of a similar occurrence being reported during an athletic contest.

H. E. Jaques
Iowa Wesleyan College

PARAFFINE PAPER SCREEN FOR SHOWING THE POSITION OF RETINAL IMAGE

Under the title, "The Inversion of the Retinal Image," Hartridge[1] refers to a statement by Senet[2] that the retinal image is not inverted. The former author then states that the evidence for that inversion is absolutely reliable and proceeds, in five paragraphs, to summarize the evidence on which the inversion of the retinal image is based. I quote his first two paragraphs:

"(1) If the eye ball of an albino animal be removed intact, and be mounted in a tube, so that while the rays from external objects enter the pupil, the posterior surface of the eye ball can be examined by an observer, then owing to the absence of pigment in the choroid the image formed on the retina is clearly visible. This image is seen to be inverted, top being at bottom and right being at left.

(2) In the case of an ordinary animal the choroid and sclera can with care be removed from the eye ball, leaving the retina *in situ;* observa-

[1] Hartridge, H.: Proc. of the Physiol. Soc., May 15, 1920, published in the *J. of Physiol.*, Vol. LIV, August 1920, p. 6.

[2] Senet: *Revista de la Universidad de Buenos Aires*, 41, p. 398, 1919.

tion of the retinal image shows that it is inverted and transposed.''

The experiments suggested here by Hartridge are well enough known, but his summary calls definitely to mind the fact that it is by the use of one or the other of these experiments that demonstration of the actual position and of the inversion of the image in the eye of a mammal must usually be presented to classes of students in physiology, whenever direct evidence is given at all. Difficulties often arise in carrying out either experiment. The eye of an albino as large as a rabbit is very often not easily obtainable. Since the eye of such an "ordinary animal" as the pig may almost always be had from the butcher or the meat market so soon after the animal has been killed that the dioptrical parts are still transparent, the ordinary eye would seem to be the obvious one to use for such demonstrations. As a matter of fact, however, the preparation of the demonstration with a pigment-bearing eye is rendered always somewhat uncertain, on account of the difficulty of removing the choroid and the retinal pigment without puncturing the retina and thus destroying its value as a screen on which to see the image. I have found it easy to complete the demonstration of the inverted image in such cases by carefully cutting out a little window of about 5 mm. diameter in the retina and then pressing over this window until it sticks fast against the vitreous humor a small piece of thin paraffine paper. Standing in the place of the retina, this paper forms a very good screen upon which to receive the image.

An incandescent electric light forms an excellent *object* for use in the demonstration, which is always an interesting one to students and certainly quite conclusive, as Hartridge says.

Geo. D. Shafer
Leland Stanford, Jr., University.

QUOTATIONS

SPIRIT PHOTOGRAPHS

There is a society or club known as the Magic Circle which consists of professional conjurers, but admits a few approved amateurs, to the kindness of one of whom, a distinguished member of the medical profession, we are indebted for a copy of a report, dated May 31, issued by the Occult Committee of the Circle. This committee, which consists of expert conjurers, has been appointed to investigate what are called "spiritualistic phenomena," and at the suggestion of Sir Arthur Conan Doyle appears to have turned its attention first to spirit photographs. The report deals with the inquiries made by the committee into the claims of two people—a man and a woman—who it was alleged were producing spirit photographs of a remarkable nature in unopened packets of photographic plates. Neither of the mediums came out of the ordeal unscathed. When a fraud-proof packet was sent to the male operator he obtained no results. He stated that the packet had twice been "held," but that the "usual sensation" had not been felt. As soon, however, as a packet that could be tampered with was submitted, a "psychic extra," as it appears to be called, was obtained on one of the plates. Unfortunately for the performer the conjurers had tampered with the packet first. In addition to other tests, a straight line of red varnish (invisible in the red light of the dark room) had been painted across the top left side of the edge of the stack of six plates. On the return of the packet by the medium three of the red marks were found at the bottom, showing that these plates had been reversed. When the operator was asked for an assurance that the packet had really been returned unopened, he replied in the affirmative. He said that it was quite usual to get adverse remarks from persons who did not understand, and that such remarks were not worthy of notice. Shall we admire the power of spirits, or deplore the frailty of human nature? The lady medium was vouched for by Mr. and Mrs. Hewat McKenzie, who conduct an institution known as the British College of Psychic Science. Three sittings were held with this medium. First, two members of the committee secured a private sitting. It was required that the plates, enclosed in a sealed packet, should be sent for "magnetization" some days in advance, and at the sitting these plates were exposed, and on development "extras" were on most of them. On one a face was visible in the midst of a cotton-wool effect; the others had crude markings, ascribed by the medium to unformed "ectoplasm" or to "spirit lights." As will be observed, she had acquired some of the latest spiritualistic terminology. At the second sitting, arranged by Mrs. McKenzie, a sealed box of six plates, forwarded in accordance with instructions, was produced by the medium. The box was opened and the plates transferred to metal dark slides; a service was then held, hymns being sung, and the Lord's Prayer recited. The plates were then exposed and an "extra" appeared on one of them—on No. 1 plate—which the investigators satisfied themselves had been substituted for the first plate of the original package. The medium had by this time become suspicious and nervous, and in fact she was not equal to holding her own with professional conjurers. She, however, consented to a third sitting, and for this an unopened box of unprepared plates was sent. It therefore became necessary that the plates should be secretly marked before being placed in the dark slides. One of the investigators, having placed the open stack of plates before the medium under the ruby light, secretly attached a small pad of pink material, chemically prepared, to the ball of his right thumb, and in handing the plates one by one to the medium an invisible mark was impressed on each. The medium gathered up the slides, and going into the studio took them to a small table on which her handbag was standing. The ostensible object was to obtain the hymn-books for the service, but the move being anticipated, the members of the deputation placed themselves in convenient positions to observe her actions. The hand holding the slides was seen to be placed inside the bag; one slide was dropped into a side pocket and a duplicate slide picked up with the hymn-books. Four plates were developed, and on one which did not show the mark a "spirit extra" appeared. All this may be amusing to the cynic, but the conclusions the committee of the Magic Circle draw are that although spirit photographers, like conjurers, meet changing conditions by the adoption of new methods, there are at present at least two methods in general use by some, at least, of the mediums who devote themselves to obtaining photographic "extras." In the one case, when the plates are accessible before the sitting, the spirit form is impressed, in advance, by contact with a selected transparency. In the other, when the packet is not available beforehand, the exchange for a prepared plate is made by a subtle move after the original plates have been loaded into the dark slides. The committee assert that they have never imposed a test which would not have served to demonstrate the straightforwardness and honesty of the medium, and conclude with a promise to extend to any honest medium fair, impartial and courteous treatment, and to give him a free hand to carry out the experiment in his own way.—*British Medical Journal.*

SCIENTIFIC BOOKS

The Evolution of Climates. By MARSDEN MANSON. 1922. *Published by the author.*

DR. MANSON has been long and widely known as a student of geologic climates. When his attention was first directed to the subject the currently accepted theory—which indeed still persists—postulated the solar control of terrestrial temperatures similar to that which now dominates such temperatures, but it early became apparent that not all of the problems presented could be satisfactorily solved under this assumption. For instance, the non-zonal distribution of climates such as certainly obtained during at least the major part of pre-Pleistocene time, the frequent recurrence of mild temperatures in polar areas, glaciation at or near sea level in and adjacent to the tropics, etc., have not been satisfactorily explained on the basis of exclusive solar control. This leads to the postulate of a dual heat supply—that is a part derived from the earth itself and a part from the sun. The manner in which this postulate works out and the solution it seems to afford to the various problems involved is set forth in the present paper.

In 1903 Dr. Manson published a preliminary paper under the same title as the present one, in which he reviewed the various theories that have been proposed to account for the origin and distribution of climatic differences, and after practically twenty years of investigation, reading, and correspondence the present work can be considered as a summation of results. It is divided into three parts, the first of which sets forth the scope of the problem, while the second part deals with the application of the principles set forth to the facts of paleontology and geology, and the third to a recapitulation of conclusions and their general application.

Dr. Manson of course recognizes that on account of the low conductivity of the earth's crust it has been held by physicists and mathematicians that this source was inadequate as a factor of importance, but after reviewing the data on which this assumption is based he "feels obliged to reject the conclusions as 'incompetent, irrelevant, and immaterial'." He holds that "both earth heat and solar radiation prevailed as active factors in temperature control during all of the eras of geologic history and until the modern era of solar control; that the former was available as ocean stored heat, but the supply was held in the forming crust by reason of its low conductivity and was slowly made available by denudation and the exposures of radio-active materials, etc., or by periodic changes in the topographic form of the earth's surface which made increments of the interior sources of energy available."

This earth heat warmed the early oceans, the first effect being to increase evaporation and cloud formation. This ocean stored heat was conserved by the moist air and clouds and in part restored by the effects of solar radiation. This continued until the exhaustion of earth heat was registered by the cold oceans of Pleistocene time.

The causes for the initiation of glaciation as well as the alternation of glaciation and deglaciation or inter-glacial periods have given rise to almost endless speculation. Many students have stated frankly that they can see no possible or reasonable explanation of, for instance, the Permo-Carboniferous glaciation that occurred in or adjacent to the tropics, under direct solar control, and under this assumption this is about the only conclusion that can be reached. But Dr. Manson offers an explanation that is not only logical but seemingly possible not to say probable. He says: "The two conditions essential for glaciation are: (1) *Cold Continental Areas*—cold from more rapid chilling when remote from ocean influences, from elevation, from exposure to cold anti-cyclonic winds, and, upon the final loss of efficient earth heat; (2) *Warm Oceans,* to supply water vapor in sufficient amounts to deeply glaciate and to maintain continuous cloudiness to intercept solar energy."

"Land areas chilled prior to the oceans and were therefore exposed to glaciation. Furthermore in cooling oceans each of these impairments occurred at a critical temperature; first that degree which could just maintain cloud density in zones of minimum cloudiness; and lastly, that degree which could just maintain cloudiness in zones of maximum cloud density. Moreover, if, during the existence of either glaciation, the oceans should fluctuate in temperature to points somewhat above or somewhat below these critical temperatures, corresponding variations in the generation of water vapor would necessarily follow, imposing variations in the integrity of the cloud sphere in each latitude. Each fall below this critical temperature would impair the cloud sphere, and each rise above this temperature would restore it, thus alternately exposing the surface to solar energy and shutting off the same until the oceans again chilled below the critical temperature."

This in brief outline is Manson's explanation of the phenomena of glaciation and deglaciation. The theme is of course fully elaborated in the paper, and whatever its fate may be it is something that will have to be reckoned with by all future students. All will admit that any explanation that is put forward to account for glaciation or deglaciation must apply equally to these phenomena wherever they occur, and while many theories have been proposed that may seem to cover particular cases they fall short of accounting for all. Dr. Manson's explanation applies as well to the Huronian and Permo-Carboniferous as to the Pleistocene glaciation. It is a notable contribution.

F. H. Knowlton

SPECIAL ARTICLES

RECENT DISCOVERIES OF THE ANTIQUITY OF MAN

This paper is an abstract of two lines of research recently undertaken by the authors which will be published under the titles: "Old and New Standards of Pleistocene Division in Relation to the Prehistory of Man in Europe,"[1] "Pliocene (Tertiary) and Early Pleistocene (Quaternary) Mammalia of East Anglia, Great Britain, in Relation to the Appearance of Man."[2]

At the April, 1921, meeting of the National Academy, Dr. Osborn ventured the prediction that a large-brained type of man would be found in the Pliocene. He was not aware that such a discovery had actually been made in the Upper Pliocene Red Crag deposits near Ipswich, in the summer of 1921, because Mr. Moir's discovery of Red Crag and of sub-Red Crag man had not been accepted in England. It was not until an unmistakable human industrial level was found at Foxhall, near Ipswich, in the summer of 1921, that this locality was visited by the French archeologist, Breuil, who announced this important discovery at the Archeological Congress at Liége, in August, 1921. Dr. Osborn immediately planned to visit this locality and to make a careful survey and review of the animal life which surrounded Foxhall man. This review, fully set forth in both papers above named, shows that Foxhall man—capable of making ten or twelve different kinds of flint implements, of providing himself with clothing and of building a fire—sets an unmistakable Upper Pliocene date for the antiquity of man, in which he was surrounded by relatively primitive mastodons, rhinoceroses, saber-tooth tigers and two species of elephants, a fauna closely similar to the Upper Pliocene fauna of the valley of the Arno River, near Florence, Italy.

More recent than the Foxhall industry is that of Cromer on the coast of Norfolk, discovered during the summer of 1921. Cromer is also treated as of Upper Pliocene age by British archeologists, but it is unmistakably *Lower Pleistocene;* it belongs to First Interglacial time.

To establish this second point, Dr. Osborn enlisted the cooperation of Dr. Chester A. Reeds, beginning in the month of September, 1921, and undertook an exhaustive examination of the old and new standards of Pleistocene division in Europe, namely, of Geikie, Penck, Brückner and Leverett, ending with the recent work of Depéret and of De Geer. While these authorities do not agree as to causes or as to the duration of the Ice Age, a most important result of concurrent observation in England, France, Germany, Switzerland and North America is that there were certainly within the Ice Age four, and possibly five, distinct periods of glaciation, with at least four interglacial periods, all embraced within the Quaternary. British geologists and at least one French geologist, Marcellin Boule, include the First Glaciation within Tertiary time, but all the other authorities named above regard the First Glaciation as the opening of Quaternary time. The latter view is the one adopted by Osborn and Reeds and is clearly set forth in the synthetic diagram which summarizes our present knowledge of the geologic succession, of the industrial phases, and of the geologic appearance of human types. This table will be submitted to the coming International Congress of Geology at Brussels.

As a result of the researches summarized by the authors, we are now able to fix with considerable certainty the geologic level of the entire succession of human industries, namely, the Foxhallian, Cromerian, Chellean, Acheulean, Mousterian, Aurignacian, Solutrean, Magdalenian and Campignian. We are also able to fix with considerable exactitude the geologic age of the successive races of men, *i. e.,* Trinil, Piltdown, Heidelberg, Neanderthal and Cro-Magnon, which appear between Foxhallian and Magdalenian industrial times.

Henry Fairfield Osborn
Chester A. Reeds
American Museum of Natural History

[1] This paper, presented in abstract by Dr. Reeds before the Geological Society of America, is now in press in the *Proceedings* of the society.

[2] This paper by Dr. Osborn will appear in full in the *Geological Magazine,* London, 1922.

THE RECURRENCE OF ACUTE PARATHYROID TETANY IN COMPLETELY PARATHRYOIDECTOMIZED ANIMALS DURING THE OESTRUS CYCLE[1]

IN a previous communication Luckhardt and Rosenbloom[2] have shown that completely parathyroidectomized animals can be cured of all symptoms of tetany by the intravenous injection of Ringer's solution administered daily as indicated for a period of about forty days. After that period of time[3] the animals can be put on a meat diet limited in quantity only by their own choice and enjoy excellent health with no signs or symptoms of tetany except as noted.

Clinically it has been known for some time that some women who had been subjected to goiter operations suffered from tetany at each menstrual period. It was not clear, however, that the tetany was due to hypofunction of the parathyroid glands.

As is perhaps generally known, bitches go into "heat" about twice a year. At this time even normal dogs may show signs and symptoms which are indistinguishable from attacks of mild tetany occurring in parathyroidectomized animals. Anorexia, hyperpnoea, retching, vomiting, and mild fibrillations of the skeletal muscles are seen off and on particularly during the last week of œstrus.

It was therefore interesting to note what would happen during the œstrus period of bitches that had suffered a complete removal of all four parathyroids months previously.

We can present a report on two of such animals.

The one animal was completely thyroparathyroidectomized on October 23, 1921. All injections were stopped in January, 1922. From that time on the animal remained in splendid condition on a stock diet of meat, bread and bones. Tetany in very severe form was induced for the last time in February, 1922, by feeding the animal a large amount of meat mixed with barium sulphate. Mild tetany consisting of fibrillations of front and hind legs appeared spontaneously on ordinary diet on March 10, 11 and April 4, 1922. The dog was not depressed. The symptoms would be present one moment and absent the next hour only to recur several hours later together with a mild hyperpnoea. At these times the animals had a marked polydipsia. On April 9 an enlarged vulva and a distinct bloody vaginal discharge was first noticed. The tetany symptoms became more severe from day to day until on April 15 the animal had a severe tetanic seizure with depression, anorexia, hyperpnea, generalized fibrillations, clonic contraction of the temporal muscles (chattering), and a spasticity so marked that walking was difficult. Intravenous injections of Ringer's solution were freely given; and the animal was better on the following day. The tetany continued in more or less severe form until May 4. But even now (May 30, 1922) fibrillations of the neck and leg musculature can be seen now and then (perhaps because of early pregnancy).

The other animal was parathyroidectomized on January 29, 1922. Four days later the animal had depression, salivation, groaning, spasticity, tremors, clonic and tetanic convulsions. Indeed, artificial respiration had to be given because of a tetanic spasm of the diaphragm. As a result of the usual treatment the animal recovered. For a week or two it seemed doubtful whether the animal would survive. After that the general condition improved. Intravenous injections were discontinued on the forty-sixth day. The animal was exceptionally alert and playful. Its food (meat) consumption was not limited. On May 7, almost two months later, the vulva was noticeably enlarged. On the following day anorexia appeared. A fit of sneezing was followed by a spasm of the facial muscles. The ears were kept back; and the animal was greatly depressed. The condition became worse on the succeeding days. On May 12 retching and vomiting began. On the following day the animal was spastic. Fibrillations and clonic contractions were generalized but were especially noticeable in the temporal muscles.

[1] From the Hull Physiological Laboratory, the University of Chicago.

[2] Luckhardt and Rosenbloom: *Proc. Soc. Exp. Biol. and Med.*, XIX, No. 3, 1921, p. 129.

[3] Luckhardt and Rosenbloom: *Proc. Soc. Exp. Biol. and Med.*, this number.

Periodic spasms of the larynx and incessant vomiting continued for the next eight days. The generalized fibrillations gradually diminished in intensity but the clonic jerkings of the temporal muscles persisted together with anorexia and a marked depression. The gastric juice which was vomited up contained appreciable free and total acidity. Throughout this period intravenous injection of Ringer's and enemata were freely given. On May 20 the animal seemed decidedly better. Thereafter the condition gradually improved. At the time of writing (May 30) the animal is again free from all symptoms of tetany. All treatment was discontinued 14 days after the reappearance of the tetany.

In many respects the tetany appearing during the œstrus cycle of this animal was more severe than the tetany seen the first month following the parathyroidectomy.

We are in no position to explain the reoccurrence of the tetany with all its severity during the œstrus cycle months after the absense of any sign suggestive of tetany. The facts however seem to show that the tetany appearing in partially strumectomized women during menstruation is due primarily to hypofunction or absence of the parathyroids. As in previous work we observed during the tetany seizures signs pointing to a paresis of the sympathetic nervous system (enophthalmos), pseudoptosis, paretic nictitating membrane, bradycardia, conjunctival injection, general vasodilation, and a sluggish *atonic gastero-intestinal tract*. The latter condition (paralytic ileus) would favor the production of toxic products by bacterial action; the splanchnic dilatation (paresis of vasoconstrictor control) would permit of so rapid an absorption of these poisonous products that the liver would be functionally inadequate to neutralize them because of the speed of their delivery (alimentary toxemia). As in Eck fistula animals parathyroidectomized animals suffer from an intestinal toxemia. On this hypothesis the reported Ca deficiency in parathyroidectomized animals might well be an *effect* of the tetany condition rather than its *cause*.

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THE ALGEBRAIC METHOD OF BALANCING A CHEMICAL EQUATION

A CHEMICAL equation is said to be "balanced" when, for each element involved, the number of gram atoms in the left member of the equation is equal to the number of gram atoms in the right member. Given, then, the initial and final substances concerned in a chemical reaction, say

$$\alpha Ag_2AsO_4 + \beta Zn + \lambda H_2SO_4 = \delta AsH_3 + \varepsilon Ag + \zeta ZnSO_4 + \eta H_2O$$

"balancing" the equation consists in finding a set of values for α, β, λ, etc., such that the above named condition is fulfilled.

There are several methods of balancing a chemical equation. With simple equations the necessary coefficients are at once evident, or become so on brief application of the expedient of trial and error. In more complicated equations, however, the method of trial and error becomes tedious and other methods are convenient. In an oxidation-reduction reaction, consideration of the valence changes will usually give enough data to enable one to arrive at a solution of the problem, but this method is limited, even in application to such equations.

The algebraic method of balancing an equation is of general application and will be found time saving in dealing with complex equations. This method is outlined in a few of the textbooks, but is not in general use.

THE ALGEBRAIC METHOD

The ordinary method of balancing a chemical equation algebraically is a very simple procedure. In the following equation, let a, b, c, etc., represent the coefficients of the balanced equation:

$$aAg_2AsO_4 + bZn + cH_2SO_4 = dAsH_3 + eAg + fZnSO_4 + gH_2O$$

It is obvious that one may write algebraic equations expressing the number of gram atoms of each element involved in the reaction. Thus:

For silver: $2a = e$
For arsenic: $a = d$
For oxygen: $4a + 4c = 4f + g$
For zinc: $b = f$
For hydrogen: $2c = 3d + 2g$
For sulphur: $c = f$

Since this results in six equations amongst seven unknowns, the value of each of the unknowns may readily be found in terms of any one of the unknowns, a numerical value being then assigned to the latter such that fractional coefficients will disappear. For example, from the six equations given above it follows that:

$$a = a \qquad e = 2a$$
$$b = \frac{11a}{2} \qquad f = \frac{11a}{2}$$
$$c = \frac{11a}{2} \qquad g = 4a$$
$$d = a$$

and calling $a = 2$, the chemical equation is:

$$2Ag_2AsO_4 + 11Zn + 11H_2SO_4 = 2AsH_3 + 4Ag + 11ZnSO_4 + 8H_2O.$$

NUMBER OF EQUATIONS AND NUMBER OF UNKNOWNS

In applying the algebraic method there may be written as many equations as there are elements concerned, and obviously there will be as many coefficients as there are compounds. Since the relation between number of equations and number of unknowns determines the applicability of the algebraic method, one is led to inquire into this matter with respect to the chemical equations ordinarily encountered. A random selection of fifty equations from an inorganic chemistry text-book reveals the following:

If $x =$ number of elements concerned
$y =$ number of compounds concerned

Then:

For 4 of the equations: $x = y + 1$ (Case I)
For 17 of the equations: $x = y$ (Case II)
For 28 of the equations: $x = y - 1$ (Case III)
For 1 of the equations: $x = y - 2$ (Case IV)

Since x independent equations fix every possible ratio between $x + 1$ unknowns, it is evident that in Cases I, II and III above the number of *independent* equations written will be one less than the number of unknowns, although the procedure of the algebraic method yields actually two additional (dependent) equations in Case I and one additional equation in Case II.

Case IV offers a curious condition, for here it is evident that the ratios between all the unknowns can not be fixed, and there may be found an infinite number of sets of coefficients which will balance the equation. The following equation is an example:

$$aKMnO_4 + bH_2SO_4 + cH_2O_2 = dK_2SO_4 + eMnSO_4 + fH_2O + gO_2.$$

The fact that this equation may be balanced in an infinite number of ways has no significance chemically, since the valence changes of manganese and oxygen settle the matter and there is only one set of coefficients which permit the equation to represent the chemical facts involved. In this case the valence changes involved require that $5a = 2c$ and this adds an additional equation to those required by stoichiometric considerations, and the problem of finding the coefficients falls then under Case III above. There are chemical equations, however, which can be balanced in an infinite number of ways having due regard for valence requirements. In the equation:

$$aK_2Cr_2O_7 + bH_2SO_4 + cFeSO_4 + dH_2S = eK_2SO_4 + fCr_2(SO_4)_3 + gFe_2(SO_4)_3 + hH_2O + iS$$

there are nine unknown coefficient and seven equations. Valence changes of chromium, iron and sulphur require that $6a = c + 2d$, but this equation is included in those required by stoichiometric ratios and the problem remains indeterminate. There will be $3a - 1$ true solutions for every value given a.

NUMBER OF ELEMENTS AND NUMBER OF COMPOUNDS IN A CHEMICAL REACTION

From a chemical standpoint, the fact that, with but few exceptions, x elements enter into reactions involving either x or $x + 1$ compounds may strike one as curious. Closer examination of this point, however, does not appear to reveal anything in the way of a law of nature, but indicates that the rule arises from certain limited values in the equations ordinarily used in inorganic chemistry, as is shown below:

Let $x =$ Number of elements
$y =$ Number of compounds
$c =$ Total number of elementary symbols appearing
$r =$ Unnecessary repetition of symbols (*i. e.*, in excess of $2x$).
$k =$ Average number of elements per compound (*i. e.*, $\frac{c}{y}$)

Then for any chemical equation:

$$c = 2x + r$$

$$\frac{c}{y} \text{ or } k = \frac{2x}{y} + \frac{r}{y}$$

$ky - 2x = r$, which is an expression in which the difference between x and y is fixed by k and r.

The preponderance of binary and ternary compounds in inorganic chemistry, with occasional appearance of single elements would readily lead one to give k an average value in the neighborhood of 2.25. The actual average for k in the fifty equations referred to above is 2.285, the extreme values being 1.5 and 3.1.

The repetition of acid radicals in many of the reagents of inorganic chemistry, coupled with the fact that it is seldom possible to determine the products of a reaction amongst more than three substances, results in an average value of r, not far from that for k. Actual average for fifty equations is 2.44.

These average values for k and r require that the average value for x and y should not differ widely.

Harry A. Curtis

South Clinchfield,
Virginia

THE IOWA ACADEMY OF SCIENCE

The academy held its thirty-sixth annual session with Drake University, Des Moines, on Friday and Saturday, April 28 and 29. After a short business meeting President Morehouse gave his presidential address on "The cosmology of the universe." The academy then divided into sections for the reading of papers, and at six o'clock the sections met for dinners. In the evening President Edgar O. Lovett, of Rice Institute, Houston, Texas, gave the public address on "Some aspects of science." This address and the reception which followed were given at the splendid new municipal observatory, built by the city of Des Moines in one of its public parks and dedicated to Dr. Morehouse, the astronomer of Drake University. Opportunity was given the members for inspecting the equipment of the observatory and seeing the stars through the nine-inch telescope.

On Saturday morning the sections resumed their meetings, and at ten o'clock the academy convened to hear some papers of general interest. The following were elected as officers for the ensuing year:

President, R. B. Wylie, State University, Iowa City; *vice-president,* O. H. Smith, Cornell College, Mount Vernon; *secretary,* James H. Lees, Geological Survey, Des Moines; *treasurer,* A. O. Thomas, State University; *chairmen of sections: Botany,* H. S. Conard, Grinnell College, Grinnell; *chemistry,* Edward Bartow, State University; F. E. Brown, State College; *geology,* S. L. Galpin, State College, Ames; *mathematics,* C. W. Emmons, Simpson College, Indianola; *physics,* L. D. Weld, Coe College, Cedar Rapids; *zoology,* H. W. Norris, Grinnell College.

Resolutions were adopted favoring reforestation and conservation, and opposing the transfer of public forests to the Department of the Interior.

The following papers were presented:

ARCHEOLOGY

The new Albin inscribed tablet: Ellison Orr.

Decorative markings on some fragments of Indian pottery from Mills County, Iowa: Paul R. Rowe.

GEOLOGY

Recent studies of the Pleistocene in western Iowa: G. F. Kay.

Till-like deposits south of Kansas River in Douglas County, Kansas: Walter H. Schoewe.

Status of sedimentation in Iowa: A. C. Trowbridge.

Origin of limestone conglomerates: Miss Louise Fillman.

Classification of lenses: Miss Louise Fillman.

Notes on some mammalian remains reported in Iowa during the past year: A. O. Thomas.

Records of Paleozoic glass-sponges in Iowa: A. O. Thomas.

An Iowa Cambrian eurypterid: O. T. Walter.

The Laramie hiatus in the southern Rockies: Charles Keyes.

Horizontal oblique faulting in inclined strata: Charles Keyes.

Taxonomic rank of Pennsylvanian grouping: Charles Keyes.

A deposit of pyrites in coal: John M. Lindly.

The deep well at Winfield: John M. Lindly.

The structure of the Fort Dodge beds: James H. Lees.

The area near Stuart, Iowa: John L. Tilton.

Some Black River brachiopods from the Mississippi Valley: Carroll Lane Fenton and Mildred Adams Fenton.

Oil prospects in Iowa: John E. Smith.

The Rockford geodes: Sidney L. Galpin.

MATHEMATICS

IOWA SECTION, MATHEMATICAL ASSOCIATION OF AMERICA

The method of averages: G. W. Snedecor.

Mathematical bulletins: T. M. Blakeslee.

Topics in general analysis: E. W. Chittenden.

The place of the equation in a scheme of education: C. W. Wester.

Pre-symmetric determinants whose elements are finite sums: E. R. Smith.

On the meaning of the classification of statistical series by means of the Lexis ratio: H. L. Rietz.

Definitions of imaginary and complex numbers: E. S. Allen.

An extension of the figurate numbers: J. F. Reilly.

PHYSICS

A redetermination of the principal reflecting powers of isolated selenium crystals: L. P. Sieg.

Solubility and polarity: William Kunerth.

A comparison of intensities required under direct and under indirect lighting systems: William Kunerth.

Coefficients of diffusion of salt vapors in the Bunsen flame: George E. Davis.

The path of a rigid electron which moves in a magnetic field of constant strength rotating with constant angular velocity: E. O. Hulburt.

Phenomena in gases excited by radio frequency currents: E. O. Hulburt.

The broadening of the Balmer lines of hydrogen with pressure: E. O. Hulburt.

Nodal distances in acoustics: G. W. Stewart.

A variable single band acoustic filter: G. W. Stewart.

A new form of telephone receiver and transmitter: C. W. Hewlett.

The scattering of X-rays by light elements: C. W. Hewlett.

The attenuation factor in acoustic wave filters: H. B. Peacock.

The Hall effect and specific resistance of evaporated films of silver, copper and iron: J. C. Steinberg.

Effect of automobile headlight lenses by box photometer method: D. M. Smith.

ZOOLOGY

Iowa microlepidoptera: A. W. Lindsey.

Brood "A" of the white grub extends its range in Iowa: H. E. Jaques.

A study of the eggs of the white-marked tussock moth: Miss Susannah Poulter and H. E. Jaques.

A scribofacilograph for labelling kymographic tracings: T. L. Patterson.

Effects of stretch on smooth muscle responses: B. M. Harrison.

Observations on the habits of a tarantula in captivity: Albert Hartzell.

Some recently published errors respecting the cranial nerves of the dogfish: H. W. Norris.

Cranial nerve components in Amia, Lepidosteus, Polyodon and Scaphirhynchus: H. W. Norris.

Morphological studies on the injury to apple caused by Ceresa bubalis: J. C. Goodwin and F. A. Fenton.

Some hereditary pathogens: W. E. Sanders.

Some notes on Empoasca flaviscens: R. L. Webster.

Simultaneous fast and slow drum records of fatigue: F. M. Baldwin.

Nest-digging and egg-laying habits of Bell's turtle: Frank A. Stromsten.

Notes on some of the rarer birds of the Ames region: H. E. Ewing.

Bird records of the past two winters, 1920-1922, in the upper Missouri valley: T. C. Stephens.

Sociology as a science: Hornell Hart.

Chance in development as a cause of variation: P. W. Whiting.

Criteria of superior intelligence: Reuel H. Sylvester.

The mental and physical status of children entering the public schools: J. E. Evans.

Behavior of trapped and banded birds: Dayton Stoner.

BOTANY

A comparative study of the common and red-seeded dandelions: Miss June Berry.

Some influences of the submarginal vein in leaves: Robert B. Wylie.

The sperms of Vallisneria spiralis: Robert B. Wylie.

Types of wound healing in certain foliage leaves: Robert B. Wylie.

Morphology of the vein-islet in certain dicotyledons: Sara I. Lewis.

Bud characters of native trees of Jasper County, Iowa: F. P. Sipe.

The American Lotus: L. H. Pammel.

Some observations on the plants of the Sierras: L. H. Pammel.

Further studies on the germination of trees and shrubs: L. H. Pammel and Miss Charlotte M. King.

The effect of weeds upon crop production: A. L. Bakke and L. H. Pammel.

Notes on species of Rhamnus of southwestern United States and California and the occurrence of Puccinia coronata: L. H. Pammel.

Structure and function of the stigma in relation to the germinative requirements of the pollen in the Easter lily: J. N. Martin, Fred C. Werkenthin and Miss Elizabeth Hudson.

The structure and development of the seed coat and cause of delayed germination in Mellilotus alba: J. N. Martin.

The genus Cucurbita—Its origin, description and key to the species: Fred C. Werkenthin.

The relation of the mosaic diseases of wild catnip and cultivated cucumbers: J. H. Muncie.

Studies of insect transmission and cross-inoculation of mosaic on the Solanaceæ, Cucurbitaceæ and Leguminaceæ: O. H. Elmer.

Nodal infection of corn by diplodia: L. W. Durrell.

Effect of hardness of water on the fungicidal value of mercuric chloride solutions: J. C. Gilman.

A manual of ferns and "fern allies" of Grinnell and vicinity: Henry S. Conard.

A manual of gymnosperms (evergreens) of Iowa: Henry S. Conard.

Parry's Catalog of Iowa Plants of 1848: Miss Winnifred Ellsworth.

CHEMISTRY

IOWA AND AMES SECTIONS, AMERICAN CHEMICAL SOCIETY

A study of dolomites from the Austrian Tyrol: Nicholas Knight.

The role of organic chemistry in plant and animal therapy: Henry Gilman.

A new method for the introduction of an ethyl group: Rachel Hoyle, John B. Schumaker and Henry Gilman.

A rapid and inexpensive electrolytic determination of copper without the use of platinum cathode: Stephen Popoff and T. C. Tucker.

Inexpensive apparatus for use in large classes of quantitative analysis: Stephen Popoff.

The electrometric titration of tin. Critical study of the standardization of solutions for use in titration of tin: Stephen Popoff and F. L. Chambers.

The color of soils as an indication of plant food content and fertility: P. E. Brown.

A chemical classification of the activities of soil micro-organisms: Paul Emerson.

Water purification in Iowa: Jack J. Hinman, Jr.

The electrometric determination of sulfurous acid with permanganate: W. S. Hendrixson and L. M. Verbeck.

The electrometric standardization of titanium solutions: W. S. Hendrixson and L. M. Verbeck.

The electrometric titration of organic acids: J. H. Buchanan and C. J. Meister.

The effect of the introduction of steam into stop end retorts in the manufacture of coal gas: George W. Burke.

A note on lantern slide making: E. W. Rockwood.

The relation of high school chemistry to college chemistry: Edward Bartow.

Studies on Yeast IV. On the presence of the antineuritic and the growth promoting vitamines in yeast grown in a synthetic medium: V. E. Nelson, E. I. Fulmer and V. G. Heller.

Studies on Yeast V. Is bios a single substance? E. I. Fulmer and V. E. Nelson.

A solubility survey—(1) An apparatus for the determination of solubility up to the periodic system: P. A. Bond. *(2) A cross section of the periodic system—solubilities in sulfur dioxide:* M. C. Waddell with P. A. Bond.

Diacyl derivatives of ortho aminonaphthols: L. Charles Raiford and K. C. Armstrong.

The cost of softening water with various soaps: O. R. Sweeney and Robert McKinney.

The possibilities of the commercial utilization of corn cobs: O. R. Sweeney and H. V. Wright.

Alkyl sulfates—(1) Studies on the equilibrium between alcohols and sulfuric acid, and the sulfates and water: Harry F. Lewis. *(2) The relative hydrolysis of the sulfates by water and acids:* H. F. Lewis and O'Neal Mason. *(3) The influence of molecular weights on the hydrolysis:* H. F. Lewis and Arthur Damerow.

Further data on the vitamin "A" content of white and yellow corn: A. R. Lamb.

The colorimetric determination of hardness in water: H. F. Lewis and Arthur Damerow.

Recent attempts to disintegrate the atom: Gerald L. Wendt and Clarence E. Irion.

The decomposition of potassium chlorate. I. Spontaneous decomposition temperatures. II. The effect of pressure on decomposition: F. E. Brown, J. Austin Burrows and H. M. McLaughlin.

James H. Lees,
Secretary

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CONTENTS

COMMON AIMS OF CULTURE AND RESEARCH IN THE UNIVERSITY[1]

By definition universities aim to compass the whole range of knowledge. In practical operation they are characterized rather more by diversity than by unity of effort. It is in the nature of things that bodies so constituted should attempt to express the various phases of thought represented through many kinds of organization, and we expect to see philological, chemical, biological and other types of clubs or societies forming a normal part of the machinery of every great educational institution. According to the particular interests of the moment these agencies within the walls group themselves in different ways to accomplish specific kinds of service.

The most interesting of all organizations peculiar to the university are the two widely inclusive societies representing scholarship or culture in Phi Beta Kappa and research and science in Sigma Xi. These two bodies express in their aims nearly the whole range of higher purposes of academic effort. It has seemed to me that a study of their interrelations, extending to a redefinition of their common objects, might help to set forth that continuously needful statement and restatement of the reason for existence of institutions of higher learning. Inclination to consider the purposes of these societies has been particularly strong as the course of my life has carried me into contact with research and education in such a manner as to bring into close relation, and yet into striking contrast, the types of academic mind which we call scientific and humanistic. Having seen these interests so frequently defined with special reference to their separateness the desire has grown

[1] Presented as the annual address before Phi Beta Kappa and Sigma Xi, University of Pennsylvania, June 13, 1921.

to secure a better understanding of their true relations.

Although recognizing fully the specific aims of scientific and of humanistic investigation one can not avoid being impressed with the importance of considering the similarity of their methods and purposes. It is particularly desirable to consider this interrelation as a great group of thinking people still holds humanistic and scientific problems so different that common criteria may not be used generally in their solution.

Scholarship and culture as they are involved in the aims of Phi Beta Kappa have been considered often to represent a goal quite different from that toward which the scientific investigator strives in Sigma Xi. Scholarship should mean understanding and wisdom, not merely information. Culture has been taken to represent refinement of educational attainment and appreciation of knowledge, coupled with the development of personal characteristics giving that balanced judgment sometimes known as mental poise. Culture should furnish perspective and interpretation. Its perspective should make it possible to fit into their proper relations all available facts and to determine the position which new knowledge should take. In its truest expression it should be active and not passive, constructive and not absorptive. The imitative spirit is its greatest danger. True culture is a comprehensive vision and an attitude of the active interpreting mind.

Sigma Xi was organized to promote comradeship in research. Its activity has been limited not infrequently to the so-called natural history subjects. I am unable to conceive of this organization as functioning logically if it does not cover the whole range of investigative or constructive thought in which the scientific method is used. I think of it as standing for development of the attitude of mind which produces the builder, rather than for conduct of specific researches within a limited field.

Research has been defined as a reaching out to bring together, organize and interpret whatever may be added to our store of knowledge. It may express itself in the most intensive studies in very narrowly defined regions, but is most truly exemplified when it involves the wider relationship of specific facts to the whole structure of knowledge.

In the processes of research it is difficult to distinguish between those operations which are merely the gathering and those which are interpretation and definition. Simple collecting of materials without giving them their proper places and without interpreting them is work of a relatively low order and is doubtfully classed as original investigation.

By definition the present discussion is limited to relationships between culture and research as expressed in the university. A clear understanding of my purpose, therefore, involves recognition of the real aim in university activities. Without intending to offer a complete classification of the objects and plans of educational work it may be well to set forth the following as representing some of the aims of university life. These are, first, to hold before young men and women the mirror of knowledge and experience in which they may be able to see reflected the qualifications which fit them individually for this or that profession; second, to give classified information; third, to develop wisdom or judgment; fourth, to stimulate the growth of constructive or creative ability; and, fifth, to inculcate the element of character, which defines our relation to the world of human life. The highest aims of education are far from being generally understood. Many still think of this agency as informational rather than constructive, teaching imitation rather than initiative, and as focussed upon the past rather than the future.

One of the most fully valid criticisms of university study lies in the fact that too often it looks backward without adequate expression of relation between past and future. The young men and women who form the student body are at that early stage in which they have practically no past and naturally live in the present and future. Their eyes are turned forward with keen expectation of what the coming years may bring. Life and movement of life are to them the supreme enjoyment. Until their individual pasts begin to evidence marked effect upon the trend of their futures, uninterpreted history and experience represent to them only shadowy forms or objects of ill-defined curiosity. Quite in contrast to the ideas of youth the machinery of the university may lend itself to too strong emphasis upon what is behind us. Thus educator and educated seem to look in opposite directions, and like Lot's wife, who "looked back from behind him," the educator may become as lifeless as a stone or fossil without sensing the change, while the company of youth moves on.

With a well-ordered program of university work, development of constructive ideals in the student inevitably carries with it in the scientific studies an unlimited series of questions regarding the relation of each element of nature to other items or forces, and requires recognition of continuity or law through all space and through past, present and future. Similarly in humanistic study the ideals of conduct and character come to rest upon realization of a continuity of interests and responsibilities in the world of human life. These ideas of interrelation, which may in one sense be called law, are necessary to the clear expression of both research and culture. Scientific understanding of nature depends upon our realization of the continuity of its principles of being and action. The meaning of what is covered by culture and scholarship we shall not know adequately until we understand the interrelations of events in the history of human institutions.

Large use of the principle of unity is essential if we would succeed in attaining the ideals of education either in science or in culture. The university programs which have greatest value are not prepared for the immediate future of the student but concern rather his activities at the time of maximum effectiveness. If the student's life be of normal span he graduates near 21 and his period of greatest value to the world lies between 35 and 65, or from ten to forty years after graduation. If the many years of education are to count in the stage of most fruitful service, the work must be carefully planned for attaining this end. It should be clear that the most valuable information which the student carries away is not comprised in the immediately practical things for use to-morrow or the next day, but in the basic principles and methods which in later years will help to answer the new and critical questions certain to arise, and in the answering of which there will be the largest opportunity for personal development. The details of specific studies in university experience are largely lost, but the attitude of mind resulting from honest thought, and the elemental laws which furnish the foundation for all constructive work will be of increasing importance.

From the point of view of culture and also of science the subject of history is one of the greatest of all agents for making possible our understanding of the principle of continuity. History has not too often been considered a science, although in its effect upon the human mind its operation is almost identical with the idea of continuity or unity in physical laws. It has had too small a part among the great opportunities of humanistic education. Oddly enough the tritest phrase growing out of this study is that "history repeats itself," and therefore we seem only to be studying a past which in effect may be repeated in the present or future. But what is it that history repeats? In addition to the idea of continuity, the most evident things coming out of historical research are that history expresses two almost unvarying principles, one, instability, the other, progress; one the view that everything is subject to change; the other that this instability includes in its operation a general movement toward what is more complex and in the realm of intelligence toward fuller comprehension and understanding. I am willing that this statement be challenged, and shall not attempt within these narrow limits to give it full defense. It may only be remarked that if this view be accepted there is no greater lesson to teach a student than that, contrary to commonly accepted conservative views, the future in which he will live his life will not be like either the present or the past. The direction of movement in the future may, however, be indicated by the evidence drawn from a careful scrutiny of history.

In preparation for later life, the well-trained student of history will look forward with a definite expectation of shifting lines, and should be prepared for those situations in which judgment may be exercised either to accelerate or to retard the natural movement of progress. The laws of history show us a normal instability which should be recognized and capitalized. We should expect to interpret the trend of events. The gift of intelligence puts before us the opportunity to help naturally with normal progress. The possibility which increased knowledge gives for greater evil does not mean that evil must therefore be done. It is only an evidence of wider range of capacity. It is scarcely conceivable that with all the consequences clearly understood real intelligence could permit the following of a path that would lead to its own destruction.

It is difficult to discuss the influence of culture in the broader sense upon science and research, or the relation of these two elements with the current reversed; but in the hope that the effort will be understood as an attempt to view the problem constructively, I venture to suggest what seem to be some of the normal interactions.

Let us assume for immediate purposes of this discussion that the essence of research is the attempt to understand, organize, utilize and increase our store of knowledge. The only persons who are not believers in the value of research are those who studiously keep away from the borders of knowledge. To one who has investigated in any subject our painful limitations are only too evident. The successes of research in every field within the past decade show that the possibilities open more widely with every discovery. One of the most dangerous types of people we may have engaged in handling affairs of moment is that which assumes all useful knowledge to be comprised within the facts already assembled and fails to recognize the possibility of progress in nearly every direction in which we choose to investigate.

Progress in discovery and in constructive thought has increased our social inheritance so rapidly that the luxuries of one age often become necessities of the next. If life is defined as a form of motion, true living in the human sense is a state of motion in which the conditions seem not fully satisfied without a kind of advance which we call progress. I doubt whether happiness is possible without a sense of accomplishment, either individually or socially. Research by bringing a stream of new materials into application serves as one of the most important agents for making human progress and happiness possible.

In order that we may know the materials with which we are to work in the future, education must present organized and simplified knowledge to each incoming generation. In addition to pointing out what is already known it is the duty of the university to indicate the direction in which progress may be expected or desired. It is important that special stress be laid upon the kind of thought and the methods necessary for progress in order that the future investigator may do his part. Among the greatest teachers within or without the university we rank those who have set forth not only what is known but also what should be known and should be done. In general they have shown the way by example as well as by precept and have been among those advancing exploration, discovery and philosophic interpretation.

I believe that the lessons of history suggest continued advance or progress of the human type, both in social organization and in physical being. Social evolution represents an unbroken train of experience and therefore gives the greatest possibilies for accumulation of power and of opportunity to use it. In this type of evolution research is the most effective instrument employed. Physical evolution is related to replacement of individuals in the succession of generations. Without physical advance the limits set for mental capacity in individuals will mean the ultimate attainment of a level of social evolution beyond which we may scarcely reach; but what I see of history expands my optimism to accept the view that nothing within our horizon of information gives evidence that the final stage of physical betterment is yet in sight. I do not believe that with increasing knowledge we shall lose such opportunity for advance as may still be open to us.

Research in science has suffered severely, both within and without the university, by reason of failure to recognize the magnitude of the field in which it operates and the interrelation of the elements comprised in it. The researcher must, by definition, be a specialist, in that he should understand more fully than any other person the height or depth or breadth of a particular element or law of nature. Narrow specialization is often considered to represent research, and contraction of the limits of investigation is not infrequently desirable. But the greatest specialist does not merely go up high or down deep. He sees from these advantageous positions the real significance of his explorations. If he proceeds far in any direction without interpreting what is learned in terms intelligible to others, the journey has been merely a personal excursion and not a contributing voyage of discovery.

I come therefore to speak particularly of the need for contact between research and culture, in order that the broader human relation of culture and scholarship may bring to research a better power of expression and a deeper interest in its ultimate significance, thus making more useful the fruits of discovery. Research may profit greatly by contact with every human interest involved within the wide comprehension of culture. Much of the material uncovered by constructive work in science has not reached utility or become real contribution to humanity by reason of the view that investigation is complete without interpretation, or that it is an end in itself without regard to human use or meaning.

Science and research have missed great opportunities because of aloofness from the more strictly humanistic aspects of investigation extending into the realm of culture. Problems of research have so multiplied within the field of natural science that there has perhaps been good reason for our failure to discover that the most complicated, and therefore in many ways the most attractive problems possible to the investigator are above and beyond those which have mainly engaged our attention. Important as are the nature of matter, chemical affinity and organic evolution, some of the greatest fields for discovery still relate to the fundamental understanding of human behavior and cultural interests, both in the individual and in the group sense. With adequate cooperation between the scientific investigator and the humanist research should advance rapidly in the study of man and his cultural expression. Investigation of the physical basis of mental action may never produce such results as have recently revolutionized natural science. On the other hand, it may be that human research will go farther beyond our present knowledge than radioactivity has carried us forward in physics. Are we to believe that man, probably the most complicated of all objects or instruments in the universe, may be neglected as the object of research by reason of his high level of development? Is it not clear that added knowledge, such as should be secured by united effort of the scientific investigator and the humanist, would give further control of our powers and greater satisfaction in their use?

It is with the hesitation of one known as a representative of the scientific school that I touch upon the other phase of the problem, namely, the possible contribution of research to culture and scholarship. If I were to indicate what might from my point of view seem a dangerous element in scholarly and cultural studies as contrasted with the situation in science and research, it would be to suggest that there is not in any branch of knowledge a finished chapter or a closed book, and that there is no field in which the principle of growth and progress may not be expressed profitably through constructive work. Culture must in some measure stand for conservatism and precedents. Theology tends by definition to be one of the most rigid of all phases of human thought, but scholarship stands next in rigorous adherence to standard. This condition is natural. Even the normal instability of evolution shows generally a stately and unhurried movement which illustrates the idea of standards in rate of change. The researcher states, "There is more unknown than known"; the scholar says, "We have before us only the known and must therefore base our practical lives upon it."

Scholarship in a passive or conservative position diminishes its value. Culture not merely sets standards of form but may also indicate the rate of progress. It may not only require that we know the best from the past, but should demand the best that can be secured in the present and future. The study of human actions and interests is not to be limited by assumption that creation, even in the human sense, is ever complete, or that existing states of law or culture are final. Science and research should be tied to the humanistic group of agencies for a combined investigation of problems of every kind relative to man. Culture should be a constructive force with the authority of history, and an active source of ideas and ideals.

Research and cultural activities not merely overlap and have common aims, but their highest expression develops through influence of similar types of constructive ideals. The idealism which gives life and hope to culture and science may be academic, unprofessional, or even unfashionable, but it has contributed much toward securing the present privileges of humanity. The practical man insists that he is limited by what is and not by what might be. The idealist dwells upon what should be, with the hope that what is, by reason of its instability and by virtue of the laws of change, may ultimately come to be the thing desired. The practical man with his hands tied by what he *must* do sets precedents and limits which sometimes bind the wheels of progress. The idealist, with the widest view of unity and movement reaching through the universe of being and of thought, visualizes the larger possibilities and helps to sweep away obstacles in the path of advance along lines of natural development.

And so, without further expansion of this view, it is clear that I do not hope to see less diversification in university activity but only more unity. We should represent here every type of thought. We must assemble, organize, interpret and construct in every region over which knowledge may extend. We must have differing types of mind and multifarious points of view. With meticulous refinement of technique some will seek out the minutest details of obtainable information and set them in order with relation to the ocean of available facts. Some will work upon the nature of matter and others on the theory of the state. But with all this differentiation, the principles of unity, or law, and the interrelation and interdependence of all knowledge should everywhere be recognized and made the basis of advance in thought. The delight in construction and the joy in expectation of progress should be lessons of experience which no one could fail to understand. Culture and scholarship should help science and research to better orientation. The explorer and builder should be imbued with that culture which gives the clearest vision of the road for human progress.

We must not forget that for each individual the end and aim of university effort is the securing of that knowledge which fits him into the niche in which he may perform the largest service; and that the university is not an apprentice shop, but is a source of ideals and a type of environment peculiarly fitted for growth of constructive minds. Let us be clear that whatever the university gives represents wasted time, effort and material, unless it is received in a spirit of reverence and with the idea that the greatest satisfaction lies in service as a builder who does not work for personal ends. It is said that geniuses are born, not made; but those who come into the world to live non-contributive, purely individual lives, leaving the world no better than they find it, we may truthfully say are only made, not born. Contribution to meet real human needs gives perhaps the only way by which we obtain full right of recognition as individuals in the strictly human sense. We may not know why living things must grow if they would live, or why history has given a choice between progress and oblivion, but the thinking world has always recognized the validity of this view.

We remember that the Great Teacher explained to Nicodemus the Pharisee: "Marvel not that I said unto thee, Ye must be born again." With all the spiritual meaning that this saying carries may it not suggest to us also that constructive service gives, with a sense of reality, a new and true life, a verifiable personality in the kingdom of creative beings. What greater work can a university perform than through its vision, its constructive power and its culture to open the way to that kind of service which brings the joy of progress and the continuing rewards of real accomplishment.

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THE WORLD'S SUPPLY OF IODINE IN RELATION TO THE PREVENTION OF GOITRE[1]

OWING to the varying reports as to the concentration of iodine in sea water, I have made a number of determinations on water dipped from the Santa Monica, Cal., pier. Even after filtration, this water contained so much colloidal material as to interfere with the determinations. It was finally observed that thorough shaking with carbon tetrachloride and filtration removed this sufficiently to make analysis possible. The carbon tetrachloride was purified by the addition of a drop of bromine, action of sunlight and shaking with an excess of sodium thiosulfate solution. In determining this excess, some very dilute sodium carbonate solution was poured into the carbon tetrachloride and tenth normal sodium thiosulfate run in, about half a cc. at a time, followed by shaking, until the color disappeared. This solution was separated off and more carbonate and about two cc. of thiosulfate added with thorough shaking, followed by separation of the water phase. The carbon tetrachloride was then dried and distilled, the first distillate being rejected.

It was found that evaporation of the sea water until sodium chloride began to crystallize out made it acid, due to precipitation of calcium carbonate and the hydrolysis of $MgCl_2$, magnesium being a weak base, but there was no loss of iodine. Furthermore, a dry salt could be made of the sea water, without appreciable loss of iodine. This was accomplished by evaporation until the calcium carbonate precipitated; precipitation of the remaining calcium and magnesium by the addition of 100 cc. of seven per cent. Na_2CO_3 solution for each liter of original volume; filtration; washing the precipitate on the filter and evaporation of the filtrates to dryness.

[1] From the Southern Branch, University of California, and the University of Minnesota.

In the analysis of the iodine content of salt, it was dissolved in water and the same procedure followed as with brine. In analyzing water or brine, standard solutions of the same NaCl content but varying concentrations of iodate were made up and treated in the same way as the unknown. The quantity of reagents added varied with the samples, and no portions were thrown away until the yield of iodine was found to be complete. Each sample if not near neutrality, was neutralized, using test paper, and about 10 cc. of concentrated HCl per liter added. In case buffers were present, at least enough acid was added to react acid to brom-phenol-blue (or methyl-orange). An excess of arsenious acid was added to reduce the iodate to iodide, the equivalent of 1 to 10 cc. of tenth normal per liter, and allowed to stand 20 minutes or more. At this stage colloids, if present, were removed. One per cent. sodium nitrite solution was added to the extent of ten times the quantity of arsenious acid. The sample was then extracted with several portions of carbon tetrachloride, which were then collected in a separatory funnel. In cases of 0.04 milligram per 100 cc. of the sample, a pale pink color could be detected in the carbon tetrachloride. The smallest workable quantity, often 1 cc. of very dilute (less than 0.1 per cent.) sulfurous acid was shaken with the extract until complete extraction of the iodine was effected. The carbon tetrachloride was removed from the sulfurous acid solution and a drop of concentrated sulfuric acid added, followed by sufficient sodium nitrite solution to oxidize the sulfurous acid and completely oxidize the iodide to iodine. The iodine was extracted with a sufficient quantity of carbon tetrachloride to fill the colorimetric apparatus (which varied in nature with the size of the yield) and compared with the standards. There must be nearly the same quantity of iodine in the final standard taken for comparison as in the unknown, and the treatment must be identical, quantitatively, especially in regard to volume relations and thoroughness of shaking.

The quantity of iodine found in the sea water was 0.05 milligrams per liter, which is a confirmation of the findings of Winkler for

Adriatic sea water. Winkler probably had less decaying organic matter in his samples than were present in mine, as he makes no mention of difficulty on account of the presence of colloid material.

A sample of water which I dipped up from the Saltair pier, in the Great Salt Lake, Utah, contained only 40 per cent. more iodine than in sea water although the chlorine concentration was about 500 per cent. greater than in sea water. Since the Great Salt Lake is the residue left from the evaporation of Lake Bonneville, which was 1,000 feet deeper than the Great Salt Lake, and received practically all of the drainage of the Great Basin, covering Utah and parts of neighboring states, we have here a demonstration of the small quantities of iodine that are given up in the weathering of both igneous and sedimentary rocks.

Practically all of the iodine of the earth's surface is in the sea, which contains about sixty billion metric tons of iodine in the form of inorganic salts. This iodine probably entered the sea at the time chlorine accumulated in it. Iodides were probably the most soluble salts on the earth's surface, chlorides being next in solubility. If the earth was once hot on the surface, it is probable that hydriodic acid existed in the atmosphere and was washed into the sea with the first rain. Insoluble iodides of heavy metals are considered by Emmons to be secondary formations, due to the seepage of sea water through ores.

Judging by the prevalence of goitre, there is often a deficiency of iodine in our food and drink. At present, so little is known about the exact quantities of iodine taken into our stomachs that we can judge only by the number of cases of goitre. Omitting the details of local distribution of goitre, there is a wide goitre belt extending north along the Appalachian mountains to Vermont, thence west through the Great Lakes region to Montana and Washington and turning south it finally includes all of the Rocky Mountain and Pacific states. In fact, the goiterous belt includes the mountainous and glaciated regions. Since the run-off from mountainous and glaciated regions has carried away so much of the soluble material, it seems likely for this reason in addition to other evidence that the goitre belt is a low iodide belt.

Since the goiter belt includes large cities and millions of population, it seems unlikely at present that all of its inhabitants will receive iodide medication in pure form. Since the sea contains the bulk of the supply, the transfer of iodine from the sea to our food or drink should be increased. Perhaps the most attractive method is the inclusion of sea-foods in our diet, but this is limited. Dr. Turrentine of the Kelp-Potash Plant at Summerland, Cal., informs me that powdered kelp, when added in small amount to food can not be tasted and when added in larger amount imparts a pleasing taste to it. Since it is richer in iodine than ordinary sea-food and is relatively abundant, it should be an important source of iodine in our diet. Since sea water and salt-deposits contain iodine, salt might be made an important source of iodine in our dietary scheme. Blood and shell fish are about the only foods that do not require the addition of salt to make them palatable and fill our physiological needs, and hence the presence of iodine in salt would insure its universal consumption. Mr. O. S. Rask and myself failed to find iodine in any one of a number of samples of salt examined. Salt could easily be prepared from sea water as described above with the retention of the iodine compounds and at a cost not exceeding that of present-day table salt. Some of the magnesium carbonate precipitated from it could be added later if it be desired to make a shaker-salt, but from a nutritive standpoint, the addition of calcium phosphate for this purpose is highly desirable.

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INTERNATIONAL MEETING OF CHEMISTS AT UTRECHT

At Utrecht on June 21 to 23, there was held the first gathering at which chemists from Germany and Austria have met with chemists from England, America and other countries for the presentation and discussion of scientific papers. The following persons were present: America: L. M. Dennis, D. A. MacInnes, W. A. Noyes.

Austria: E. Abel, J. Billiter, F. Emich, A. Kailan, A. Klemenc, F. Pregl, A. Skrabal, R. Wegscheider. Czecho-Slovakia: J. V. Dubsky, A. Simek. Denmark: N. Bjerrum, J. N. Brönsted, J. Petersen, Chr. Winther. England: E. C. C. Baly, F. G. Donnan, W. C. McC. Lewis. Germany: M. Bodenstein, G. Bredig, O. Hahn, P. Pfeiffer, R. Schenck, W. Schlenk, A. Stock, P. Walden, H. Wieland. Holland: J. Backer, J. J. Blanksma, Ernst Cohen, A. F. Holleman, F. M. Jaeger, H. R. Kruyt, W. Reindeers, P. van Romburg. Latvia: M. Centnerschwer. Russia: N. Schilow. Switzerland: J. Piccard.

The original suggestion of the meeting was made by Professor Donnan of London and preliminary plans were made at a meeting in the home of Professor Cohen of Utrecht in June, 1921. The details were carried out by Professor Cohen.

The following scientific papers were read and discussed:

E. C. C. Baly (Liverpool): Photochemical Catalysis.

P. Walden (Rostock): Ueber freie Radicale.

W. A. Noyes (Urbana): Positive and Negative Valences.

W. Schlenk (Berlin): Beiträge zur Chemie der freien Radikale und über den wechselnden Affinitätswerth der Kohlnstoffverbindung.

M. Bodenstein (Hanover): Die photochemische Bildung von Phosgen.

L. M. Dennis (Ithaca): The Preparation and Properties of Metallic Germanium.

H. Wieland (Freiburg i. B.): Ueber freie Radicale.

N. Schilow (Moscow): Vertheilungs-gleichgewichte.

J. Piccard (Lausanne): Absorptionsfarben zweiter Ordnung.

E. Abel (Vienna): Ueber direkte und indirekte Esterbildung in absolutem und wasserhaltigem Glyzerin (Nach Versuchen von Karl Heidrich).

A. Klemenc (Vienna): Dampfdrucke isomerer Benzolabkömmlinge.

M. Centnerschwer (Riga): Vorschlag zur Einführung einer kleinen Masseneinheit (Radion).

At a reception in Hotel Pays-Bas, Wednesday afternoon, there were addresses of welcome by G. L. Voernman, president of the Chemical Society of Holland, by Professor Went, president of the Royal Academy of Science of Amsterdam, and a response by W. A. Noyes, of Urbana.

The delegates were royally entertained at luncheon and at dinner each day, and on Friday there were tea and a reception given by Count van Sanderburg in his palace.

The gathering was not only for the purpose of promoting the development of chemistry through the discussion of topics of common interest by men from widely separated countries, but it was also a frank attempt to renew old friendships and form new ones between men of nations recently at war. Expression of a desire to promote permanent peace met with a hearty response.

RESPONSE BY W. A. NOYES, UTRECHT, JUNE 22, 1922

It is a great pleasure to be present at this international meeting in Holland. Last year you sent to us in America a fine representative in the person of Professor Cohen. When he was at our university in Urbana, we not only listened with great interest to the account he gave of the fine scientific work which he is doing in the van't Hoff Laboratory but we were also glad to hear of the scientific and intellectual life of your universities. We were particularly impressed by a statement he made to us about the Nobel prizes. You have here some five million people—some one says six million—I do not know very accurately—but he told us that you have received in Holland five Nobel prizes for scientific work. We in America have somewhat more than a hundred million people and we have received two prizes for such work. I am sure no other country can show such a record as Holland of nearly one prize for each million of her inhabitants. Professor Cohen also told us a part of the secret of your unparalleled work in science. He said that it is written in the fundamental laws of your state that the universities are founded to train men for the service of the state and also to train them in the methods of research. You have reason to be very proud of the way in which the spirit of your law has been carried out.

We are here for serious scientific discussions but there is another thought very much in the minds of every one. For the first time there is gathered here an international group of chemists from nations that were on opposite sides during the great war.

On my last day on the other side of the Atlantic I spent a few hours in Quebec. There, many years ago, two great generals fought each other on the Plains of Abraham. Those generals both died in the battle and there on the front of the Parliament House I saw the statues of Wolfe and of Montcalm standing side by side. In that Parliament House meet the representatives of a nation part of whose people still speak French and part of whom speak English. Those two statues are, to me, prophetic of that which must come if Europe will not destroy herself. We are learning during these days the help which comes from talking over our scientific problems together. There is almost no limit to the advances which the world may make if nations can be willing to live together at peace. I have a great hope that states will learn those same lessons of the value of international cooperation and helpfulness that scientific men learned long ago. Let us hope that our meeting may contribute a little toward that end as well as do something for the advance of chemistry.

SCIENTIFIC EVENTS

THE ROYAL SANITARY INSTITUTE

The *British Medical Journal* reports that the thirty-third congress of the Royal Sanitary Institute, which was held at Bournemouth from July 24 to 29, was attended by some 500 persons, including delegates from the British dominions and colonies and from many foreign countries, as well as by representatives of government departments, county and town councils, and other public bodies. The president of the congress was Major General J. E. B. Seely, M.P., who in his presidential address protested against economies at the expense of the public health, and said that the three very important principles which lay at the basis of the congress were, first, the vital necessity of the health of the people to the maintenance of the British Empire; second, that national health required the organization of all the various agencies; and third, that the health policy of the nation should not be merely the prevention of disease and premature death, but the increase in human capacity and happiness. Great advances had been made in the provision of cleaner towns, better sanitation, good water supplies, food control, drainage and sewerage, but not enough had been done for the education of the people in a healthy way of life. The housing problem could be solved only by steady and persistent work in every district over a number of years. Curtailment in the school medical service had been spoken of in the interests of economy, but he considered that that service was not only saving the lives of hundreds of children, but was laying the foundation for a healthy nation in years to come. Meetings for the reading and discussion of papers were held in five sections: Sanitary Science, Engineering and Architecture, Maternity and Child Welfare, including School Hygiene, Personal and Domestic Hygiene, and Industrial Hygiene. In the Section of Sanitary Science a discussion was held on methods of securing continuous treatment of persons infected with venereal diseases, in which papers were read by Dr. J. Johnstone Jervis, Dr. W. E. Facey, Mr. Kenneth Walker, and Dr. Joseph Cates. In the Section of Maternity and Child Welfare including School Hygiene, papers were read by Dr. John Robertson on the regulation of the distribution of milk and food at maternity and child welfare centers, and by Dr. D. C. Kirkhope on certain preventive and curative aspects of the school medical service. Papers were also read on different aspects of maternity welfare by Mr. Aleck W. Bourne, Dr. R. Veitch Clark, and Dr. R. J. Maule Horne. In addition to the meetings of the sections, a number of conferences were held of sectional representatives, such as sanitary authorities, medical officers of health, engineers and surveyors, veterinary inspectors, sanitary inspectors and health visitors. The popular lecture, on "The value of clean fresh air," was delivered by Professor Leonard Hill, F.R.S., who said that physiologists could help greatly to point the way to a happy and healthy life, but ignorance and custom enveloped the people, and it was problematical whether our civilization might not stifle itself like older civilizations and die out. The discipline and the laws of health, which included moral restraints, alone could save it.

THE FRENCH DYE INDUSTRY[1]

The issue of *La Nature,* April 15, contains an interesting summary of the French dyestuff industry, particular attention being paid to progress made since 1914. In 1913, 2,000 tons of dyes, of the value of seven million francs, were imported. Eighty-five per cent. came from Germany and ten per cent. from Switzerland. The balance of the consumption of 9,000 tons represented French manufacture. It is pointed out, however, that the dyestuff factories of France, of which there were four, were almost completely dependent on Germany for intermediates, the home production of which represented scarcely ten per cent. of the requirements. There were in addition German works which received intermediates or even finished dyes from Germany. The article refers to the ready adaptation of the dye works in Germany to the manufacture of munitions during the war, and does not omit to point out that, without the means of obtaining synthetic nitric acid, which the enemy had also perfected, his dye works would not have been of the slightest use to him.

The French efforts during the war are described at length. In April, 1916, the Syndicat National des Matières Colorantes was established, which had relations with the state and further arranged to take over after the war the national factories used in the manufacture of explosives. The Compagnie Nationale des Matières Colorantes et de Produits Chimiques was constituted in January, 1917, and at once set to work. Two factories rapidly grew up, the first at Nogent-les-Vierges on a semi-technical scale, and a large factory at Villers-St-Paul, with a contemplated capacity of 4,000 tons of synthetic indigo a year. This was abandoned during the German advance in 1918 and the material removed to Lyons, but it has again been set in operation, and, as a result of intensive work, the total production of the French factories had grown from 175 tons in 1919 to 765 tons in 1920. Since that time the production has decreased on account of the economic crisis, although the capacity of production is now stated to exceed 13,000 tons. With a few exceptions, dyes of all the main types are manufactured and progress is being made.

The company has two large centers of production. The Oissel Works, installed at the old national factory, with an area of 39,000 sq. m. of buildings, is connected with the main line from Paris to Rouen. The power is generated by turbo-alternators of the most modern type, each of 1,000 kilowatts. The factory is at present making intermediates, of which more than sixty are being produced, together with sulphur dyes and azo-dyes. These are produced directly from the intermediates without isolation of the latter from solution.

The second works is that at Villers-St.-Paul, with an area of 35,000 sq. m. of buildings, on the main line from Paris to Compiègne. A very modern boiler plant is installed, which when complete will consume 300 tons of coal daily. In this works are made the dyes which require special apparatus, such as indigo and alizarine, phthalic acid and basic dyes derived from it, triphenyl and diphenylmethane dyes, pyrazolone dyes, etc. Vat dyes are also made, and there are large research laboratories.

At Saint-Denis the old works has been enlarged, while a new works at Isère grew up during the war. It is stated that prices are now high owing to high costs of raw materials, and the yields could also be improved by the further efforts of the chemists, and particularly of the engineers.

[1] From *Nature.*

GOOD ROADS SCHOLARSHIP

Names of judges appointed to award the four years' university scholarship offered in connection with the national good roads essay contest are announced by the Highway Education Board.

The judges are: Henry C. Wallace, secretary of agriculture; George Horace Lorimer, editor of the *Saturday Evening Post,* and Dr. John Grier Hibben, president of Princeton University. The judges accepted responsibility for the award of the scholarship at the invitation of Dr. John J. Tigert, United States commissioner of education, who also is chairman of the board.

They have been supplied with copies of

fifty-four essays, representing each state, as well as the District of Columbia, the Canal Zone, the Philippines, Porto Rico, Hawaii and Alaska. Selection of the best essays, out of the thousands written in the states and territories, was made by leading educational institutions, such as a state university, or the state department of education.

It is estimated by officials of the board that at least 250,000 pupils of high school grade participated in the contest, and these fifty-four manuscripts, therefore, represent the cream of all papers presented. Essays were written on the subject, "How good roads are developing my community." In many states local prizes were given, as well as state prizes by the institutions conducting the contest.

The scholarship is given by H. S. Firestone, Akron, Ohio, a member of the Highway Education Board. It is intended to defray tuition and expenses of the student in college and is valued at not less than $4,000. The successful student, to be selected by the judges, may attend any college or university in the United States. It is expected that the judges will reach a decision in time to permit the successful boy or girl to enter college this autumn. The scholarship is given annually for the best essay on a subject pertaining to good roads.

THE ASSOCIATION OF IRON AND STEEL ENGINEERS

The sixteenth annual convention will be held September 11 to 15, at Cleveland, Ohio. Following is the tentative program:

MONDAY, SEPTEMBER 11

9:30 A.M.

Business session—Election of officers.

2:00 P.M.

Report of Standardization Committees. F. W. Cramer, chairman.

Report of Sub-Committee on Motors. D. M. Petty, chairman.

Report of Sub-Committee on Lighting. R. G. Bauer, chairman.

Report of Sub-Committee on Control. F. W. Cramer, chairman.

Report of Sub-Committee on Cranes: "Résumé of AI&SEE Crane Code." R. S. Shoemaker, chairman.

Report of Sub-Committee on Transmission: "Investigation of Insulators for Steel Mill Service." A. R. Leavitt, chairman.

Report of Electric Development Committee. R. B. Gerhardt, chairman.

Report of Electric Furnace Committee. E. T. Moore, chairman.

Report of Safety Committee. "Safety Organization—General Safety Rules." F. A. Wiley, chairman.

TUESDAY, SEPTEMBER 12

9:30 A.M.

"Generating Station Development": D. B. Rushmore and E. Pragst.

2:00 P.M.

"Electrification of the International Nickel Company's Works for Monel Metal": F. C. Watson.

WEDNESDAY, SEPTEMBER 13

9:30 A.M.

"Steam Turbine Operation": L. W. Heller.

"Internal Combustion Engines for Power Generation in Steel Mills": D. M. Petty.

2:00 P.M.

"Judging the Combustion of Gaseous Fuels from Gas Analysis": A. G. Witting.

Topical Discussion—"Boiler Practices of 1922": J. B. Crane, E. R. Fish, Alfred Cotton, R. E. Butler, R. M. Rush and P. H. Falter.

THURSDAY, SEPTEMBER 14

9:30 A.M.

"A Review of Steel Mill Electrification": B. G. Lamme and W. Sykes.

2:00 P.M.

"Improvement in Efficiency of Electric Power Supply": Dr. C. P. Steinmetz.

7:00 P.M.

Sixteenth annual banquet.

FRIDAY, SEPTEMBER 15

9:30 A.M.

"Some Considerations in the Electrification of the Steel Plant Railroad Yard": R. B. Gerhardt.

2:00 P.M.

Inspection trips—Cleveland industrials.

SCIENTIFIC NOTES AND NEWS

The centenary of the death of two distinguished astronomers occurred last month. William Herschel died on August 25, 1822, and Jean Baptiste Joseph Delambre on August 19.

At the meeting of the French Association for the Advancement of Science, held at Montpellier from July 24 to 29, M. Mangin, director of the Paris Museum of Natural History, gave the presidential address on the "War against the enemies of plants." M. Desgrez presided, and M. Viala was chosen to succeed him in the presidency. The meeting next year will be at Bordeaux.

M. Bergson presided at the two sessions of the Committee on Intellectual Cooperation of the League of Nations that met at Geneva on August 1. Reports were presented by M. de Reynold, of Switzerland, and Mme. Curie, of France, respectively, on the situation in Austria and in Poland. The question of international cooperation in bibliography was discussed and a committee was appointed consisting of M. J. Destrée, of Belgium, M. de Reynold, Miss Bonnevie, of Norway, and Mme. Curie.

The astronomers who are visiting Australia for the eclipse were given a civic welcome on August 8 by the Lord Mayor of Melbourne and afterwards entertained at luncheon by the federal ministers at the Federal Parliament. The prime minister expressed the willingness of the government to afford the utmost facilities to ensure the success of the expedition. Dr. W. W. Campbell, director of the Lick Observatory, replying, said that Australia had shown greater interest and rendered more assistance than the government of any other country for previous expeditions with which he had been associated.

Henry Edward Pellew, of Washington, has become Lord Pellew, the sixth viscount of Exmouth, at the age of ninety-four years. The title will devolve on Dr. Charles E. Pellew, of New York, formerly associate professor of chemistry in Columbia University.

Dr. Robert Aitken, astronomer, Lick Observatory, has returned from the meeting of the International Astronomical Union which was held from May 2 to May 10 at Rome. Dr. Aitken acted as chairman of the commission on double stars at the international meeting and was re-appointed chairman of the commission for the period 1922-25. He was also made a member of the commission on positions and orbits of minor planets, satellites and comets. Dr. Aitken took part in the meetings in celebration of the centenary of the Royal Astronomical Society of London which were held from May 28 to May 31 in London. While there Dr. Aitken had the honor of presenting the Bruce Gold Medal of the Astronomical Society of the Pacific to the astronomer royal, Sir Frank Watson Dyson.

Dr. J. S. Kingsley, who has been on leave of absence for the past year, has retired from the faculty of the University of Illinois with the title of professor emeritus of zoology. His address for the future is 2,500 Cedar Street, Berkeley, California.

Professor G. A. Miller, of the University of Illinois, has recently been elected an honorary member of the Indian Mathematical Society. This society was organized in 1907 and its membership list, dated 1922, includes about 200 names. It then had only one honorary member.

Professor L. Bairstow has been elected chairman of the Royal Aeronautical Society in succession to Lieutenant Colonel M. O'Gorman.

A. W. Ambrose, chief petroleum technologist of the United States Bureau of Mines, has been appointed assistant director of the bureau, to fill the vacancy created by the resignation of E. A. Holbrook, who has accepted the deanship of the mining school at Pennsylvania State College. The duties of F. J. Bailey, assistant to the director, have been increased by assigning to him virtually all the business matters of the bureau formerly handled by the assistant director.

Colonel Delcambre has been appointed director of the French Meteorological Office.

Harold E. Babcock, of Cornell University, has resigned his position in the department of farm management and agricultural economics of the College of Agriculture to become manager of the Cooperative Grange League Federation Exchange.

Dr. D. I. Andronescu, of Emerson, New Jersey, has accepted a position with the Department of Agriculture of Romania as chief of the department of plant breeding. His address will be Statiunea Agronomica, Baneasa-Bucuresti, Romania.

Among the British civil list pensions granted "in consideration of their circumstances" during the year ended March 31, 1922, and announced in *Nature* are: Lady Fletcher, in recognition of the services rendered by her late husband (Sir Lazarus Fletcher) to science, £60; Dr. Francis Warner, in recognition of the services rendered by him in his investigations into the mental and physical condition of defective children, £100; Sir George Greenhill, F.R.S., in recognition of his services to science and his ballistic work, £125; Mrs. J. M. Miller, in recognition of the services rendered by her late husband (Dr. N. H. J. Miller) to agricultural science, £50; Mrs. Alice Mabel Ussher, in recognition of the services rendered by her late husband (Mr. W. A. E. Ussher) to geological science, £50; Mrs. Agnes E. Walker, in recognition of the services rendered by her late husband (Mr. George W. Walker, F.R.S.) to science, £75; the Misses Ellen C., Gertrude M., Alice B., Katherine E. and Mary L. Woodward, in recognition of the services rendered by their late father (Dr. Henry Woodward, F.R.S.) to geological science, £125.

According to the *Journal* of the Washington Academy of Sciences, at a meeting of the executive committee of the Institute for Research in Tropical America it was decided to concentrate the efforts of the institute on the establishment of a research station in Panama near the Gorgas Memorial Institute which is to be erected in the outskirts of the city of Panama. The members are Thomas Barbour, Harvard University; H. E. Crampton, Barnard College (representing the New York Academy of Sciences); A. S. Hitchcock, Smithsonian Institution; A. G. Ruthven, University of Michigan, and Dr. Witmer Stone, Philadelphia Academy of Sciences.

M. Daniel Berthelot, professor of physics in the University of Paris, gave the lecture at the joint meeting of the five French academies held on July 17.

Dr. Stephen Smith, distinguished for his contributions to public health, died on August 26, in his ninety-ninth year.

Gisbert Kapp, born in Austria in 1852, professor of electrical engineering at the University of Birmingham, died on August 10.

Mrs. J. A. Owen Visger, author of books on natural history, died in London on July 30, at the age of eighty years.

Hans Batterman, at one time director of the astronomical observatory at the University of Königsburg, has died at the age of sixty-two years.

M. Louis Favé, known for his work on oceanography, died on July 31 at the age of sixty-nine years.

The third annual meeting of the Southwestern Geological Society will be held at Dallas, Texas, on September 15 and 16. Visiting geologists, who are in that part of the southwest are invited to be present at this meeting.

The Gutiérrez prize of 400 pesos will be awarded by the Havana Academy of Sciences for the best work on the medical geography of some part of Cuba. The Cañongo prize of 200 pesos is offered for the best work on any scientific subject, and the Gordon gold medal for the best work on the "Physiological conception of sleep." The competing articles must be sent in anonymously, and be in the hands of the secretary before March 30, 1923.

An institute of theoretical and applied optics has been established at Paris with a course lasting two years and a laboratory for research. A monthly journal has been established with the name *Revue d'optique théoretique et instrumentale,* which has the cooperation of the French syndicate of makers of optical apparatus and instruments of precision.

Nature states that a new biological station for the study of limnological problems and for research on the development of fresh-water fishes has been established at the Lake of Trasimeno, in Umbria. The University of Perugia has assumed responsibility, and the director of the station is the professor of physiology, Dr. Osvaldo Polimanti.

According to *The Experiment Station Record,* the entomological laboratory and offices of the Station Agronomique de la Guadeloupe were recently destroyed by fire. Among the material lost was the mailing list, and the station asks to be informed of individuals and institutions desiring to continue to receive its publications. Correspondence should be addressed to the director, Station Agronomique, Pointe-à-Pitre, Guadeloupe, West Indies.

At the meeting of the American Psychological Association at Princeton in 1921, there was constituted a Section of Consulting Psychologists to represent persons able to carry on the applications of psychology at a recognized scientific level. Up to the present, the membership in this section has been restricted to members of the Section of Clinical Psychology. Applications for membership to the Section of Consulting Psychologists can now be received from all members of the American Psychological Association who are engaged in the applications of psychology. The committee in charge will act upon these applications at the next annual meeting of the association. For further information address the representative of the committee, Dr. F. L. Wells, 74 Fenwood Road, Boston, Mass.

The Wintersteiner Collection of 13,000 microscopical preparations of eye pathology has been acquired by the St. Louis University through the generosity of Mr. Charles Rebstock, of St. Louis. This collection, which is said to be the most complete in Europe, will be utilized for graduate instruction in ophthalmology.

It is proposed to build an observatory on the top of the Jungfrau. The Swiss Meteorological Bureau has carefully studied the proposal, and decided that should the observatory be erected it ought to be placed on the Sphinx rock. The rock stands above the Jungfraujock at the height of 11,721 feet, 388 feet higher than the Jungfraujock railway station. The observatory, which would be intended for meteorological observation, should, owing to its altitude, prove important and useful. Its construction, however, would involve a great expense, but it is hoped that the state and the scientific bodies of Switzerland will contribute towards its erection.

It is stated in *Nature* that the British Research Association for the Woolen and Worsted Industries announce the following awards of research fellowships and advanced scholarships for the year 1922-23: Mr. G. W. Chester, Liverpool, £200 to conduct research on wool fats at the University of Manchester; Mr. John L. Raynes, Nottingham, £100 to conduct research on the bleaching of wool at the University College of Nottingham; Mr. George Barker, Baildon, £100, to conduct research on the action of water on wool as regards strength, elasticity, lustre, dyeing properties, etc., at the University of Leeds. Scholarships have been granted to Mr. Arthur Banks, Sutton Mill, Keighley, tenable at Bradford Technical College; and Mr. William B. Elliot, Wellington Road, Hawick, tenable at the South of Scotland Central Technical College, Galashiels.

The *Journal* of the American Medical Association states that a deputation received on July 13 by the British minister of health laid before him the present status of graduate medical education in London. The committee appointed by Dr. Addison, former minister of health, recommended that an institute or college of hygiene be established in London. This has been made possible by the munificent gift of the Rockefeller Foundation, and furthered by a promise from the minister of health of an annual grant of £25,000 for upkeep. A site has been selected and other arrangements are in progress. It was further recommended that a graduate medical school be established to serve as a center of a great teaching organization, in which the special hospitals of London, the Poor Law infirmaries and the medical schools, with their clinical units and research departments, would all find their place. It advised that, as an integral part of the organization, there should be a bureau or central office controlled by a committee of management and providing a library, a hostel and full facilities for social intercourse. Nothing has been done to advance this second recommendation, and it is on this point that the deputation made representations to the minister. The president of the Royal College of Physicians of London, the president of the Royal College of Surgeons of England and the chairman of the committee on graduate education of the British Medical

Association, were among the members of the deputation.

The program for the Eighth National Exposition of Chemical Industries, to be held in Grand Central Palace, New York, N. Y., September 11 to 16, 1922, numbers among its speakers not only many eminent chemists but several well-known public men. There are already about 400 exhibitors. Every branch of the chemical and chemical equipment industries, as well as numerous allied houses, will be represented at the exposition. The chemical products displayed will include all types manufactured in the United States: Coal, medicinals, and dyestuffs, technical chemicals for the rubber, leather, paper, textile, paint, and other consuming trades,—"everything in chemicals from the crudest of crude materials to the most delicate aromatic ready for the perfumer's use." A number of new devices in apparatus and machinery developed since the termination of war-time activity and completed since the 1921 Exposition will be displayed for the first time, as well as improvements on machinery long standard for industrial operations. Many of the machines will be seen in actual operation. Some new features which will be on display are: New special high-capacity evaporator; Lead pumps for handling phosphoric acid under pressure; new adaptation of the all hard-rubber pump for use in muriatic acid loading; recent development on a balanced automatic control valve and in direct reading resistance thermometer; new ideas in pyrometers; developments of the past year in butyl alcohol and furfural and their derivatives for solvent purposes; the use of liquid chlorine in the paper industry in place of bleaching powder; new dust controlling and humidifying equipment; new ideas for loading machinery on trucks; all types of containers, steel fiber, wood and glass.

The *Journal* of the Royal Society of Arts states that because it represents an entirely new industry to Malaya, the formal opening of the pottery works at Gopeng, was made the occasion of somewhat elaborate ceremonies. The plant, which is situated about 16 miles from Ipoh, is equipped to handle all the processes from refining the crude clay to the decoration of the completed piece. According to a report by the United States consul at Penang, casting and jolleying are the processes used, permitting a comparatively large output with labor that is not yet thoroughly trained. Teapots, jugs, ewers and basins are already being turned out, notwithstanding that a few weeks ago the Malay girls employed in the casting room had never seen a pottery. As the available labor becomes more skilled the production of porcelain ware in bulk is contemplated. All the materials required for pottery making are found within three miles of the works. Besides supplying its own clay requirements, the company ships china clay to cotton mills in Bombay and paper mills in Calcutta. The barrels for packing the product are made at the works.

UNIVERSITY AND EDUCATIONAL NOTES

The will of Arthur B. Emmons, of Newport, R. I., leaves $50,000 to the Museum of Fine Arts of Boston and $25,000 to the Children's Hospital of the same city, and the Newport Hospital. Berea College, Kentucky, Hampton Institute, Virginia, and Tuskegee Institute, Alabama, receive $10,000 each.

Dr. Andrew M. Soule has resigned the presidency of the Georgia State College of Agriculture, to accept the presidency of the University of Wyoming, to take the place of Dr. Aven Nelson, who returns to his former position as head of the department of botany.

Dr. J. L. Beeson, for twenty-five years professor of chemistry at the Georgia State College for Women, Milledgeville, Ga., has been elected acting president of the college.

William F. G. Swann, Sc.D., professor of physics in the University of Minnesota, has been appointed professor of physics at the University of Chicago. Professor Swann was connected with the Royal College of Science, London, and the University of Sheffield before coming to the United States in 1913. For six years he was chief of the physical division, Department of Terrestrial Magnetism of the Carnegie Institution at Washington.

Dr. Henry H. Goddard, for the past four years director of the State Bureau of Juvenile

Research at Columbus, Ohio, has resigned to accept the professorship of abnormal psychology in Ohio State University. He will continue his clinical work and his researches in the abnormal field.

Dr. J. Bronfenbrenner, formerly assistant professor of preventive medicine and hygiene at the Harvard Medical School, has accepted a similar appointment in the department of bacteriology.

Mr. John L. Buys, Ph.D. (Cornell, '22), has been made assistant professor of zoology in the Municipal University of Akron, Ohio., in the place of Dr. W. R. Allen, who goes to the University of Kentucky.

L. E. Miles, plant pathologist for the State Plant Board of Mississippi, has become associate plant pathologist and associate professor of plant pathology at the Alabama Polytechnic Institute.

Dr. Simon Klosky, of the research department, Edgewood Arsenal, Chemical Warfare Service, has been appointed instructor at the Martin Maloney Chemical Laboratory of the Catholic University of America.

Dr. Walter Ritchie, assistant lecturer in biology in the University College, Aberystwyth, has been appointed assistant lecturer in biology at the Technical College, Bradford, in succession to Mr. L. P. W. Renouf, who has been elected to the professorship of zoology in the University of Cork.

DISCUSSION AND CORRESPONDENCE

RELIEF FOR RUSSIAN ASTRONOMERS

To the Editor of Science: Complying with your request, I will make a brief statement as to the efforts which have been made by the American astronomers in recent months toward the relief of the physical needs of our colleagues in Russia.

Letters began to filter in from Russia about a year ago. We thus learned, for instance, that the grounds of the great Pulkowo Observatory had again been chosen as a field for artillery practice between rival factions. Fortunately, there had been a little intimation of what might happen, and no damage was done to telescopes or other apparatus, the most valuable lenses having been stored below the possibility of damage. The letters foreshadowed impending distress for the necessities of life, and the natural anxiety about the winter of 1921-2. Later letters showed that the anticipations were being realized with distressing completeness.

At the meeting of the American Astronomical Society held at Swarthmore, in convocation week, or about January 1, 1922, a Committee on Russian Relief was appointed, consisting of Professors J. A. Miller of Swarthmore, Benjamin Boss of Albany, and H. C. Wilson of Northfield. A generous subscription of about $150 was made at the meeting, principally for relief of astronomers at Pulkowo and for M. and Mme. Ceraski, formerly of the Moscow Observatory. The committee decided not to make further appeal for funds.

During the latter part of the winter the calls for help from the Russian observatories were numerous and beyond the means of the staff of any one observatory; consequently, after learning that the committee of the Astronomical Society had decided not to take further action, a small, informal committee assumed the responsibility and issued an appeal to the members of the staffs of the American observatories and departments of astronomy—having in mind that a monthly contribution might be given for five months, from the persons connected with our larger institutions.

Meanwhile, the American Relief Administration was extending its operations, and direct information was coming to us of the receipt of the food packets. An actual demonstration of the workings of the A. R. A. was hardly necessary, in view of the splendid efficiency of all relief work in which Mr. Hoover has had a hand.

In order to avoid any waste of time in correspondence between the members of a committee having proper geographical distribution, the three members were chosen from the same staff, and decisions could thus be reached immediately and appeals answered on the same day that they were received. One member of the committee is Russian, and thus our foreign friends were enabled to write their letters in

Russian, without the inconvenience of translating them into a language different from their own. The valuable personal acquaintance of this member in Russia was of great assistance in drawing up a list of institutions which ought to be reached.

The response to the appeal in America was immediate, and very generous. Up to August 15th, a sum of \$1,657.47 had been received, and food packets amounting to \$1,490 had been sent for distribution among the scientific staffs of twenty-five institutions, observatories or universities, and to some isolated astronomers or their dependent families. These packets were sent at intervals, considerably oftener than a month, as the funds came in for the purpose. We have received interesting testimony as to the care and judgment of the A. R. A. in the selection of contents of the food packets, having learned from the direct experience of our friends that a \$10 packet has actually supported two persons for a month. It should also be recalled that one fourth of all packets was used for the general relief of Russian children.

The recipients of the first shipments were requested to give us the names of other astronomers or their families that might need assistance, and thus the list has been considerably increased. Many replies have been received, but not yet has there been time for all to acknowledge the receipt of the food packages. The distress has been very great in the Crimea—perhaps where it had been least expected—and it was not possible for the A. R. A. to establish warehouses in this district until rather recently. From six to eight weeks seems to have been necessary for the actual receipt of the food at points which could be reached most expeditiously.

The last general distribution of food packets was made at the end of July, and we have assumed that by the time it reaches the persons for whom it is intended the new harvest will have removed the immediate urgency of relief. The balance which the committee has in the bank will be used in responding to calls from individuals not yet reached, or those in remote districts where the distress may still be acute.

No expenses of the committee have been charged to the fund, so that the distribution has been net. This, of course, applies also to the splendid work of the A. R. A.

The followers of the stars are a scattered, other-worldly folk, but their work on far-away things has brought them close together. Personal acquaintances are probably closer among astronomers and their families than is the case in most other branches of science. It has, accordingly, been a simpler matter for the American astronomers to give this little help to their Russian colleagues than it would have been for those in other departments of endeavor having a greater constituency. Men and women of America in several other branches could readily have contributed a hundred times what the astronomers could do—and perhaps they have—but the presumptive lack of personal contact would have made this a rather difficult proposition. The letters from Russian astronomers leave no doubt as to the sincerity of the appreciation of even this small measure of relief from America.

The members of the committee have been: George Van Biesbroeck, Otto Struve and the writer.

Edwin B. Frost,
Chairman

Yerkes Observatory,
Williams Bay, Wisconsin
August 18, 1922

BOTULINUS TOXIN

Sometime ago Dr. Schlesinger and myself (*Proc. Soc. Exp. Biol. and Med.*, 19, 1, 1921; *Jour. A. M. A.*, 78, 1519, 1922) stated that the toxicity of crude filtrate from cultures of *Bacillus botulinus* may be greatly increased by the proper degree of acidification (approximately p_H 4). When we tried to find the limits of potency of such an acidified solution of toxin, we were extremely surprised to discover that even such minute quantities of solution which contained only 3×10^{-18} cc. of the original culture filtrate exhibited all the specific properties of the original toxin and killed mice in less than 48 hours when injected intraperitoneally. When this acidified solution of toxin was diluted further, the results became less regular, in fact the dilution containing 3×10^{-21} cc. of the original toxin killed only 5 per cent. of the animals tested.

In the current issue of SCIENCE (August 4, 1922, page 143), Dr. Stehle questions this observation. He states that one cubic centimeter of toxin does not contain enough molecules to supply a molecule of toxin for each cubic centimeter of the final dilution. Indeed, he rightly concludes that "the average 3×10^{-21} cc. quantity of solution would contain no toxin." We agree with Dr. Stehle's conclusion, but we think it offers an explanation of, rather than a contradiction to our findings.

Our findings do seem unbelievable. Moreover, in view of the fact that mice are not very reliable as test animals for toxicity, together with the possibility of some error in dilution due to inaccuracy of pipettes, we do not insist on the accuracy of the figures and offer them merely as the best proof of the apparent extreme increase of the potency of toxin—a condition unknown with other bacterial toxins. As a matter of fact, we doubted the figures obtained originally and repeated the experiment many times. Finally, we checked our finding by a calculation similar to that used by Dr. Stehle (in our calculation we followed the reasoning found in Walker's "Introduction to Physical Chemistry," Macmillan, 1907, pages 214-219). This calculation, in fact, gave us the audacity to offer our figures which before seemed to us ridiculous. According to our interpretation, this calculation showed that each cubic centimeter of the dilution of the toxin to the eighteenth power might still contain enough of the specific substance to kill mice regularly (over 80 per cent. of animals thus treated died within 48 hours and about 10 per cent. more died within the next 24 or 48 hours), whereas in the dilution to the twenty-first power, many of the one cubic centimeter portions of the solution might not have contained even a single molecule of toxin, which apparently explains why only 5 per cent. of the animals injected died. When identical results were obtained on at least three different batches of toxin, obtained on different lots of culture medium, and on repeated tests on each of these batches, we decided to publish these unusual findings. I wish to take this opportunity to add that we still expect to find some source of constant error in our procedure or in our calculation. We know of no good proof indicating that the toxin may act as a catalyst, nor are we willing without further good reason to believe in the existence in the body of some vital center consisting of a small group of cells (not more than 100 and possibly less), the injury to which would lead to death in 80 per cent. of animals tested. Furthermore, continuing the above calculation, we were forced to conclude that the molecular weight of such an active toxin as we have seemingly obtained when computed on the basis of total solids could be about 380 and when calculated as protein (on the basis of total nitrogen) could be no greater than 260, which makes it extremely difficult to see how such a simple substance can possess the degree of specificity in respect to antitoxin neutralization which our solutions demonstrated.

In order to clarify the question, I would like to sum up the arguments which seem to favor the validity of our observations.

(1) When 3×10^{-18} cc. of the acidified culture filtrate of *Bacillus botulinus* is injected intraperitoneally into mice of 17-21 grams, the animals die with all the symptoms of botulinus poisoning in mice.

(2) When receiving this small amount of toxin the animals die within 24-48 hours, which is a typical incubation period for botulinus toxin.

(3) Animals receiving protective injection of a homologous (type A) antitoxin invariably survive the injection of the amount many millions of times greater than 3×10^{-18} cc. of this active solution.

(4) The animals receiving large amounts of botulinus antitoxin type B (heterologous) are not protected even against a single dose of 3×10^{-18} cc. of acidified type A toxin.

(5) The potency of acidified toxin is destroyed by a very short exposure to heating at 80 degrees C.

(6) When the reaction of acidified toxin is brought back to neutral (before dilution), the resulting solution has the titer of the original toxin. The re-acidification and re-neutralization can be accomplished several times in succession with the result that acidification invariably increases the potency and neutralization returns it to the original titer.

(7) When one cubic centimeter of the original toxin has been distributed through a sufficiently large amount of a diluent so that not every cubic centimeter of the diluent would be theoretically expected to contain one molecule of original toxin, the results of the injection of such highly diluted toxin become irregular and apparently depend on the presence or absence of a molecule or a small number of molecules of toxin in each portion injected.

(3) While not every filtrate yielded an equally potent product on acidification, the same filtrate consistently titrated as indicated, even though repeated tests were performed several days and weeks apart.

On the other hand, it is evident that there are a number of considerations militating against the validity of our observations.

(1) Using the same strain of the organism and similar culture medium, it was not always possible to obtain the same degree of increase in potency of the acidified filtrates, although in all cases some increase was observed. Apparently, the uncontrollable differences in composition of the culture medium during the early growth of the organism has something to do with the degree of change in potency which the toxin will undergo upon its subsequent acidification.

(2) It is difficult to conceive how such a small number of molecules which can theoretically be expected to be present in the small amount of toxin injected can produce the effect.

(3) The extreme simplicity and low molecular weight which the active substance seems to possess according to calculation is difficult to reconcile with its strict biologic specificity which would postulate a more complex structure.

(4) We find that while this active toxin is neutralized by a specific antitoxin, the neutralization does not go according to the law of multiple proportions, but is in fact more efficient.

(5) It is difficult to explain why such a simple molecule as that which the active toxin seems to possess can not pass bacterial filters which are comparatively permeable to the original toxin.

These, as well as other considerations, indicate that a further study of the subject is necessary. We feel more inclined to believe, and some of our most recent observations strengthen this belief, that while the toxin does unquestionably undergo an increase of potency under certain conditions of the experiment, the degree of this increase probably is not as great as some of our findings seem to indicate. We suspect that there may occur an ultramiscropic precipitation of the toxin-carrying portion of the medium. If the minute particles of such a precipitate should possess particularly high adsorptive power, they could be carried from dilution to dilution and thus vitiate the accuracy of the calculation. Since circumstances force us to interrupt this study for the time being, we thought it worth while to call the attention of other workers to this interesting phenomenon. With this in view, we are preparing detailed protocols of the experiments to date which we hope to publish in the near future.

J. Bronfenbrenner
Harvard Medical School,
Boston

SOIL SHIFTING IN THE CONNECTICUT VALLEY

Recently two articles have appeared in the current volume of Science (Nos. 1413 and 1426), reporting soil shifting by wind. In the Connecticut Valley in the vicinity of Amherst sand storms are a common occurrence. The prevailing winds, coming from the northwest, have a rather uninterrupted sweep down the valley, and at times pick up and transport large quantities of soil consisting of sands, sandy loams, silt loams, clay loams and clays. It is the coarser members of the above soils that are most eroded because the heavier soils are usually covered with vegetation.

This shifting of the soil by wind action has no doubt had an important part in shaping the topography of the region, which may be described as the level to rolling bottom of an ancient lake or arm of the sea dotted with sandy knolls or modified sand dunes. The shifting also presents to the farmers of the section some problems of soil management.

Probably the most striking instance in recent years of wind erosion of soils in this vicinity occurred on the days of April 27 to 30, 1922. Observations by the writer showed a drift as deep as three inches, the deepest observed being on the south sides of tobacco barns. Onion seeds were blown out of the soil necessitating in some cases reseeding, and no doubt many tons of fertilizer were carried from recently fertilized onion fields on which a first application of one ton of high grade fertilizer is the common practice. It was observed that any sort of a ground covering, even loose tobacco stalks, was rather effective in checking erosion, but a growing cover crop as commonly used in tobacco, but not onion, fields was most effective.

The winds most disastrous from the standpoint of soil erosion are those of two or more days' duration, the first day usually being required to dry the soil. Although sandstorms may occur frequently during the year, the most damage is done in the spring when the land is being or has been recently prepared for crops.

A. B. Beaumont

Amherst, Mass.

SCIENTIFIC BOOKS

Development and Activities of the Roots of Crop Plants: A Study in Crop Ecology. By John E. Weaver, Frank C. Jean and John W. Crist. 17 x 25 cm., VI + 117 pages, 42 figures, 14 plates. Carnegie Inst. Washington, Publ. no. 316. May 11, 1922.

Students of plants, especially in physiology, ecology and agriculture, will be interested in Weaver, Jean and Crist's book on the roots of crop plants, in which is brought forth a mass of detailed information in a field that has been largely neglected until recently. The studies now reported are a continuation of those presented in Weaver's "Root Development in the Grassland Formation" (1920). Much of the present work follows the methods of his earlier investigations on the form and distribution of the root systems of uncultivated plants. The descriptive data are obtained by what must seem to most botanists very tedious and laborious excavations; each root is traced to its end and the size, form, etc., of the whole root system of each plant is shown diagrammatically on a chart. The published charts frequently show the size of the top, as well as the depth and spread of the root system and the number of roots. Root systems of plants growing under field conditions are described, in several stages of their development, for Lincoln and Peru, Nebraska, for Phillipsburg, Kansas, and for Burlington, Colorado, these stations having mean annual precipitations of about 33, 28, 23 and 17 inches, respectively. The plants dealt with are: oats, wheat, barley, maize, potato, alfalfa and sweet clover, for the seasons of 1919, 1920 and 1921. Some excellent experimental studies bearing on the soil-depths from which water and nitrate were removed during several developmental stages of the plants are considered in the final chapter of the book.

It is pointed out that the root systems of crop plants show modes of growth similar to those of native plants growing in the same region, both being apparently influenced by the environmental moisture conditions. With higher evaporation intensities and drier surface soils the root systems tend to be developed less extensively in the superficial soil layers and they extend farther into the deeper layers. There are some differences between the different forms of plants, but all the forms studied usually have, at the approach of maturity, a set of roots that ramify laterally in the upper 30 or 40 cm. of soil, and a set that reach downward, with more or less profuse branching, to depths of from 1 to nearly 3 m. The two portions of the root system may be relatively distinct or they may be nearly continuous. The deepest soil layers reached are of course not generally well occupied by branches.

The authors emphasize the fact that the roots of crop plants usually penetrate and ramify far beyond the depth of tillage (12 to 20 cm.) and their studies lead to the conviction that much of the soil water and solutes entering the plant during its later growth stages must come from the greater depths. This appears to be at variance with statements in the prevailing text-books, as the authors remark, but of course the discussion of root activities is still necessarily very superficial in such treatises. It seems probable that, with increasing age of the plant, the region of greatest absorption is gradually transferred to the deeper soil layers. In almost every case of actual excavation, the total root development below the region of tillage was found to be as great as, and usually much greater than, that within the tilled region. To gain some quantitative information regarding absorption from the different soil layers, some ingenious experiments were carried out. The methods devised for this experimental study of absorption, together with the results secured, constitute the most valuable part of this book, and they should furnish an added impetus toward a physiological phase of root ecology, which is much needed and which seems about to be developed from several points of view.

Vertical sheet metal cylinders were employed as soil containers, large enough to allow complete development of the plants. The moist soil was placed in these, consecutive horizontal layers 15 or 30 cm. thick, separated by horizontal wax partitions that prevented movement of soil solution between adjacent layers but did not hinder root penetration. Sodium nitrate was added to some of the layers. Several kinds of controls were also employed. Rain was practically excluded. Oats, barley, potato, maize and two native grasses were studied, at various stages of their development, determinations being made of the loss of water and of nitrate from the several soil layers.

The amounts of water removed from the different soil layers were closely related to the frequency of roots, and absorption occurred from all layers occupied by the root systems. Maize absorbed large quantities from the third and fourth 30-cm. soil layer (counting from the top of the cylinder), and smaller quantities from the fifth. Potato absorbed to a depth of 75 cm., approximately the lower limit of the root system. Similarly, nitrate was markedly absorbed from the deeper occupied layers; maize removed 203, 140 and 118 parts per million from the third, fourth and fifth 30-cm. layer, respectively.

While the quantitative data are not expressed in terms such as would render them most valuable from all points of view (the authors use parts per million for nitrate measurements and percentage data for water measurements, both apparently based on the dry weight of the soil), yet they furnish convincing evidence that roots absorb water and nitrate at whatever depths the roots occur in the soil. This is quite in accord with what should be expected from our knowledge of the molecular physics of root absorption.

When a root system advanced into a soil layer to which nitrate had been added it developed more profusely than would have been the case without the extra nitrate, and this stimulation of branch development in the fertilized soil was accompanied by a corresponding retardation in the farther advance into the next layer below. From this observation it is suggested that, in field practice, the presence of added fertilizer salts in the superficial soil layers may hinder the development of roots into the deeper-lying soil, with possible resulting crop failure in case of a subsequent serious lack of water in the surface layers.

As a minor detail, it is regrettable that the metric system of measurements of distance seems not yet to have been appreciated by the authors, though weights are expressed in grams instead of ounces.

From my own point of view, the authors' presentation might have been improved considerably by a more thorough digestion of the results, with less space devoted to unessential details and more given to the fundamental considerations. There is evident a noticeable tendency toward "publishing the note-book." The general headings of the tables, and the column headings, might have been made much clearer. A well-made summary of the descriptive portion of the book would have rendered it much more valuable and far-reaching. And the experimental results apparently contained considerable evidence that was not deduced from them, concerning some of the most fundamental questions of physiology. For example, it is not very useful to know rates of water or nitrate absorption from a soil as the authors express these, but it would be very enlightening to have these data expressed on the basis of the soil volume, or simply as absolute weights. What I have in mind, in this instance, is the question whether the solvent water of the soil solution carries the solute nitrate into the roots at its own rate of capillary or imbibitional flow, or whether the nitrate enters more or less rapidly than its solvent. A little more logical analysis and more attention to the deeper and somewhat hidden meanings implied in the experimental results might have strengthened the presentation very much. These suggestions are not made here, however, as serious adverse criticisms of the book I am reviewing. They are introduced, rather, with the idea that they may be a bit helpful in preparing the way for studies that will carry our knowledge of root ecology far beyond the present conceptions of any of us. The experimental methods employed by the authors involve essentials that are very promising indeed, and the results here published form an excellent beginning toward the illumination of one of the darkest corners of physiological ecology.

Burton E. Livingston

SPECIAL ARTICLES

SOME ALGAL STATISTICS GLEANED FROM THE GIZZARD SHAD

In a recent paper[1] the writer called attention to the desirability of using the gizzard shad, *Dorosoma cepedianum* Le Sueur, as collectors of the plankton algæ. These "living tow nets" do not get caught on snags and roots, the string does not break, and the algal collection is very representative of the body of water from which the fish were taken. It is necessary only to catch the young fish and examine their stomachic and intestinal content to secure a proportionate concentrated sample of the plankton. In aquatic areas where the gizzard shad are common these fish are well worth considering as aids in the collection of the plankton algæ.

Through the courtesy of its director, Dr. Stephen A. Forbes, the laboratory of the Illinois State Natural History Survey sent me some months ago several specimens of gizzard shad, collected in certain streams and ponds of Illinois during the late spring and summer of 1899 and 1900. Rather extensive collections of gizzard shad from Ohio, made during the summers of 1920 and 1921, gave some interesting statistics regarding the distribution and abundance of the non-filamentous algæ in various localities of the state. A comparison of the results of an examination of the stomachic and intestinal content of the fishes from Ohio and Illinois reveals similarities and differences in the algal flora of ponds and streams of the two states and in addition warrants some conclusions concerning the algal food of the gizzard shad in general.

1. The total number of species and varieties in an identifiable condition in the gizzard shad from the two states is a hundred and fifty. Very nearly identical forms indicate the phytoplankton similarity of the habitats from which the fish were taken.

2. The amount of mud present in the digestive tract is in some cases considerably more abundant in the Illinois fishes. It is not, however, in either case a matter of selection on the part of the fish but rather a direct function of the number of suspended mud particles present in the water, *i. e.*, it depends upon what enters with the water as the fish swims along with its mouth open.

3. Diatoms are relatively much more abundant in the Illinois fishes than in those taken in Ohio. When a microscopic mount is made of the intestinal content of some of the Illinois specimens, little else except diatoms can be seen. In this connection one might almost improve upon the epitome of Dr. Mann:[2] "No diatoms, no hake," for in that case it was necessary to have herring and copepods as

[1] *The Ohio Journal of Science*, 21, No. 4, p. 113, 1921.

[2] *Ecology*, 2, No. 2, p. 79, 1921.

intermediaries. Here, however, is a chain of two links, obviating the necessity of the "middle man," and five words tell a complete story: "No diatoms, no gizzard shad." In some fishes from Ohio another story is told by changing diatoms to *Pediastrum;* still another, if one puts in *Scenedesmus;* for most of the young fishes examined the complete story reads: "No phytoplankton, no gizzard shad."

4. Flagellate forms, species of *Euglena* and *Phacus* in particular, are less common in the Ohio fishes.

5. The relative abundance of the different forms of the phytoplankton of the bodies of water is revealed by the algal content of the gizzard shad found there.

6. In general, algal species belonging to the order *Protococcales* form more commonly a larger portion of the food of the gizzard shad than do either flagellates or diatoms. Sometimes, however, the condition is reversed; but this is apparently purely a matter of the plankton content of the water.

7. The fewness of the zooplankton forms is somewhat less marked in the specimens from Illinois than in those from Ohio. This may again be due to the predominance of the phytoplankton over the zooplankton in the localities where the fish were obtained.

8. The paucity of stream phytoplankton in comparison with that of ponds and lakes is shown by the relative algal content of the digestive tract of the gizzard shad taken from running and quiet waters. The excessive diatom content of stream water at certain periods—producing the so-called "pulses" of Kofoid[3]—when there is a marked rise in temperature is only temporary and may be explained, as Professor Transeau suggests, by the rapid dissolving of the mucus and a consequent breaking up of the chains and colonies of diatoms. This usually takes place in the small tributaries where the individual diatoms are thus freed from their places of attachment; and the main stream is merely the recipient of the contribution, not the source of the sudden "pulse."

9. There is a continuation of the above story in which the gizzard shad plays an important rôle: it feeds the game fishes, and the game fishes feed man. Thus, the gizzard shad is making useful for man the energy stored in plant forms which occupy no land areas, which do not interfere with the ordinary disposition or utilization of bodies of water (except the occasional contamination of water for drinking purposes by some algæ), which involve no labor of cultivation on the part of man, and which are of no value for direct human consumption.

[3] *Bulletin of the Illinois State Laboratory of Natural History,* 6, pp. 226, 569, 571, 1903.

10. The world's population in the last hundred years has increased about 150 per cent. Along with this increase has had to come a corresponding increase in the world's food supply. One of the ways in which this necessity has been met is the securing of new acres of soil in which to grow crops. It is easily seen, however, that there is a limit to new acreage. In the future, therefore, we may have to turn more of our attention to the cultivation of the waters for food supplies. We may have to develop an industry of aquiculture as we have developed an industry of agriculture. The time is rapidly approaching when fish will be more highly prized as food and more extensively used than now. As that time comes, the cultivation of algæ will be a first step toward greater fish production. A second step may be the introduction of fish like the gizzard shad into fish ponds and lakes to make more readily available the phytoplankton for fish food.

L. H. Tiffany
The Ohio State University

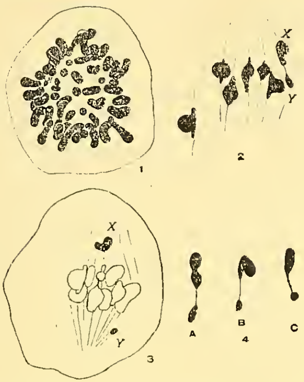
THE SEX CHROMOSOMES OF THE MONKEY[1]

Previous studies on the spermatogenesis of the opossum ('22) and on man (in press) have

[1] Contribution No. 159, Department of Zoology, University of Texas. The present work has been aided by a grant from the National Research Council—Committee for Research on Sex Problems. In view of the crowded condition of our journals which greatly delays publication, the author is presenting in this brief way the essential facts of general interest to biologists. The completed study will give the detailed evidence. Painter, T. S.: 1922, "The Spermatogenesis of the Opossum," *Journ. Exp. Zool., Vol.* 35.

shown that both of these mammals possess the X-Y type of sex chromosome. The spermatogenesis of the "ring-tail" monkey (exact species not yet determined) shows essentially the same conditions as were found in the opossum and in man.

In dividing spermatogonia (fig. 1) one counts 54 chromosomes. It is to be noted that the smallest element has no mate of like size and shape. It is the "male determining," or "Y" chromosome.



During the first maturation division one finds among the tetrads an element the two components of which are very unequal in size (fig. 2). This is the X-Y sex chromosome complex. The X and the Y components go undivided to opposite poles of the cell, so that the secondary spermatocytes have either an X or a Y chromosome. In the second maturation division the sex chromosome (either X or Y) divides equationally. 27 chromosomes have been counted in the late telophase of the second maturation division. (In figs. 2 and 3 only part of the tetrads are shown).

In figure 4 the sex chromosomes—as seen in the first maturation division—are given for A opossum, B monkey, C man. It is interesting to note that recent work on the genetics of man (Schoenfield—See Castle, SCIENCE, Vol. 55, p. 703) confirms the results of my cytological studies.

THEOPHILUS S. PAINTER
UNIVERSITY OF TEXAS

A SIMPLE GAS GENERATOR FOR LABORATORY USE

IT is frequently necessary to prepare small quantities of carbon dioxide, hydrogen, hydrogen sulfide, chlorine, hydrochloric acid gas, oxygen, etc., in the general laboratory work and in many laboratories it is not practicable nor desirable to maintain a lot of elaborate equipment for the generation of these various gases, especially for the small quantities intermittently needed.

To prepare a special flask each time occasion arises to generate a gas is at least bothersome and time consuming and involves a waste of reagents. On the other hand, a simple piece of apparatus, taking no more room on the shelf than a reagent bottle, adaptable to the preparation of any of several gases at a moment's notice without waste of reagent, commends itself.

The apparatus here presented developed from such a need and can be easily prepared out of ordinary laboratory equipment; a large wide-mouthed bottle, two test tubes, two cocks, rubber stoppers and glass tubing are all that is required.

An examination of the diagram will show the simplicity and convenience of construction and operation.

CONSTRUCTION

Into the wide mouthed bottle *A* is fitted a large rubber stopper *D-D* containing one small hole for the tube *H* terminating in stopcock *N*, and a large hole for the large test tube B. At

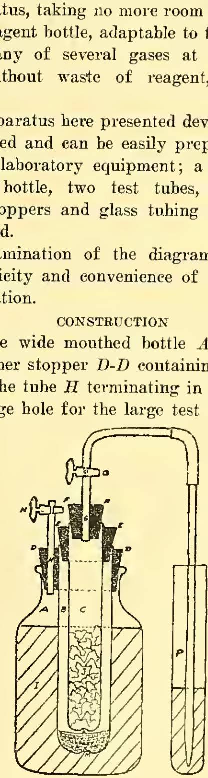


FIG. 1

the bottom of the large test tube is a hole M and over it is snugly fitted a layer of glass wool L. Into B the stopper E-E is placed, through which passes a smaller test tube C. This tube also has a small hole at the bottom K, and is fitted at the top with a stopper F-F through which passes a delivery tube fitted with stopcock O.

The large test tube B in stopper D-D should fit especially tight as it is not to be removed from the stopper. E-E should fit more loosely as it may be removed at will.

The bottle A is the reservoir for the acid I.

The tube B is a chamber for holding tube C.

C contains the zinc, iron sulfide, marble, peroxide, bleaching lime or fused ammonium chloride, etc. (which should, of course, be in lumps) with which the acid acts. A rack of tubes filled with different reagents and fitted with stoppers the same size as E-E afford a ready source for each gas, or tube C may be dumped and filled with a different reagent as desired.

Pinch cocks may be used instead of glass, or nearly any preferable type might be substituted.

Operation

Tube C, containing marble, zinc or whatever substance is required, J, and fitted with stoppers E-E and F-F and tube G, cock O of which is closed, is introduced into the chamber B. The air or gas in C prevents the acid from entering.

To operate, open N and O. Close N after acid has run into C through M and K so that the acid will not be forced out of C. Pass the delivery tube into the test tube P or collect in any other fashion.

To stop the generation, see that N is open. Close O. The gas will force the acid out of C, and out of B. The apparatus may then be set away for another time, or if preferred C may be removed in a comparatively dry condition both inside and outside after closing N so that the chamber B will remain empty while C is being removed.

The acid need not be changed except when any impurities it contains might interfere with the test to be run, or when it has eventually become exhausted. To supply new acid simply remove the stopper D-D which takes with it all the fixtures, empty the jar A and refill. Replace the stopper, and all is ready for use.

Arthur P. Harrison
Bureau of Plant Industry,
U. S. Department of Agriculture

THE OHIO ACADEMY OF SCIENCE

The thirty-second annual meeting of the Ohio Academy of Science was held at Ohio State University, Columbus, April 14 and 15, 1922, under the presidency of Professor Raymond C. Osburn, of Ohio State University. Eighty-seven members were registered as in attendance; forty-six new members were elected.

The usual geological excursion was postponed until June 3 and 4, and took the form of a joint field meeting, on invitation of the geologists of the Michigan Academy of Science, for the study of the glacial geology and Silurian rocks of southeastern Michigan and adjoining portions of Ontario. The party was under the leadership of Mr. Frank Leverett, of the University of Michigan, and Professor W. H. Sherzer, of the Michigan State Normal College. Professor J. E. Carman, of the Ohio State University, collaborated in directing the investigations at certain localities.

The Committee on State Parks and Conservation reported progress in the listing of areas suitable for preservation. Director Taber, of the State Department of Agriculture, addressed the academy on the game preserves owned or leased by the state. The academy expressed its formal approval of the establishment of a state commission, including scientific representation, to advise in the acquisition of state parks and preserves and in their regulation to secure the maximum recreational, scenic and scientific returns.

The trustees reported the twenty-fifth annual gift of two hundred and fifty dollars from Mr. Emerson McMillin, of New York City, in furtherance of the research work of the academy. A resolution of thanks and the birthday greetings of the academy were sent to Mr. McMillin by night letter, to reach him on April 16, his seventy-eighth birthday. (The death of Mr. McMillin on May 31 has already been reported in Science. He was a member of the academy since 1892, although his residence in New York had made attendance at the meetings impossible for many years).

Professor George D. Hubbard presented an appreciative memoir of G. Frederick Wright, who died on April 20, 1921. Professor Wright had been a member of the academy since 1892, and was one of the first group of fellows elected in 1920. He served as president in 1899. The memoir will appear in the Annual Report.

The following members were elected to fellowship in the academy: Annette F. Braun, Edward E. Clayton, William C. Devereaux, Henry Herbert Goddard, Clarence H. Kennedy, Kirtley F. Mather, Susan Percival Nichols, Bradley M. Patten, Jasper D. Sayre, Alpheus Wilson Smith, Frank R. Van Horn.

Officers were elected as follows: *President,* A. P. Weiss, Ohio State University; *Vice-presidents: Zoology,* Charles G. Rogers, Oberlin College; *Botany,* E. Lucy Braun, University of Cincinnati; *Geology,* Kirtley F. Mather, Denison University; *Physics,* R. C. Gowdy, University of Cincinnati; *Medical Sciences,* C. F. Spohr, Ohio State University; *Psychology,* H. H. Goddard, Ohio Bureau of Juvenile Research; *Secretary,* Edward L. Rice, Ohio Wesleyan University; *Treasurer,* A. E. Waller, Ohio State University.

The scientific program was as follows:

PRESIDENTIAL ADDRESS

Some common misconceptions of evolution: Professor Raymond C. Osburn, Ohio State University.

PUBLIC LECTURES

Disease and disease resistance in plants: Professor L. R. Jones, University of Wisconsin. (In joint session with the Ohio State University chapter of Sigma Xi).

Ether-drift experiments at Mount Wilson, California: Professor Dayton C. Miller, Case School of Applied Science.

PAPERS

Some proposed state parks for Ohio: J. ERNEST CARMAN.

Segregation and man: MAYNARD M. METCALF.

American biological stains for microscopical preparations: S. I. KORNHAUSER.

Further studies in the cytology of Anisolabis: S. I. KORNHAUSER.

Notes on tropical photography: WILLIAM RAY ALLEN.

Some unsolved problems in tidal zone ecology (By title): Z. P. METCALF.

Preliminary survey of certain aquatic habitats on the Bass Islands: F. H. KRECKER.

Some results from a pure-line isolation culture of Euglena gracilis Klebs: W. J. KOSTIR.

A source of material for study of parasites: MAYNARD M. METCALF.

Specific names for parasites: MAYNARD M. METCALF.

Studies of the biology of freshwater mussels: WILLIAM RAY ALLEN.

The relationship of the Syngnathidæ: JAMES E. KINDRED.

A quarter century of bird migration at Oberlin: LYNDS JONES.

A case of unhindered growth of the incisor teeth of the woodchuck: STEPHEN R. WILLIAMS.

A cicindelid from Lake Bennett, British Columbia: LYNDS JONES.

Factors influencing reproduction in the cucumber beetle (Diabrotica vittata Fabr): W. V. BALDUF.

Distribution and control of two important grape insects: D. M. DELONG.

A study of the distribution of the leafhoppers of Presque Isle, Pa.: D. M. DELONG.

Emergence of a subimago Mayfly: F. H. KRECKER.

Some factors which have limited and directed insect evolution: CLARENCE H. KENNEDY.

Insect parasites and predators in spider's nests: MARY AUTEN.

The inter-relation of the Hessian fly (Phytophaga destructor) and one of its parasites: T. H. PARKS.

Biological significance of the endocrines: A. B. PLOWMAN.

The effect of formaldehyde on the vitamins of milk: A. M. BLEILE *and* R. J. SEYMOUR.

Variation in the dandelion and some of its causes: P. B. SEARS.

A forest map of the Erie basin: P. B. SEARS.

The distribution of flowering plants on the smaller islands of Lake Erie: MALCOLM E. STICKNEY.

The sexual nature of vegetative or dichotomous twins of Arisæma: JOHN H. SCHAFFNER.

Influence of length of daylight on sex reversal in hemp: JOHN H. SCHAFFNER.

Some root and stem rots of clover in Ohio: SYLVESTER S. HUMPHREY.

Mosaic disease of tomato: Raymond A. Dobbins.

Energy relations of plants: E. N. Transeau.

Ecological distribution of grasses of North America: E. L. Stover.

The algal food of fishes: L. H. Tiffany.

Seedling blights of corn: Wilmer G. Stover.

The course of a plant disease: Wilmer G. Stover.

Extension work in plant pathology with special reference to the control of corn and potato diseases: E. E. Clayton.

Barberry eradication in Ohio: J. W. Baringer.

A study of variation in Russula: H. C. Beardslee.

Geologic control of river navigation in northeastern Bolivia: Kirtley F. Mather.

The gorges of the Yangtze Kiang: George D. Hubbard.

An inter-glacial gorge at Youngstown, Ohio: G. F. Lamb.

New points in the geology of Kelleys Island: Mildred Fisher.

Some new data concerning the Bellefontaine outlier: Clarence F. Moses.

The Pottsville formation of Ohio: Helen Morningstar.

The Bainbridge caves: Robert F. Webb.

The formation of box canyons in sandstone: J. E. Hyde.

Mineralization along the dikes of southern Vermont: Harriet G. Bray and Alden H. Emery.

The Wheeler National Monument: Robert F. Webb.

Colloids in geologic problems: George D. Hubbard.

Dynamics of the lithosphere: O. C. Jones and George D. Hubbard.

Drainage changes north of Lake Superior: Robert F. Webb.

The Arctic as one of the centers of distribution of early Paleozoic faunas: August Foerste.

Meanders of Rio Securé and Rio Mamoré, Bolivia: Kirtley F. Mather.

Iron molding sands of Ohio: J. A. Bownocker.

Report on the Edward Orton Memorial Library: J. A. Bownocker.

New fish remains from northwestern Ohio: J. Ernest Carman.

Some fossils from the Sylvania sandstone: J. Ernest Carman.

Type specimens of fossils in the geological museum at Ohio State University: Helen Morningstar.

Stylolites: their nature and origin: Paris B. Stockdale.

A mounted topographic map of Ohio: G. W. Conrey.

Notes on the Cincinnatian: W. H. Shiddeler.

Forecasting the weather in the Ohio Valley: William C. Devereaux.

The electron theory of metals: Alpheus W. Smith.

The effect of a unidirectional field upon alternating current permeability and energy loss in iron: Alva W. Smith.

Infra-red absorption bands as a means of determining molecular properties: Erwin F. Lowry.

Certain aspects of the problem of the static versus the dynamic atom: F. C. Blake.

The study of "illumination" in physics courses: F. C. Caldwell.

Some interesting pictures in infra-red: Yale Roots.

Duriren—a product of Ohio industry: James Withrow.

A case of dual personality: Henry H. Goddard.

The field of psychology: B. H. Bode.

The theory of differential education as applied to the handicapped pupils in the elementary grades: J. E. W. Wallin.

Qualitative clinical tests and psychological theory: H. B. English.

Psychic complexes: A. W. Trettien.

A comparison of initial and subsequent examinations of the same individual by the same psychological methods: Mabel R. Fernald.

DEMONSTRATIONS

Common mole (Scalopus aquaticus machrinus Refinesque) "embalmed," and internal parasites of same: F. A. Hanawalt.

Tracheation of Lestes nymph: Clarence H. Kennedy.

A plerocercoid (larval) tapeworm from the liver of the squirrel—externally segmented: Stephen R. Williams.

Head of woodchuck, showing unhindered growth of incisors: Stephen R. Williams.

Types of tomato mosaic: Raymond A. Dobbins.

Seedling blights of corn: Wilmer G. Stover.

Stalactites in glacial sand and recent conglomerates from Canton, Ohio: G. F. Lamb.

Illumination charts: F. C. Caldwell.

Edward L. Rice,
Secretary

Delaware, Ohio

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VOL. LVI SEPTEMBER 15, 1922 NO. 1446

CONTENTS

DISCOVERY OF CRETACEOUS AND OLDER TERTIARY STRATA IN MONGOLIA[1]

THE American Museum of Natural History announces,[1] under date of May 3, 1922, that strata of Cretaceous age, overlain by two distinct Tertiary formations, have been discovered in the Gobi region of southeastern Mongolia.

They were found on the outbound trip from Kalgan to Urga at a point about 260 miles northwest of Kalgan. Strata of Cretaceous age are wholly unknown in Eastern Asia, as far as the writers of the present communication are aware, and because of the apparent importance of the find, it was decided to leave the geologists in camp at this place while the rest of the party moved on. Accordingly Messrs. Berkey, Granger and Morris spent a week in additional inspection of the ground and furnish the notes for this memorandum.

Obretcheff, the Russian geologist, who gives an account of a reconnaissance trip over this same route from Ude to Kalgan, describes sedimentary beds at many places, always referring to them as representatives of the Gobi formation. His only age determination, however, was made on the basis of a few fragments of *Rhinoceros,* found at the escarpment five miles south of Iren. These remains were judged by Eduard Suess, to whom they were referred, to indicate an age not earlier than the Miocene. The Tertiary age of the rest of the occurrences mentioned by him seems to have been taken for granted and apparently that is in general correct, but it is evident that the Gobi formation can not properly include strata of both Tertiary and Cretaceous ages.

[1] Abstract: "Discovery of Cretaceous and Older Tertiary Strata in Mongolia," Walter Grauger and Charles P. Berkey. American Museum *Novitates,* No. 42, 7 pp. 1 fig., August 7, 1922.

It is clear also that the term Gobi formation or Gobi series is properly applied to the Tertiary beds instead of to those of Cretaceous age.

The best exposures of this underlying Cretaceous formation are in the vicinity of the small salt marsh Iren Dabasu, where a total thickness of about 150 feet of nearly horizontal strata is judged to be of this age. Tertiary beds not older than the Miocene lie on top of the Cretaceous strata and are best exposed about five miles south of Iren. Twenty miles farther south early Tertiary beds were found in essentially the same relation.

The finding of this upper Cretaceous formation makes a new designation necessary. For this purpose nothing seems to be as appropriate as the name of this locality. We therefore propose the term "Iren Dabasu formation" for these beds.

Remains in all three beds are fragmentary, decidedly so in the Houldjin gravels, but they are of unusual interest apparently and we have taken everything which has any character.

Dinosaurs are represented in the Iren Dabasu beds by one complete tibia, ends of femora and humeri, presacral and caudal centra, many good foot bones, including claws of fore and hind feet, portions of a small carnivorous dinosaur skull with two or three teeth, and two teeth of a predentate, as well as two portions of jaw with the alveoli of some teeth, also predentate. Remains of the small *Ornithomimus*-like creature are particularly abundant and the last day at Iren Dabasu we picked up probably fifty good foot bones and centra from two or three knolls. We could find no teeth of the little fellow though—wonder if he was edentate like *Struthiomimus?* The Cretaceous exposures are very limited so far as we could see but may, of course, outcrop in other basins to the east or west of the road. We did not have time to extend our work in either direction. The outcrops we did see will stand a more careful going over.

The Houldjin gravels are exposed as a rather thin capping to a low bench of Cretaceous which we followed for several miles. Things are badly broken up here—even such massive bones as the heads of femora and humeri were usually cracked into several pieces before deposition. There is one fine bone—a calcaneum of the big beast which would be a match for the astragalus of *Baluchitherium*[2] (?). I can think of nothing else to which it might belong. It is as long as the great *Megatherium* calcaneum from Long Branch, N. J., but is not edentate. A head of a femur is the size of one's head and other limb bone ends correspond. Some enormous rhinoceros teeth (broken) may belong with this animal. Smaller teeth are surely *Rhinoceros*. We did not explore the full length of the exposure and there are possibilities in excavation at one or two points of the bluff where we did explore.

The Irdin Manha beds offer the greatest opportunity for future work. Mammalian remains are abundant though fragmentary and we examined less than two miles of a line of exposures extending many miles both east and west of the trail. A small lophiodont (*Helaletes*-like) is most abundant and we got numerous teeth besides two maxillæ (one with premaxilla and orbital region) and a few lower jaws, also numerous foot bones, limb bones and vertebræ. Next in abundance is a perissodactyl, looking much like our late Eocene titanotheres. We have several premolars, many incomplete molars and one lower jaw with p_3—m_3 in fair condition. Other forms are curiously rare, a creodont lower jaw and an artiodactyl astragalus or two being the only things noted. Trionychids are common and we saw a complete though badly broken carapace which we were hurrying to get to our car before a storm overtook us the last day we were there. We made three trips down from Iren Dabasu camp but could not do more as our food was getting short and we had to join the rest of the party here.

In the vicinity of the small salt lake Iren Dabasu, the Cretaceous beds lie immediately on the slate floor of the basin and between this base and the first determinable beds of later age, in this case late Tertiary, about 150 feet of strata are exposed. The bottom members are dominantly sands and sandstones, prevailingly thin-bedded, some of which are strongly

[2] A gigantic perissodactyl described by C. Forster Cooper from Baluchistan.

cross-bedded and well cemented. The middle members become finer grained, more mixed with clay and more variable in color. The upper beds are dominantly clays and sandy clays and very fine sands, varying in color from white to dark red and drab and yellowish green. No less than twenty distinct beds or layers can thus be distinguished, all of which are regarded as belonging to a single geologic formation.

Only the lower members of this "Iren Dabasu" formation have been found to be fossiliferous. The list includes:

1. Predentate dinosaurs, probably of the bipedal type.
2. Carnivorous dinosaurs of at least two genera, the smaller one being of the *Ornithomimus* type.
3. Crocodiles.
4. Turtles of the *Trionyx* type.
5. A few pelecypod shells.

The geologic column for the Iren Dabasu basin therefore is essentially as in the following table:

Recent	Uplift and Erosion				
	Peneplanation				
Tertiary	Miocene or Later	Upper barren sands Rhinoceros gravels	25'+ 5'	The Houldjin Formation	The Gobi Series
	Oligocene or Eocene	Upper barren sandstones The Lophiodont bed	25'+ 4'	The Irdin Manha Formation	
	Physical and Faunal Break				
Cretaceous	Upper barren members, chiefly clays, marls and fine sands		90'	The Iren Dabasu Formation	
	Lower or Dinosaur beds, chiefly sands and sandstones		60'		
	Great unconformity				
Pre-Cretaceous	The old-rock floor, chiefly slates, limestones and igneous rocks				Probably The Nank'-on Series

3. An artiodactyl of the size of a Virginia deer.
4. An enormous mammal, probably a perissodactyl and possibly related to or identical with *Baluchitherium*, discovered by Forster Cooper in Baluchistan.
5. A tortoise of large size.

There is a sharp physical change immediately below this formation and only the coarse sandy conglomeratic member at the very base has been found to be fossiliferous. The fossil remains are unusually fragmentary.

Irdin Manha Formation (Early Tertiary)

For the early Tertiary beds found twenty-five miles farther south, also assumed properly to belong to Obretcheff's Gobi Series, we propose to use the term "Irdin Manha formation." It appears to lie immediately on Cretaceous beds, the Iren Dabasu formation, and again there is a sharp change in type of rock. The beds are cross-bedded sandstones, limy sands and pebbly sandstones. Only the lower member has been found to be fossil-bearing. It is characterized by the following forms: (1) Small Lophiodonta of at least two species in great abundance; (2) A perissodactyl about the size of the Upper Eocene titanotheres and possibly related to this family; (3) A small artiodactyl; (4) A small creodont; (5) An abundance of turtles of both the hard-shelled and soft-shelled groups; (6) Teleost fishes.

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The Houldjin Beds (Middle Tertiary)

For the late Tertiary beds found five miles farther south and belonging to the Gobi Series of Obretcheff we propose the term "Houldjin Beds," taken from the local name of the upland formed by these beds. They are characterized by the following fossil content:

1. A rhinocerid.
2. A large carnivore.

THE FEEDING POWER OF PLANTS[1]

Different species of plants vary greatly in their feeding power or ability to secure the required elements from the natural mineral matter of the soil or from difficultly soluble phosphate and potash minerals which may be applied as fertilizers. The character of the native vegetation is in many cases determined partly by differences in the feeding power of plants. Of the cultivated plants it is well known that buckwheat will feed much more strongly on rock phosphate than corn. The subject is thus not only of scientific interest but also of great practical importance.

It was formerly believed that the mineral matter of soils was made soluble and available to plants through the action of various acids excreted by the plant roots. Later experiments, especially those by Czapex, indicated that, other than carbonic acid, plants normally excrete at the most only minute quantities of acids. As is now well known practically all plants excrete through their roots large quantities of carbonic acid. Attempts to explain differences in feeding power on the basis of differences in amount of carbonic acid excreted have not been successful.

It might, however, still be argued that it is not necessary for plants to actually give off or excrete the acids in measurable amounts in order that they exercise an influence on the solution of mineral matter; it might be argued that all that is necessary is for the acids to saturate completely the walls of the root hairs which come in intimate contact with the mineral particles. That this is not the correct explanation is evident from what follows.

During recent years, by aid of the hydrogen electrode much valuable information has been secured regarding the acidity of plant juices.[2] This information is aiding greatly to clarify our conception regarding the feeding power of plants and the relation of plant growth to soil acidity and alkalinity. It indicates that the excretion of other acids than carbonic or mere presence of them in the walls of the root hairs is not an important factor in the feeding power of plants, for it is now known that a plant with a nearly neutral sap may feed more strongly on relatively insoluble minerals than one with a decidedly acid sap; *e. g.*, sweet clover and alfalfa with relatively slightly acid root saps of p_H 6 to 7 feed more strongly on feldspar than buckwheat with a relatively strongly acid root sap of p_H 4 to 5. If plants made the mineral matter of soils available through the excretion or presence of acids other than carbonic, then the reverse should be true, that is, the buckwheat should feed more strongly on feldspar than alfalfa and sweet clover because it would excrete or have present much the strongest acid. Similarly corn with a more acid sap than either alfalfa or sweet clover should feed more strongly than the other two on rock phosphate and feldspar if it were a matter of excretion or presence of acids, but again the opposite holds true. Undoubtedly, if data for more species of plants were available many more cases of this kind could be cited.

It is therefore necessary to find some other explanation for certain differences in feeding power than those thus far given, for evidently there are other factors than the excretion of acids which exercise a controlling influence on the feeding power of plants. A number of years ago the writer presented a new theory[3] regarding the feeding power of plants in which the feeding power for rock phosphate was explained on the basis of the law of mass action and chemical equilibrium. The reaction making the phosphorus of rock phosphate available to plants is one between carbonic acid and the tricalcium phosphate in rock phosphate which may be represented as follows:

$$Ca_3(PO)_2 + 2H_2CO_3 \rightleftarrows Ca_2H_2(PO_4)_2 + CaH_2(CO_3)_2.$$

[1] Published with the permission of the director of the Wisconsin Agricultural Experiment Station.

[2] Truog, E., and Meacham, M. R., *Soil Science*, 7, (1919), pp. 469-474; Clevenger, C. B., *Soil Science*, 8, (1919), 217-242; Bryan, O. C., *Soil* Science, 13, (1922), 271-302; Bauer, F. C., and Haas, A. R. C., *Soil Science*, 13, (1922), pp. 461-477.

[3] Science, N. S., 41, (1915), pp. 616-618; *Research Bulletin 41*, 1918, Wis. Agr. Expt. Sta.

In order that this reaction continue indefinitely, it is necessary that both products of the reaction be removed in somewhat the proportion that they are produced. This is the condition that actually exists with plants like buckwheat and sweet clover which use a large amount of calcium. They are thus enabled to feed strongly on rock phosphate, as is found by experiment. In case the calcium content of a plant is low, and the calcium bicarbonate is not removed in as high a proportion as the soluble phosphate, the rate of solution of the phosphate becomes slower and slower with time and thus the plant is unable to feed advantageously on the rock phosphate. This is the case with plants like oats and corn which have a low calcium content.

This theory may be tested in other ways; *e. g.*, the immediate availability of rock phosphate to plants like corn is much greater on acid soils than on the non-acid ones. This is due to the removal and precipitation of the calcium bicarbonate from solution by the soil acids. The effect on the availability of the phosphate is the same as though the calcium bicarbonate were removed by the plant. Working with quartz cultures, Bauer[4] has shown that the availability of rock phosphate to corn may be increased by leaching the cultures occasionally. This leaching removes the excess of soluble calcium bicarbonate and the effect is again the same as though it were removed by the plant. The addition of ammonium salts has also been found to increase the availability of rock phosphate. This is at least partly due to the effect of ammonium salts in increasing the solubility of calcium bicarbonate, which has the same effect up to a certain point as is produced by removing the calcium bicarbonate.

There is no question but what the application of the law of mass action to a study of the conditions of solution of mineral matter around the plant roots makes possible a correct explanation of many differences in the feeding power of plants. The conditions necessary for the continued solution of mineral matter in which two soluble products are formed at the feeding points of roots are explained by this means. When only one soluble product is formed as is the case in the solution of phosphorus from iron and aluminum phosphate by hydrolysis and the solution of potassium from orthoclase feldspar by either hydrolysis or carbonation, and in fact the solution of most bases from the silicates of the soil, differences in the feeding power of plants for these are not explained directly by the foregoing principle. The reaction of these minerals with the solvent at the feeding points of roots may be represented as follows:

$$FePO_4 + 3H_2O \rightleftarrows Fe(OH)_3 + H_3PO_4.$$

$$2KAlSi_3O_8 + H_2CO_3 + H_2O \rightleftarrows H_4Al_2Si_2O_9 + 4SiO_2 + K_2CO_3.$$

In both of the reactions only the last product is soluble and hence is the only product that can be removed either by the plant or in any other way. The conditions of solution are thus the same for all plants since water and carbonic acid are present in all cases. Differences in the feeding power of plants for the essential elements of these compounds must, therefore, be due to differences in conditions in the interior of the plants where the elements are actually used by being precipitated out of solution to form an essential part of plant compounds, making it possible for some plants to utilize more completely the elements from dilute solutions than others. In other words some plants can get along with more dilute solutions of certain elements than others.

The discussion in this connection will be limited to the base-forming elements. These elements are used by plants largely for at least three rather distinct purposes: (1) They are precipitated or held in physical and chemical combination with important colloidal plant compounds or complexes of which they may form an essential part. (2) In the form of the carbonate or bicarbonate they are used for the regulation of the reaction of plant proteins and other compounds, the plant sap, and precipitation of acids like oxalic out of solution. (3) They may act as carriers of acid forming elements. Potassium is used largely for the first purpose. Calcium is used for both the first and second purpose. Some

[4] *Soil Science*, 9, (1920), pp. 235-247.

plants, for example, the cultivated legumes, many of the cruciferæ, and buckwheat, require large amounts of calcium, much of which is probably used for the second purpose. Magnesium is probably used to a considerable extent for the third purpose as a carrier of phosphorus. Calcium and potassium may, of course, also be used for the third purpose, but it is only with the first two purposes that the present discussion is concerned.

In connection with the first purpose it is important to consider the following: There are always at least two important factors which determine how completely an element may be precipitated out of solution; viz., the reaction of the solution and the solubility of the precipitate formed. A proper regulation of the reaction is the most important factor in many precipitation processes. As a rule base-forming elements are more completely precipitated from a slightly acid or neutral solution than from a more acid one.

On this basis plants with a slightly acid or neutral sap especially of the leaves where the most active processes take place should be able to utilize potassium advantageously from a more dilute solution and feed more strongly on a slightly soluble potash mineral like feldspar than those plants with a more strongly acid sap, providing the reaction of the nutrient solution is favorable for the plants. Although the data available along this line are very meager, an examination of what there are indicates that this is actually the case. The sap of sweet clover leaves[5] ranges from slightly acid to slightly alkaline. Of the data known to the writer this is the only case in which the sap is sometimes alkaline. Theoretically the plant should feed strongly on the potash in feldspar and in actual test with quartz cultures Bauer[6] found it able to make a normal growth when forced to obtain all of its potash from feldspar. Of the common agricultural plants for which there are data available buckwheat has the most strongly acid sap of any in the leaves and it feeds very poorly on feldspar as should theoretically be the case. In tests with quartz cultures the writer found that alfalfa and sweet clover can obtain the necessary potassium for normal growth from more dilute solutions than corn and buckwheat which have a more acid sap. Much more data are needed before conclusions can be made definitely for all cases. The available data indicate strikingly the importance of the internal acidity on the feeding power of plants for potassium.

What has just been said in regard to potassium applies only when the nutrient or soil solution has a reaction which is favorable for the plant. If the nutrient solution is distinctly more acid than the plant sap, it will tend to make the plant sap more acid and the situation in regard to feeding for potassium may be greatly disturbed. In this connection it should be noted that alfalfa and sweet clover require relatively large amounts of potassium and quickly suffer from a lack of it, if the even dilute required concentration in the soil solution is not maintained due to a lack of the relatively insoluble potash minerals.

Undoubtedly the solubility of the potassium compounds formed in different plants is also a factor in the feeding power, but it seems reasonable to believe that to some extent the potassium compounds in different plants are similar and hence have somewhat similar solubilities. The solubility factor, therefore, because of its greater probable uniformity would not cause as great differences in the feeding power as the internal acidity factor which varies a great deal.

The relation of the feeding power of a plant for calcium which is to be used for the first purpose stated, to the acidity of the plant sap is probably the same as in the case of potassium. The amount of calcium required for the first purpose is, however, usually relatively small and the amount present in the soil solution relatively large so that the use of calcium for the first purpose is not a critical factor in the feeding power of a plant for calcium.

When plants use high amounts of calcium, the major portion is probably often used for the second purpose previously stated. The feeding power of a plant for calcium for this purpose seems to be related to the acidity of the plant sap, but the relation, as theoretically should be the case, is opposite to what it is

[5] Haas, A. R. C.: *Soil Science*, 9, (1920), pp. 341-368.

[6] *Soil Science*, 12, (1921), pp. 21-41.

with potassium, as is evident from the following: The reaction of the sap of different common agricultural plants has a range of p_H 4 to 8. This range is practically the same as that of the soil solution[7] in the humid region. It thus appears that plants through adaptation have come to have somewhat the same reaction as the medium on which they grow. It is well known that plants growing in solution cultures of unfavorable reaction tend to change the reaction of the culture to a more favorable one which is usually near that of the reaction of the plant itself. The plant does this[8] by utilizing a larger proportion of the acidic or basic constituents of the nutrient medium as the case may be. This again follows from the law of mass action, and the composition of the plant is thereby somewhat altered. Because of the highly buffered condition of the soil, plants can not materialy change its reaction in the way a solution culture is changed.

The unfavorable situation of a plant like alfalfa with a sap reaction of p_H 6 growing on a soil with a soil solution reaction of p_H 5 is thus apparent. This plant requires large amounts of basic material for the second purpose. How can it obtain this basic material for this purpose from a solution or medium which is ten times as acid as its own sap and system? It can not do it advantageously and hence the growth is slow and the content of basic material in the plant becomes lower than normal and even the reaction of the sap may become more acid than is normally the case. In extreme cases the plant not only grows slowly but also becomes sickly in appearance and easily succumbs to unfavorable weather conditions or parasitic diseases.

The buckwheat plant also requires a large amount of basic material. In fact, at the blooming stage it has a higher content of calcium than alfalfa, and yet it grows well on acid soils. The explanation of this is found in the high acidity of its sap, namely p_H 4 to 5. It can thus utilize advantageously a soil solution of p_H 5 as a source of basic material for the partial neutralization and regulation of its own sap and system.

The feeding power of a plant for calcium which is to be used for the second purpose is dependent largely on the normal acidity of the plant sap. The more acid the plant sap the more advantageously can the plant compete with another system—the soil and its solution, for neutralizing material which is largely lime in the case of plants and soils. Plants like oats and corn have a low content of calcium and probably use most of it for the first purpose. They apparently do not produce much acid which needs to be neutralized. Their sap is normally quite acid. They are thus well able to get all the calcium they need from even quite acid soils. The opposite relation of the acidity of the plant sap to the feeding power of many plants for calcium and potassium is now apparent. A high acidity means a low feeding power for potassium in dilute solution and a high feeding power for calcium needed for the neutralization and precipitation of acids.

The nature of the injurious or toxic action of acid and alkali soils on plants is also apparent. Theoretically the nutrient solution most favorably adapted to a plant as regards reaction would be one with a reaction the same as that of the plant sap. In case the plant needed a large amount of calcium and other basic elements, a nutrient solution slightly more alkaline than the plant sap would probably be best. When the nutrient solution is more acid than the plant sap, the plant by mass action is forced to utilize acid forming elements in greater proportion than is normally the case and as a result the composition of the plant is changed giving one with less than the normal amount of basic material. If the nutrient solution is much more acid than the plant sap the solid material of the plant due to lack of bases becomes so much more acid than is normally the case, that the plant sap also becomes more acid. The change in reaction of the whole plant system greatly interferes with the normal plant processes and as a result the plant grows slowly, becomes sickly and may even die. If a plant growing in a nutrient solution of favorable reaction were transferred to one with a much more acid reaction there

[7] Truog, E., *Soil Science*, 5, (1918), pp. 169-195.

[8] Hoagland, D. R., Science, N. S., 48, (1918), 422-425.

would undoubtedly follow an abstraction of basic elements from the plant compounds by the nutrient solution, and if the change were great enough, the plant would be killed.

In this connection it should be noted that the soil solution of acid soils often contains more calcium than the soil solution of less acid or neutral soils, and yet plants like alfalfa may suffer for lack of calcium in the former case and not in the latter, due to the fact that the acidity makes the calcium less available for certain purposes even though it is in solution. Availability is thus not only a question of solubility. It also depends on the form in which an element exists in solution.

SUMMARY

1. Differences in the feeding power of common agricultural plants for the essential elements of comparatively insoluble minerals are not due primarily to differences in amounts or kinds of acids excreted. The differences are due to several factors, some of which are concerned with external equilibrium conditions around the feeding roots, and others with internal equilibrium conditions inside the plant where the elements are actually used.

2. In case two soluble products are formed in the feeding region of the roots due to the action of carbonic acid on a mineral as is the case with rock phosphate, the feeding power follows the law of mass action and chemical equilibrium, being dependent on the removal of both of the soluble products either by the plant or partly by the plant and partly in other ways; thus plants with a high content of calcium feed strongly on rock phosphate because they remove both the soluble phosphate and soluble calcium bicarbonate in proper proportion.

3. If only one soluble product is formed as is the case with feldspar, the feeding power of the plant for the potassium depends on its ability to utilize potassium from a dilute solution which in turn depends largely on the acidity of the plant sap; the less acid the sap the greater the ability of the plant to utilize potassium from this source due to the fact that potassium is more easily and completely precipitated in the form of plant compounds in the less acid sap.

4. The feeding power of a plant for calcium which is used for the regulation of the reaction of the plant sap and colloidal system, and precipitation of acids, or for other elements used for these purposes, is also dependent upon the reaction of the plant sap but the relation is opposite to that of potassium; the more acid the plant sap the more easily can the plant compete with another acid system—the soil solution of an acid soil, for needed basic material.

5. In the case of base forming elements used for other purposes than regulation of the reaction and precipitation of acids, the relation of the feeding power for these to the plant sap is perhaps the same as for potassium.

6. There are undoubtedly many other factors which affect the feeding power of a plant but it seems that the ones given often exercise a controlling influence.

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THE TEACHING OF EVOLUTION

Every student, teacher and research worker in various fields of science must find cause for sincere regret in any attitude or movement that would limit the search for knowledge, or the presentation of scientific fact in the class room. There certainly is such a menace in the suggested limitation or elimination of the teaching of "evolution." It seems rather strange that such a conflict should be staged in a century made notable by outstanding advance in both pure and applied science. At no previous time have all men profited as much by the efforts of scientific workers. Then why such a hubbub about the teaching of what many think a fundamental concept of biological science?

The trouble seemingly was started by a group of conscientious folk who saw a sharp variance between their beliefs, religious or otherwise, and the theories presented and vigorously promulgated by many teachers. Some prominent men, as Mr. W. J. Bryan, made the matter one for public discussion, and the controlling trustees of certain schools requested or demanded that the doctrine of evolution should not be taught in the institutions under their control. The question has been taken to the legislatures of two or three states with a near approach to tragedy to scientific work. In a brief and somewhat generalized form this is the history of the case through the past few months.

As is usual in such cases, as has been true throughout the conflict between scientific and religious men, this difficulty has arisen through gross ignorance, useless misunderstanding and thoughtless intolerance. We have not found any prominent scientists among the opposers of the teaching of evolution. From the vague and inconsistent references to the meaning of evolution and the subject matter of courses in which it is involved it hardly seems possible that the opponents of this teaching have had the most elementary training in the ways of science or have had any sort of open-eyed contact with the world about them. It is always dangerous to take any difficult or abstruse question to any average legislative body—and it becomes especially dangerous when the real issue is hidden in a mist of ignorance and misconception as in the case in review. Legislators must hear the majority of the people—not judge the truth of scientific theory nor establish the rectitude of religious belief. Such misunderstandings with more or less serious disturbance are wholly unnecessary, and would never arise but for unwarranted provocative aggression by one or both parties in the case.

We know one man well, who through twenty years of teaching in high school and college has never had reason to think of his biological training and religious beliefs as conflicting. He has been able to maintain perfectly harmonious relations with different leading Protestant churches, and no question as to his religious uprightness or sincerity has ever been raised. He has had a fair training in biological science and has touched the general field of science enough to understand the lines of harmony and possible variance as touching common or popular beliefs. Doubtless, many other men have had a similar experience of freedom from conflict between their religious, social and scientific work. It is easy to see how all things scientific may seem strange and often unbelievable to the man who has no scientific training or but very meager training and that of doubtful accuracy, and how theories or even facts carelessly or inaccurately stated so as to seemingly conflict with as deep-seated a thing as a religious belief would be cast out as unbelievable or heretical by such sincere folks. It must be remembered as a scientific fact that a great many people, probably a majority of Americans as well as of other folks, actually live and die by their religion, shaping social, financial, political, and moral decisions of each day and year by their religious beliefs. Scientists who will accept at once the newest and most far-fetched theory sometimes fail to take into consideration the fact just mentioned, even though the acceptance of the most important scientific teaching depends upon the attitude of the teacher toward that fact. That the untrained cannot understand the scientist's point of view is taken for granted. Is it asking too much of the scientist to expect him to take such a sympathetic attitude toward churchmen as he expects them to take toward himself? As much of the present difficulty has arisen through a failure of some who call themselves scientists to make themselves fully acquainted with the ideas of the people they would teach as through the "misguided reformers" who do not at all understand the theories they think they must oppose.

There has appeared an alarming amount of bigotry on the part of some who proclaim themselves the champions of science. The really desirable thing, after all, is the freedom for scientists to pursue their lines of research and constructive work, and on the part of others a feeling of trust that our scientific men are really doing something worth while instead of merely spinning useless or even dangerous theories. The attitude of the opponents of evolution does not seem to lead toward this desirable end; and some of the scientific men of the country have not been conciliatory in their remarks when discussing the question.

The chief cause for disagreement was stated clearly by Mr. Bryan (Quoted in SCIENCE, March 3, 1922, pp. 242, 243.) in these words: "Christians do not dispute the right of any teacher to be agnostic or atheistic, but Christians do deny the right of agnostics and atheists to use the public school as a forum for the teaching of their doctrines." Some scientists through half a century with rapidly increasing boldness have made themselves critics of religious beliefs, holding in complete disdain the opinions of churchmen, without themselves entering experimentally into the merits of the case. There really seems but little reason for a scientist thinking himself fully fitted to discuss at any length the beliefs of a non-scientifically trained man unless the latter is at the same time given full right to discuss the opinions of the former. To put the matter bluntly—both are dealing with subjects entirely out of their field and about which they are, in most cases, essentially ignorant.

The grievance, from the viewpoint of the churchman, has been increased and in some cases made unbearable by the type of biological teaching found in many high schools. The responsibility for the recent difficulties may be largely traced to this cause in all probability. Among the first things impressed upon the college freshmen in natural science courses is the infallibility of a theory of evolution. This is usually made impressive by indefinite, incomplete or inaccurate illustrations with reference to the origin of man. The thorough student of biology soon finds himself facing other theories of evolution, and later forms a proper valuation of these theories with respect to the evidences in fact upon which they are founded. We have met with senior and graduate students, however, in college and university departments of biology, in whose minds the theoretical phases of evolution completely overshadow the basic facts, whose whole conception of Darwinism is included in the descent of man from monkey. Churchmen are not to be blamed for objecting to the promulgation of such ideas. Any right minded man should strenuously oppose such a program, and scientists ought to blush for shame at such a crude presentation of the story of organic development.

The teaching of science, particularly of biology or related subjects, in the high school is the chief area of stress, the place where misunderstandings may most readily occur. Here the teacher is usually to blame, albeit unintentionally so in many instances. Most of the high-school teachers of botany, zoology and biology are drawn from among those students who have spent a year or less in such classes in college and who try to pass on to their students the ideas presented in those elementary courses. It is small reason for wonder that the ideas of evolution caught on the wing in brief lecture periods, unsupported by wide reading and undigested by extensive laboratory work and field observation, should be inaccurate, calculated to rouse protest in any community. It certainly seems that in the interest of public support of true scientific work, such teachers should be kept from service. Under present conditions of school organization this is impossible, but changes in the organization and emphasis in elementary biology courses in colleges would materially lessen the harm from this source.

The elementary courses in college and university courses taken as electives to fulfill general requirements in science are also dangerous, turning out as they do thousands of young folks with but a momentary view of limited phases of biology. But behind all this is a warped view of the relative importance of facts and theories on the part of college and university instructors. After all is said a theory of evolution is but a theory. Which particular line of procedure has produced new forms of life in the past is a basis for discussion and disagreement among the most learned. However much we may respect the theory, however well it may be supported by accumulations of facts, it is subject to adjustment or even serious modification with the presentation of every new fact, and is liable to more or less rough handling by some new Darwin, Lamarck, or DeVries, as some older theories have been shaken by an Einstein. Certainly a theory of evolution suffers violence at the hands of any one who presents it as anything other than a theory. The idea of orderly development, which is all the term evolution may rightly include, will very, very rarely arouse antagonism or even doubt. Danger comes with the presentation and insistence upon the claims of some particular type of evolution.

It should be said plainly that there are abundant unquestioned facts upon which our theories are based, and while we may differ in our opinions as to the significance of those facts, they are generally accepted. Variation of individuals of species or race, reproduction of like forms, the struggle for existence, the adaptation of organism and environment through the cutting off of the unfit, the production of new forms by hybridization, all these are facts of everyday experience, facts that may be taught without raising questions as to the teacher's religious views, facts which if more clearly and consistently taught would tend to develop a better trained group of scientific workers, teachers and general citizenry.

From the standpoint of right and wrong the teacher in college or elsewhere can not more justly force his theories upon an unwilling or unsuspecting public than can a religious enthusiast require all men to subscribe to his beliefs. The quack doctor, the religious fanatic, and the poorly balanced teacher of science are similar in that they are alike dangerous, and the general public should consider all with suspicion. Lampooning earnest religious folks because they refuse to accept all that comes to them in the name of science will not help to develop the very desirable discrimination between the true and the false, but will rather arouse more vigorous antagonism. There is no fundamental basis for conflict between enlightened and sincere churchmen and true scientists. The development of American institutions and ideals and the advancement of the material welfare of the American people have come from the efforts alike of churchmen, statesmen and scientists; and for continued prosperity, it is essential that there be harmony of purpose between these factors. It is the business of the leaders of scientific work and teachers of science to make such a discrimination between fact and theory that all must respect their findings, and to use such care in the presentation of subject matter that no one idea will be given the undue prominence that is provocative of misunderstanding and distrust. Why not make it quite clear that "Darwinism," whatever that may mean to the individual professor, is not all of evolution? Why not spend more time making clear to college students the facts of observation and experiment upon which the "Origin of Species" was founded? We are confident that more teaching of fundamental facts will lead to a better understanding between scientists and the rest of the world, and to a more hearty support of scientific endeavor.

F. L. Pickett
State College of Washington

SCIENTIFIC EVENTS

VITAL STATISTICS OF GERMAN CITIES[1]

According to official publications, the population of the 343 larger cities from which reports are accessible had increased one million, being 25,700,000 in 1921, as compared with 24,700,000 in 1920. It is evident, therefore, that 41 per cent. of the total population of the empire resides in these 343 cities. This remarkable growth of the cities is doubtless due, to a considerable extent, to the influx from the smaller towns and to the immigration from foreign countries. The number of living infants born in these cities was 560,000, or 21.8 per thousand of population, which denoted a falling off when contrasted with the record for the previous year, which was 23.8 per thousand. Since it has been found that economic factors exert a great influence on the birth rate, Dr. Roesle, taking the value of the mark in relation to the American dollar as a basis, has been making a critical investigation of the possible effect of economic conditions. In order to discover the influence on the varying birth rate throughout the twelve months of the year, it is quite evidently necessary to date back nine months the birth rate for each month, since in this manner the month in which the children were conceived is ascertained. In 1921, the birth rate of the urban population continued to drop until August, or, taking the

[1] From the *Journal* of the American Medical Association.

month of conception, back to November, 1920, in which month not only the value of the American dollar in marks but also the wholesale prices of German goods thereby affected reached the maximum of the observation period. Roesle therefore assumes that the failure of the rational increase in the birth rate for July, 1921 (conception month, October, 1920), to materialize is traceable to the further increase in the cost of living which followed the advance of the dollar and of the wholesale prices of German goods. In the months of February and March, 1921, the cost of living came down, and it is to be noted that there was a corresponding increase in the birth rate for the months of November and December, 1921 (just nine months later). It could not be shown that economic conditions exerted a perceptible influence on the death rate. The year 1921 shows the lowest recorded death rate in German cities with more than 15,000 inhabitants; namely, 13.5 per thousand of population, and excluding deaths among strangers and transients, the death rate was only 11.9. A comparison of the monthly death rates for former years brings out the fact that during the winter months of January, February and March, 1921, especially favorable weather conditions must have prevailed. The abnormally mild winter was followed by an abnormally hot summer, but the summer peak of infant mortality did not reach the terrible percentage of the summer of 1911. Also during the autumn of 1921 the weather conditions were favorable. These favorable weather conditions prevailed elsewhere as well, so that favorable death rates for the year 1921 are to be expected also from other countries. Only for the month of December, 1921, was there a higher death rate than for the corresponding month of the previous year, which is explainable by the severe influenza epidemic. The rapid and continued decrease in the death rate, since the war, is due, for the most part, to the improvement in the food situation.

THE REDWOOD TREES OF CALIFORNIA

DR. J. B. GRANT, chairman of the board of directors of the "Save the Redwoods League," has issued a report, giving the history of the league which was organized four years ago. The report, according to the *New York Times*, states that the original redwood belt is a remnant of the massive forests of this and related species that in prehistoric times covered a considerable part of the northern hemisphere. It averages twenty miles in width and extends some 450 miles from Monterey County, California, to just above the Oregon line. In the southern part of this belt, in Santa Cruz County, as long ago as 1905, the State of California established a state park, preserving what is known as Big Basin, containing many magnificent trees. Muir Woods, on the slopes of Mount Tamalpais, has already been made a national monument. And now, as a part of the Save the Redwoods movement, the nucleus of another state park has been preserved in the northern portion of the redwood belt, in Humboldt County, in the basin of the south fork of the Eel River and adjoining the California State Highway.

The Humboldt State Redwood Park, which is the beginning of a larger area to be preserved, consists of about 2,000 acres, extending fourteen miles along the California state highway, where it skirts the eastern bank of the south fork of the Eel River, between Phillipsville and Dyerville. It contains perhaps 200,000,000 feet of some of the finest redwoods. It is 230 miles from San Francisco on the main state highway leading to Eureka, California, and is administered for the state by the California State Forestry Board. It is accessible through the year by train.

One tract of redwoods saved by private donation was Bolling Memorial Grove, which is within Humboldt State Park. It was established by Dr. John C. Phillips, of Massachusetts, in memory of Colonel Raynal C. Bolling, one of the first American officers of high rank to give his life in the World War.

The establishment of Humboldt State Redwood Park is a part of the general movement to save representative groves through the redwood belt, particularly those along the "Highway of the Giants," the state highway, leading from the southernmost redwoods in Monterey to the northernmost at the Oregon line. It is in the northern region that a larger national park, preserving adequately for all time a representative redwood forest in its primitive state, will probably be established. The task of the Save the Redwoods League is to cooperate with the state in assuring the preservation of the Highway of the Giants and to aid the federal government toward establishing the national park.

The league is interested also in promoting the preservation and reforestation of cutover redwood lands. The redwood is a tree that reproduces by sprouting from the stump, and in time produces beautiful second growth trees. While these are in no way comparable in size or grandeur with the ancient redwoods that have taken 1,000 to 1,500 years to mature, nevertheless if it is possible to save the finest of the virgin stands of redwoods, the remaining redwood area will ultimately be covered with attractive second growth.

Since the league can not hope to raise more than a fraction of the needed sum through state appropriation or private contributions, it advocates federal action toward the establishment of such a park.

CERAMIC DAY

The American Ceramic Society has issued the following letter to members of the society:

Our society has provided the program for one of the days during the exposition week (11-16 inclusive) known as Ceramic Day. This will be on Friday, September 15.

President Frank H. Riddle will appear on the opening program of the exposition with the presidents of other technical societies.

Messrs. E. P. Poste and Ross C. Purdy will appear on the special program on "Specifications." Mr. Poste will discuss specifications for enameled chemical ware and Mr. Purdy will describe the problems in writing specifications for refractories.

The partial program for Ceramic Day, September 15 is:

High temperature cements, by W. H. Gaylord, Jr., Quigley Furnace Specialties Company.

Application of magnetic separator in ceramic industries, by E. S. Hirschberg, Dings Magnetic Separator Company.

Preparation of clays and minerals for ceramic purposes, by J. D. Dickey, chemist, Industrial Filteration Corporation.

Apparatus for quickly determining fineness of grind, by Eric Turner, Trenton Flint and Spar Company.

Feldspar Colloquium: W. H. Landers, George M. Darby, O. O. Bowman, 2d, V. A. Staudt, C. R. Moore, C. M. Franzheim and others.

Manufacture of gray enameled ware, by H. C. Arnold.

Whiting for ceramic uses, by A. E. Williams.

Gas producers for glass works, by C. B. Chapman, Chapman Engineering Company.

Witchery of glazes, by Paul E. Cox.

Architectural faience and its artistic possibilities, by Conrad Dressler.

Organization of a decorative ceramic research department; financial and manufacturing considerations, by Frederick H. Rhead.

R. D. Landrum
Chairman of Committee on Program.

THE GEOLOGICAL SOCIETY OF AMERICA

At the last annual meeting of the Geological Society of America held at Amherst, the fellows listened to an instructive symposium on Isostasy, in which it was clearly brought out that this is not the primary cause in the making of folded mountains. There is a greater antecedent cause, and it is the later adjustments in the mountains that are due to isostasy.

It is therefore proposed that at the meeting of the society to be held at the University of Michigan next December, there be held a symposium on "The Structure and History of Mountains and the Causes for their Development," dealing with the following questions: What are the chief internal structures of mountains? To what extent is lateral compression responsible for folding and uplift? What causes the lithosphere locally to upheave and to fold into mountains? These discussions will be led by

Charles Schuchert—The sites and nature of the American geosynclines.

Chester R. Longwell—Professor Kober's theory of mountain structure and mountain making.

William H. Hobbs—The Asiatic arcs.

Arthur Keith—The Appalachians.

Jay B. Woodworth—The mountains of New England and the Maritime Provinces of Canada.

Willis T. Lee—The Front Ranges of Colorado and New Mexico.

G. R. Mansfield—The Rocky Mountains of Idaho and Montana.

Bailey Willis—The Pacific mountains.

Edmund Otis Hovey
Secretary.

THE JOURNAL OF PHYSICAL CHEMISTRY

As a result of action by the council the *Journal of Physical Chemistry* is to be published under the auspices of three great English-speaking chemical societies—the American Chemical Society, the Chemical Society at London and Faraday Society of Great Britain. Action by the Council of the American Chemical Society at the Pittsburgh meeting completed plans for this step, which is hailed by leading chemists as a fine recognition by the two conservative British groups of the high quality of the work of American chemists, and an important advance in the science of chemistry.

The action is the result of the recent visit of Dr. Charles L. Parsons, secretary of the American Chemical Society, to England, where he had a conference with officials of the Chemical Society of London in regard to the internationalization of this journel, of which professor Wilder D. Bancroft of Cornell University is editor.

The following conditions were agreed to:

1. In future the *Journal of Physical Chemistry* shall be under the joint auspices of the American Chemical Society and the Chemical Society,[1] neither society, however, being financially liable in any way.

2. The control of the *Journal* shall be exercised by a board, consisting of eight members, four being nominated by the American Chemical Society and four by the Chemical Society. These members to be appointed for a term of two years, except that one half shall go off each year, those who retire the first year to be determined by lot. No member of the board shall serve continuously more than four years.

3. The eight members of the board will elect an editor-in-chief, who shall have an equal voice on the board, except on the question of election of the editor-in-chief, on which matter he shall not vote.

4. The lines on which the *Journal* will be run shall be left entirely in the hands of the said board.

5. It is suggested that the board shall appoint also a managing editor, who shall be responsible to the board for the business management of the *Journal.*

6. The board shall report annually to each of the societies under the auspices of which the *Journal* is published.

7. The *Journal* shall be offered to members of the American Chemical Society and to fellows of the Chemical Society at reduced subscription rates.

Dr. Parsons also reported to the council that Francis P. Garvan, president of the Chemical Foundation, had guaranteed $10,000 annually for five years for publication work. "This guarantee I make on behalf of the Chemical Foundation," Mr. Garvan wrote, "but if the funds of the Chemical Foundation prove inadequate, I will make good the guarantee personally."

[1] Later the Faraday Society became one of the parties of the agreement and will appoint one member of the board of editors.

CHEMICAL PRIZE ESTABLISHED BY THE ALLIED CHEMICAL AND DYE CORPORATION

A prize of $25,000 to be awarded annually to a chemist in the United States for contributions to chemistry was announced by the Allied Chemical and Dye Corporation of New York, in a letter read by Dr. Edgar F. Smith, president of the American Chemical Society, at a council meeting which opened the sixty-fourth annual meeting of the society at Pittsburgh on September 6. The letter from Dr. Wm. H. Nichols, chairman of the corporation, is as follows:

Confirming our interview yesterday, it gives me great pleasure to state that the Allied Chemical and Dye Corporation desires to institute an annual prize of $25,000 to reward the chemist residing in the United States, who in the opinion of a properly constituted jury has contributed most to the benefit of the science and of the world. Realizing, as we do, the enormous influence which chemists working in all the fields of that science will have on the welfare of the world, we desire by this prize to so encourage the workers that even larger benefits should accrue than those which have already placed the world under such a debt of gratitude to the profession.

We desire that you should make this announcement at such time and place as you shall deem best, and to take such steps as may be necessary to carry the matter into effect beginning with the year 1923. We assume that a committee, of which you will be chairman, will be appointed by you to consider and suggest the rules governing the selection each year of the chemist who is deemed most worthy.

We also assume that this committee would provide for the appointment of a jury to decide annually who should be the recipient. We would be glad if the committee would arrange the selection of this jury so that this company would have the appointment of two members, it being understood that neither of those members should be connected with the company.

We do not desire to limit the gift to any particular field of chemistry, recognizing as we do the importance of them all.

As the American Chemical Society is by far the largest organization of chemists, and represents every field of the science in its membership, we have thought it better to work through that society, although not limiting the gift to its members. Our sole desire is to encourage chemists everywhere in our country to do even more than they have been doing for the general good.

We have not gone into details, as we value greatly the opinions of those who would naturally be asked to serve on the committee, and do not desire to trammel them in their deliberations.

MEMBERS OF THE AMERICAN MEDICAL ASSOCIATION AND THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Members of the American Medical Association who are not now members of the American Association for the Advancement of Science have been invited to become members without the payment of the usual five-dollar entrance fee. This special invitation has been voted by the executive committee of the American Association for the Advancement of Science because of the fact that it is practically impossible for the permanent secretary's office to send an individual invitation offering this privilege to each new member of the American Medical Association each year, as is done in the case of the other scientific societies affiliated with the American Association for the Advancement of Science.

Members of the American Medical Association who are interested in this invitation are requested to write to the permanent secretary's office, Smithsonian Institution Building, Washington, D. C. They will thus secure a special invitation and a booklet of information regarding the American Association for the Advancement of Science.

Burton E. Livingston
Permanent Secretary.

SCIENTIFIC NOTES AND NEWS

The Association of German Scientific Men and Physicians holds its hundredth meeting at Leipzig from September 18 to 24. One of the public addresses is by Professor Albert Einstein.

The Swiss Scientific Society held its one hundred and third annual meeting at Berne from August 24 to 27. According to the program as quoted in *Nature,* the general addresses included the following: "The trend of modern physics," Dr. C. E. Buye (Geneva); "The nature of the so-called general neuroses," Professor Sahli (Berne); "The Aar Massif—an example of Alpine granitic instrusion," Dr. E. Hugi (Berne); "The natural form of substances as a physical problem," Dr. V. Kohlschütter (Berne); "Experimental genetics in regard to the law of variation" (illustrated by lantern slides), Dr. A. Pictet (Geneva); and "Investigations into the physiology of Alpine plants," Dr. G. Senn (Bale).

At the Pittsburgh meeting of the American Chemical Society Dr. C. L. Parsons was unanimously reelected secretary of the society. The editors of the society's journals were unanimousely reelected, namely: *Chemical Abstracts:* E. J. Crane. *Journal of the American Chemical Society:* A. B. Lamb. *Industrial and Engineering Chemistry:* H. E. Howe. Dr. W. A. Noyes was elected editor of *Scientific Monographs.* The advisory committee named H. E. Howe as successor to Dr. Johnson, who resigned as editor of *Technologic Monographs.*

Sir Charles Scott Sherrington, president of the Royal Society and of the British Association for the Advancement of Science, Waynflete professor of physiology at Oxford University, has accepted an invitation to attend the formal opening of the new biological building of McGill University in October.

Professor F. G. Coker has been presented with the Howard N. Potts gold medal of the Franklin Institute of Philadelphia, awarded to him in recognition of his recent work on photo polarimetry. The presentation was made at a dinner at the Savoy Hotel by Dr. R. B. Owens, secretary of the institute.

J. W. Gregg, head of the division of landscape gardening in the College of Agriculture, University of California, has been elected as fellow of the Royal Horticultural Society of England.

F. B. Tough, United States supervisor of oil and gas operations on leased public lands, has been appointed chief petroleum technologist of the Bureau of Mines, to succeed A. W. Ambrose, who has been appointed assistant director of the bureau.

Mr. Ernest A. Smith has resigned his position as secretary of the British Non-Ferrous Metals Research Association and accepted an appointment as research metallurgist to the Sheffield Smelting Company.

G. E. Sanders is returning to Canada this month, to take charge of the manufacture of insecticides and fungicides for the Deoro Chemical Company. For the past year he has been with the Dosch Chemical Company at Louisville, Ky.

Dr. A. P. Saunders, professor of chemistry since 1901 and dean of Hamilton College since 1909, has been given a year's leave of absence and will travel in Europe with his family during the coming winter. His address is care of Morgan, Harjes & Co., Place Vendôme, Paris.

We learn from *Nature* that Professor J. W. Gregory, of Glasgow University, reports his safe arrival at Talifu, Yunnan, after a successful journey in Tibet. Professor Gregory and his son, Mr. C. J. Gregory, left England for Rangoon at the end of March last with the object of investigating some features in the mountain structure of northwestern Yunnan and western Szechuan.

Robert T. Aitken has returned from about two years spent in Tahiti and various islands of the Society and Austral groups. His work is to supplement the investigations of the Bayard Dominick Expedition, which is making an intensive study of Polynesian origin and migration. Mr. Aitken collected material objects illustrative of the life of the present-day people, and a few that date back to the early inhabitants of these islands. He also brought back a few folk tales in fragmentary form, physical measurements of the inhabitants and photographs of the majority of the people of the island of Tubuai in the Austral group.

The American Society of Mechanical Engineers has appointed a committee to report on a standard smoke ordinance to apply to all cities of the country. It consists of O. P. Hood, chief mechanical engineer of the United States Bureau of Mines as chairman, Henry Kreisinger, P. J. Dougherty, Lloyd R. Stowe, Everett L. Aillard and Osborn Monnett.

Dr. William S. Halsted, since 1889 professor of surgery in the Johns Hopkins Medical School, died in Baltimore on September 7, aged seventy years.

Dr. Harold C. Ernst, professor of bacteriology in the Harvard Medical School from 1891 to 1921, and editor of the *Journal of Medical Research*, died on September 7, aged sixty-six years.

Dr. Edward Anthony Spitzka, specialist in the anatomy of the brain, died at Mount Vernon, N. Y., on September 4, at the age of forty-six years.

Alexander Righter Craig, secretary of the American Medical Association since 1911, died on September 2, aged fifty-four years.

W. H. Hudson, the distinguished English ornithologist and writer on natural history, died in London on August 18 in his eighty-first year.

The Brigham Young University, of Provo, Utah, has just closed its first annual Alpine summer school. The school was housed in tents at a point about 7,500 feet above sea level at the base of Mt. Timpanogos with an elevation of 12,000 feet. Courses were offered in botany and geology.

The Rockefeller Foundation, through Dr. Platt W. Covington, state director of the International Health Board of the Foundation, has agreed to donate the sum of $5,000 yearly for three years toward establishing a laboratory in San Bernardino County, California, for research work. A condition is made that the county provide a like sum for the three-year period and furnish the laboratory and an experienced physician and chemist to be placed in charge of the work. San Bernardino is one of three counties in the state to receive the offer. The object of the proposal is to better health conditions and provide means for lowering the heavy death rate.

An effort is being made in England to raise $100,000 for the construction of an airship to fly to the North Pole. Captain Charles Frobisher, formerly a war pilot, is the leader. His idea is to start with an airship from London and fly by way of Christiana and North Cape and Bear Island to Spitzbergen, where the airship would be overhauled for the final 700-mile dash. His estimate is that it would not be necessary for the ship to attain a speed of more than fifty miles an hour in order to reach the goal, and that a crew of ten and supplies could be easily carried. Another advantage of the airship over the airplane is the proposed installation of a powerful wireless in order to maintain communication with the outside world.

During October the following public lectures will be given at the Brooklyn Botanic Garden:

October 7—"A Garden Pilgrimage in England": Mr. Montague Free, horticulturist, Brooklyn Botanic Garden.

October 14—"The Origin of Cultivated Plants": Dr. Orlando E. White, curator of plant breeding, Brooklyn Botanic Garden.

October 21—"Four Seasons in the Garden": Mr. Leonard Barron, editor of *The Garden Magazine*, Garden City, L. I.

October 28—"Health and Disease in Plants": Dr. Arthur Harmount Graves, curator of public instruction, Brooklyn Botanic Garden.

According to a dispatch to the London *Times*, the opinion was expressed at the meeting of the Association of Tropical Medicine, which is holding its conference at Hamburg, attended by scientists from Holland, Java, Turkey, South America and Germany, that Germany has made a discovery of considerable importance. "Beyer 205," the discovery of the Bayerische Farbwerke, is said to be a cure for sleeping sickness, both for human beings and animals. This drug kills the microbe causing sleeping sickness in man and animals without injuring the patient. The Bayerische Farbwerke has supplied the Belgian colonial minister, on his request, with a quantity of "205" for research purposes to be used in the laboratories at Leopoldsville in the Congo, and the Belgian technical schools for tropical diseases. German scientists expect, owing to the latest development, that this discovery will point the way to a cure for malaria and also coast fever in animals.

A report was presented to the French Academy of Sciences on August 21 which gave the results of an examination by Professor Louis Boutan, of Bordeaux, of a "cultivated" pearl made by Mr. Mikimoto's method. Professor Boutan's conclusion is that the Mikimoto pearls are apparently identical with natural ones. M. Boutan says that the apparatus, by means of which MM. Galibourg and Rysiger disclose the artificial nucleus which is to be found in the ordinary cultivated pearls, is of no use in distinguishing those of the Mikimoto variety, as these have no nucleus. M. Louis Joubin, who presented the report to the academy, made the interesting point that as the "culture" process is applied to oysters which produce pearls spontaneously, Mr. Mikimoto himself can never be sure that his "cultivated" pearl is not an ordinary natural one. One effect of the report would appear to be that the authenticity of "real" pearls now depends entirely on the word of the man who sells them.

UNIVERSITY AND EDUCATIONAL NOTES

The will of the late Frederick Bertuch bequeathes, to take effect on the death of Mrs.

Bertuch, $750,000 to public purposes. Among these bequests are $100,000 to Columbia University for poor students and $50,000 to Cooper Union.

The *Journal* of the American Medical Association reports that the Medical School of the University of Rochester is making progress. A research laboratory will be completed in about three months. An affiliation is being brought about between the city authorities and the university for the building of a municipal hospital on or near the university campus, and, in accordance with the arrangements, the university medical school will furnish the professional training and nursing staffs, and the medical teaching will be carried on in the hospital. Walter R. Bloor, Ph.D., of the University of California Medical School, has accepted the chair of biochemistry, and will begin his work this fall. Dr. George W. Corner, now at Johns Hopkins University, is to be the professor of anatomy. He will assume his duties at Rochester early in 1924. Dr. Nathaniel W. Faxon, now of the Massachusetts General Hospital, will assume the position of director of the University Hospital on October 15. The school will be ready to receive students in the fall of 1924 or 1925.

Dr. Richard M. Smith, instructor in pediatrics, Medical School of Harvard University, has been appointed assistant professor of child hygiene in the new school of public health.

Dr. Charles P. Alexander, of the Illinois Natural History Survey, has been elected assistant professor of entomology at the Massachusetts Agricultural College, to fill the vacancy caused by the resignation of Dr. W. S. Regan last autumn.

Dr. Alex. McTaggart, formerly agriculturist of the Department of Agriculture Museum at Wellington, New Zealand, has been appointed assistant professor of agronomy at Macdonald College, Canada. He will be in charge of plant breeding work, with special reference to grasses and clovers.

Dr. J. W. McLeod, lecturer in bacteriology at the University of Leeds, has been appointed the first occupant of the Sir Edward Brotherton chair of bacteriology in that university.

DISCUSSION AND CORRESPONDENCE

THE ZODIACAL LIGHT

The most brilliant display of the zodiacal light that I have observed occurred on the night of April 8, 1922. My point of observation was Poulan, Worth County, Georgia (latitude 31-30 north; longitude 83-45 west). The light covered more of the heavens than shown as a zone of zodiacal light in any of the several hundred charts made of it by an observer with Commodore Perry's expedition to Japan in 1853-1856, and printed in a huge tomed report by the United States government as a part of the reports of that historic occurrence. One great volume of the Perry reports is given over entirely to the zodiacal light, forming the most massive single piece of literature upon the subject. I have observed the zodiacal light from the Straits of Magellan to 46 north latitude without having seen such a display as the one here alluded to. It dulled the near full moon. There was not a cloud in the sky. In the brilliant moonlight the zodiacal light made the spots in the heavens unilluminated by it looks like coal sacks, so great was the contrast. I have seen the aurora borealis above the Arctic circle and the aurora australis below the Antarctic line, and seldom were these exhibitions more brilliant and effective than the display that was neither on the night of April 8 last. It must be true that observers in southern latitudes are often confused by the zodiacal light and take it for an auroral burst. The zodiacal light is usually most noticeable in the western sky. This one covered more than half the heavens irregularly. It continued from 9 P.M. until 3 A.M. with varying brilliancy. Judge Roberts P. Hudson, of Sault Ste. Marie, Michigan, was my companion observer on the night of April 8.

Chase S. Osborn

Sault Ste. Marie, Michigan

THE MEALY-BUG CALLED PSEUDOCOCCUS BROMELIÆ, AND OTHER COCCIDS

In my recent review of Wheeler on *Tachigalia* insects, I gave a footnote questioning the validity of the name *Pseudococcus bromeliæ* (Bouché), as applied to the species of mealybug found on *Tachigalia*. This has brought me a letter from Hawaii, where an insect presumed to be the same is of economic importance, asking for additional information. Since the matter is one of importance to economic entomologists, it may be worth while to state explicitly why Bouché's name can not be used. I have not seen Bouché's original work (1834), but his whole description is quoted by Signoret. In 1875 Signoret received a mealy-bug on pine-apple, which he described, saying that it was probably Bouché's *Coccus bromeliæ*. Since there was already an entirely different *Coccus bromeliæ,* published in 1778 (now called *Diaspis bromeliæ*), it appears that Bouché's name was in any case unavailable. Signoret, uninfluenced by the homonym, was still in considerable doubt as to the identity of his insect, and accordingly gave Bouché's description, so that the reader might form his own opinion. That description is somewhat confusing, but we are told that the fertilized female takes the form of a convex, short, elliptical shield, a little narrower in front. The last abdominal segment is cleft. The females, after an early stage, remain in one place all their lives, unless one tears them off. The insect is common in greenhouses, on various plants. There can, I think, be little doubt that Bouché had before him the Lecaniid *Saissetia hemisphærica* (Targioni, 1867); surely it was not a mealy-bug. In the Fernald Catalogue of Coccidæ there is confused with this *Lecanium bromeliæ* Bouché, grey marbled with brown, which Signoret did not undertake to identify. It was probably *Lecanium hesperidum* (L.).

Another coccid which seems to need discussion is the large Lecaniid of the tulip-tree. Dr. W. E. Britton (Bull. 234, Conn. Agric. Exp. Station) gives a good account of this insect, but calls it *Toumeyella liriodendri* (Gmelin), stating that it was so identified by Sanders, "after a careful study." Gmelin's *Coccus liriodendri* was based on an account by Dr. John Hill, of London, appearing in the *Hamburgisches Magazine* for 1753. Many years ago I borrowed this work from the Library of Congress, and together with Mr. Pergande went over the description. The account is very vague, and contains some apparently inaccurate statements, but it evidently applies to a Lecaniid on the tulip-tree. We concluded at the time that it was not possible to reach a definite decision, and were not in favor of displacing Cook's name *tulipiferæ* (1878). There is no indication that any one has really reconsidered this evidence, and I think the scale should stand as *Toumeyella tulipiferæ* (Cook).

Sanders (*Journ. Economic Entomology*, 1909, p. 432), adopting *Pseudococcus adonidum* (L.) as the name of the common long-tailed mealy-bug (*P. longispinus* Targ.), refers to the "good description of the insect in *Systema Naturæ,* Ed. XII." The "good description" refers to "linea dorsalis longitudinalis elevata . . . area inter lineam dosalem marginemque totidem punctis in seriem longitudinalem dispositis . . . cauda bifida," etc. Conceivably this may be *Orthezia urticæ* (L.), but this is guessing. There is not anything to clearly indicate the mealy-bug, and part of the description contradicts such a reference. I am in favor of using the oldest names when there is real evidence, or even a satisfactory presumption, in their favor, but when the descriptions are inapplicable it is another matter.

The application of the generic name *Coccus* L. to the soft scales may have to be reconsidered. The original Coccus (the word meaning a berry) was the hard round scale of the oak, commonly called *Kermes*. Under the rules, a good argument can be made for considering *Coccus ilicis* L. (*Kermes ilicis*) the type of *Coccus,* on grounds of tautonomy, but there is room for diversity of opinion. *Lecanium pulchrum* King, well redescribed by Marchal (1908), should apparently stand as *L. rufulum* (*Eulecanium alni* var. *rufulum* Ckll.).

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THE DETERMINATION OF FAT IN CREAM

To the Editor of Science: I noticed in Science for July 7, page 25, an abstract of a paper read before the American Chemical Society by E. G. Mahin and R. H. Carr, entitled "Errors in the determination of fat in cream."

In 1910, the dairy department of Purdue University, under the direction of Professor O. F. Hunziker, head of the department, made extensive investigations to determine if it is desirable to use any material for eliminating the upper meniscus on the neck of the Babcock testing bottles and after a very extensive experiment, came to the conclusion that for uniform and accurate results of the cream test, the meniscus must be eliminated. The reason for this conclusion was that the color of the test, clearness of fat, amount and direction of light, kind of background of the test bottle, angle from which the test is read, etc., gives a varying meniscus.

A number of experiments were tried out at this station as well as at other experiment stations about this time with different liquids for eliminating the meniscus. Amylalcohol was one of the materials experimented with at this time, but it was found that its fat dissolving properties and the harmful effect of the vapor on the operator made it impracticable for commercial use.

Glymol, which is a white mineral oil, was found not to have the objection of the amylalcohol and at the same time eliminated the meniscus which made an accurate test so difficult. The use of glymol is now being used in practically every state of the Union and its value has been thoroughly proved. The authors of the above mentioned article, while they condemn the use of glymol, make the following statement, "If the latter is added slowly and carefully, little or no error occurs." This kind of criticism may be made of any test, but from our inspection of over 1,800 cream buying stations in Indiana, this last year, in our Creamery License Division, we have found at least 98 per cent. of the testers adding the glymol as it should be added and where the testers fail to comply with the creamery and testers' license law or perform tests that are inaccurate, their license is revoked. In cases where licenses were revoked this last year, our investigations show very conclusively that the incorrect testing was due to intent in practically every case, rather than by faulty methods of testing. In the last sentence of this article, the authors say: "It is conclusively shown that the methods (referring to the use of glymol) is not safe in the hands of the average dairy testers, but the use of amylalcohol for this purpose, substituted for hydrocarbon oils, gives reliable results in all cases." A few tests are sufficient to show that this statement is erroneous. Six samples of cream were used and the test read by adding amylalcohol. The tests were read as soon as the amylalcohol was placed on the test and the six tests averaged 22.2 per cent. After standing ten minutes, the six tests averaged 21.5 per cent, showing very conclusively that the amylalcohol dissolves a portion of the fat and does not give reliable results.

As chairman of the Creamery License Division Board of Indiana, a board which has for its purpose the enforcement of the Indiana testers' license law and the protection of the producer against fraudulent or incorrect tests of milk and cream, I am very anxious to receive all constructive criticisms of our present methods of testing, but under our present methods of checking the cream buying stations in Indiana, it is a most erroneous statement to intimate that ten large creameries in Indiana are beating the producers out of $20,000 worth of cream per year, and any one who is connected with the business and knows conditions in the state would not make such a statement, for it would be impossible under the Indiana creamery and testers' license law. The statements which the investigators have made in the article referred to are not only incorrect truths, but the damage which may result from the distribution of such an article is unlimited.

H. W. Gregory

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DR. LIPMANN'S LABORATORY OF APPLIED PSYCHOLOGY

Letters from Dr. Otto Lipmann, of Berlin, state that he is confronted with the necessity of giving up his scientific work unless he finds funds which will allow him to keep on with his laboratory of applied psychology. From the Emergency Society for German and Austrian Science and Art, I have received word that $200 will be voted by it provided that American psychologists will pledge an equal amount. A similar arrangement has been carried out by groups in two other fields.

At the suggestion of President Knight Dunlap, of the American Psychological Association, I am offering to receive and be responsible for contributions. The fund will be used for continuing Dr. Lipmann in his chosen work. Quick response promises to prevent the loss of an international leader from the field of scientific research.

Dr. Lipmann's assistance in founding and editing the *Zeitschrift für angewandte Psychologie* and its *Beihefte;* his important contributions to educational and vocational psychology, 34 titles in one recent bibliography in applied psychology; and the prospect of his many years of continued work, should rouse us out of our routine contributions. There is hope of state support for his work if he can be helped past the present depression. A recent letter makes clear that the need is pressing if he is to keep to his calling.

J. B. Miner

University of Kentucky

SHIPMENT OF AMERICAN SCIENTIFIC LITERATURE TO RUSSIA

The American Committee to Aid Russian Scientists with Scientific Literature was informed by the Headquarters of the American Relief Administration in New York that the first shipment of eleven cases, each weighing about 350 lbs., is being forwarded on the S. S. Norlina, scheduled to sail about August 15th.

The response of American scientific institutions and departments to the appeal of the Committee was remarkably generous. In handling these first shipments the American Relief Administration had considerable difficulty in following the original plan, chiefly due to the fact that many of the donors failed to prepay the charges to New York and to send advices and lists of their publications, making it necessary for the American Relief Administration in New York to make up lists from the books and pamphlets as the packages were opened. The Committee would greatly appreciate it if the donors of scientific literature for Russia would in the future enclose at least six copies of the list of publications contributed by them. This number of copies is absolutely essential in order to furnish the offices of the American Relief Administration abroad with copies of the packing lists, one to be enclosed in each case, one sent to the American Committee in Washington, still another retained in the files in New York. One copy with a special column provided on it is to be sent to Moscow and later returned to the American Committee with the record of the disposition made of each package of literature sent. All future shipments should be consigned *care Gertzen & Co., 70 West Street, New York, N. Y.*

The literature contributed by donors for delivery to specific institutions or individuals was packed without being opened and the Committee in Moscow was requested to make delivery to the person or persons designated on the package. The copy of the inventory, when it is returned from Moscow, should therefore indicate the extent to which it was practicable and consistent with our agreements to comply with the wishes of the donors.

Raphael Zon,
Secretary

QUOTATIONS

CHILDREN AND MUSEUMS

The direct educational work accomplished by museums in the United States is a perpetual source of shame to us in this country. We are well aware that much is being done in some of our own museums, often at the self-sacrifice of their officials; but have we anything to compare with what is described in a recent number of *Natural History* (March-April, 1922)—the journal of the American Museum of Natural History? Consider lantern-slides, for example. Our own Natural History Museum has recently started one or two loan collections, comprising in all some few dozen slides. Those of the American Museum number many thousands. They are stored in a room accessible to teachers, who can thus select precisely what they want for their class-room lectures. Last year more than two hundred thousand slides were circulated. It is not long since a fair collection of slides made by an assistant in our own museum was handed over to another institution because there were no facilities for keeping it in the museum itself. Needless to say, the American Museum has a lecture theater. It has 869 nature-study collections to be lent to any public school in greater New York. There are two motor cars and a motor cycle to deliver slides and collections. Each messenger visits from twenty to forty schools a day. The American Museum is about to erect a special School Service building of five stories where from three to five thousand children daily may be taken care of properly. The blind are also provided for.

Of course, all this can not be done by the ordinary officers of the museum, and that is a fact which must be recognized in this country. The American Museum has its own department of education, with Mr. George H. Sherwood at the head. In the same way the Brooklyn Botanical Garden has its curator of elementary education, who contributes to the same issue of *Natural History* an interesting article on "Gardening and the City Child." But the work which starts in the museums and public gardens of New York and Brooklyn is taken up by other outside bodies, as the School Nature League of New York City, the president of which, Mrs. John I. Northrop, here tells us how in one of the elementary schools in the middle of the slums a wonderful nature-room has been installed. It is visited by from eight hundred to one thousand children every week. Here is a place for all those miscellaneous curiosities so frequently rejected by the staid museums. They can be placed in the hands of the children and many a fascinating lesson drawn from them. The love of nature thus begun is carried out into the open by means of summer camps, and so becomes linked up with the Boy Scout camps with their traveling museums.

Well, why is it that the Americans have got so far ahead of us on these lines? They have no doubt a new field to cultivate, and they do not have to contend against the terrible weight of inertia inevitable to some of our royal and ancient establishments. But to a large extent it is because Americans are not ashamed of having an ideal and of talking about it. They do not mind saying what they are going to do, and they make the utmost of everything that they have done. This is not the Englishman's way, but it is a way that interests the public both rich and poor. It brings money from the former and enthusiasm from the latter. If we want to achieve the same results we must not be above following somewhat similar methods. Here, during the summer holidays, are the children crowding our museums at South Kensington day after day. Can not something more be done for them, even if we shed a little dignity in the process?—*Nature*.

SCIENTIFIC BOOKS

The Coccidæ of Ceylon. By E. Ernest Green. London: Dulau and Co., 1896-1922. Pp. xli plus 472; 209 plates.

Part I of "The Coccidæ of Ceylon" appeared in 1896, Part II in 1899, Part III in 1904, Part IV in 1909, and with the appearance of Part V there is completed a work that is worthy of a place among the classics of entomology.

The Coccidæ or scale insects are a group of almost unsurpassed economic importance. There is probably no horticulturist who is not familiar with at least a few of the species and whose pocketbook is not the lighter as a result of their activities. The cost of repressing them is a constant tax upon the horticultural industries everywhere, a part, in effect, of the overhead expense of producing horticultural products. And the ease with which they are transmitted from one part of the world to another has resulted in the practically cosmopolitan distribution of many of the most harmful species together with the frequent introduction into new regions of others.

So it is that the scale insects stand in need of the most careful systematic study. But the minute size of many of the species, the difficulty of obtaining adequate microscopic preparations, and the obscureness of the structures available for classification have always stood in the way of such study. Unfortunately these difficulties have been only too completely reflected in the quality of the systematic work that has been done upon the family. The systematic work upon this group is in general of by no means very satisfactory character and is in large part sadly deficient. Yet to this generalization "The Coccidæ of Ceylon" is a most gratifying exception. It stands, indeed, at the very apex of all the work that has been done upon the Coccidæ.

It is not that "The Coccidæ of Ceylon" is entirely free from defects. The fact that its preparation has extended over more than a quarter of a century precludes this, for since it was begun there have been radical changes in our methods and in our standards as well. Yet throughout it has always stood fully abreast and even in advance of the best contemporaneous work. Above all, the student, turning to its pages, can identify with relative certainty the species with which he may be dealing. With this much rendered possible, criticisms of any other features are but secondary. It is a splendid work, beautifully illustrated, well arranged and well printed. To its author all entomologists, whether economic or not, who are interested in the scale insects are under an obligation that can but illy be repaid. For the work has been a labor of love, its author's recompense the pleasure in its accomplishment.

With technical criticisms, of which there are some, I am not here concerned. Nor is it necessary to deal with the scope of the work, for practically all entomologists are familiar with this from the earlier parts. It is my desire simply to call attention to the appearance of the final part and to congratulate the author upon the completion of a huge task well done. Its completion clinches his hold upon a position that has really long been his, that of the foremost student of the Coccidæ.

G. F. FERRIS
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SPECIAL ARTICLES

PHOTOPERIODISM OF WHEAT; A DETERMINING FACTOR IN ACCLIMATIZATION

GARNER and Allard (4), working with several species of plants, found that normally a plant could attain the flowering and fruiting stage only when the length of day was favorable, and suggest the terms *photoperiod* and *photoperiodism* to designate the favorable length of day and the response of a plant to the relative length of day and night. They conclude that, varying with species and variety, there is a critical photoperiod essential for the initiation of the fruiting stage of each plant, and that when this critical photoperiod does not occur the plant tends to remain vegetative.

In a preliminary experiment, the writer has found that a proper adjustment of the daily exposure to light, independently of temperature, will control the type of growth in the winter wheat plant and that by regulation of this factor it is possible to induce the jointing and the heading stages irrespective of season. In addition, this experiment has shown that there is a minimum stimulating photoperiod for the control of each of these stages of growth in the winter wheat plant, that for the succeeding stage not being the same as that for the preceding, and each photoperiod being, therefore, within certain limits critical for the stage concerned.

Although factors governing habits of growth, the distribution and the production of wheat have been the subject of many studies, the literature available has not revealed that any have ever considered, beyond the generalizations of Garner and Allard, the factors of photoperiodism as having a deciding influence. Circumstantial evidence, however, is available, which on analysis clearly indicates that these factors are important both with winter and with spring wheats. Grantham (5), Jardine (6) and Seivers and Holtz (11) have shown the tendency of winter wheat to a vegetative type of fall growth and have emphasized that the amount of this growth is dependent on time of seeding and available fertility. Gaines (10) and Neilson-Ehle (7) have found, in certain localities of the north temperate zone, the winter character to be inheritable as a simple Mendelian major. The northern limits of the winter wheat belt in the United States bear a significant relation to the northern limits of an active growing season of 150 days (1, 2). Smith, Root and Blair (3, 8, 12, 13, 14), in statistical studies of data from Ohio, found the dominant weather factor for winter wheat difficult to determine, but all agreed that the month of March was the critical period during which the effects of snowfall and temperature were later most reflected in condition and finally in yields of winter wheat. Apparently, from their studies, the influences controlling the beginning of the development which determined final yielding ability of winter wheat occurred in March, regardless of how favorable growing conditions were for the rest of the season or how severe conditions during the preceding dormant period had been. Schafer and his associates report (9) that Hybrid 128 will not head out when planted later than March 11, and (10) that Turkey Red will joint in October when planted in April, while Hybrid 128 will not. McCall and Wanser (15) have found that Jones Fife and similar wheats joint early in the spring, while wheats of the Turkey Red type do not joint until a later date.

These observations indicate that the winter habit of wheat is caused by the absence of the critical stimulus which is essential for the initiation of the jointing stage. Though the response to the stimulus may be affected and altered by temperature and nutritional factors and, under field conditions, apparently, has been usually associated with these factors, the stimulus itself is, nevertheless, independent of them and for any given locality is controlled more by date than by current growing conditions. The observations of Schafer and his associates and of McCall and Wanser indicate that the date of the occurrence of the stimulus varies for different varieties, but for any given variety is fairly constant in a given locality.

In the light of the work of Garner and Allard and of the results secured by the writer, all of this evidence indicates, in the case of winter wheat, the stimulus for jointing to be a critical photoperiod having a maximum limit. The passing of this maximum limit results in a spring-sown winter variety failing to joint until the occurrence of shorter days during the following fall or succeeding spring. The season at which jointing then takes place depends on the occurrence of the length of day corresponding to the necessary photoperiod and an accompaniment of temperatures favorable for growth. In any case, heading, which must be preceded by jointing, is delayed until the following summer because of the longer day necessary to start this stage of development.

Although a preliminary experiment is always restricted in scope, the close agreement between the results of this experiment and the analysis of the supporting evidence makes possible a few safe tentative conclusions. The development of winter wheat requires a critical photoperiod for jointing and also a separate and distinct critical photoperiod for heading. Garner and Allard, working with dicotyledonous plants, mention but one critical photoperiod. Although varying with species and variety in the intensity of distinction, there probably are for most monocotyledonous and some dicotyledonous plants at least two critical photoperiods, one for starting culm or stalk development from the tillering or rosette stage and another for starting the heading or budding and blossoming stage.[1] The photoperiods for both responses probably have an optimum with a maximum and a minimum limit, but for winter wheat they are independent of each other, do not overlap and vary with variety. The northern limits of the distribution of winter wheat are probably very largely controlled by the relation of the date of the beginning of the active growing season to the date at which the longest day within the limits of the critical photoperiod for jointing occurs in that locality.

While the photoperiods for jointing and heading do not overlap and are entirely distinct in the case of winter wheat, they are not so distinct in the case of spring wheats. In the latter group the photoperiod for jointing is of greater magnitude than in the former, possibly without a maximum limit, and jointing and heading are possible under more nearly an identical photoperiodic stimulus. As a result such varieties when sown in the spring joint and head the same season. Photoperiodism, therefore, is the key to the distinction between winter and spring wheats.

Although no published evidence showing the effects of photoperiodism in the development of spring wheat is here referred to, there is, nevertheless, an abundance of available material, some of which will be mentioned in a later detailed report of experimental work now in

[1] In an article published in Science (June 2, 1922) since the preparation of this paper Garner and Allard recognize the two photoperiods for dicotyledonous plants but do not mention or consider monocotyledonous plants.

progress. This work, an enlargement of the preliminary experiment, is intended to cover certain phases of photoperiodism as it affects varietal adaptation and drouth resistance of both winter and spring wheats.

Whatever may be the final outcome from the standpoint of direct application in practical crop production, there can be no doubt that the present studies throw an entirely new light on crop and especially varietal response in a given locality, and that a knowledge of these factors will make possible a better and more logical interpretation of investigations in both crops and soils and will as well give a more sound basis for future work in crop adaptation and breeding.

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IMPROVED METHODS IN NEAR INFRA-RED ABSORPTION STUDY

Some twenty or more years ago Julius, Donath, Puccianti, Iklé, Coblentz and others were interested in the study of infra-red absorption in organic compounds. The apparatus they had to work with at that time made the study very tedious, and as Coblentz[1] has said, "usually after investigating half a dozen compounds the results have been given to the public" by the investigator. Using the electric arc, Nernst lamps and Zircon burners as sources of radiation, rock salt or quartz prisms for dispersion, and bolometers and radiometers for the detection of the radiation, these men succeeded in studying the absorption spectra of a great many organic compounds even far out into the infra-red. In fact, the biggest part of the work was done in the field beyond the so-called near infra-red, that is, beyond 30,000 Å.

But with such comparatively weak and unsteady sources of radiation, small dispersion, and unsatisfactory methods for the detection of this radiation, no high degree of accuracy in the measurements of absorption bands has been claimed. During the last twenty years very little work has been done in this field. Coblentz[2] has recently published a bulletin in which he gives certain data and curves for the absorption spectra of certain organic oils, both animal

[1] W. W. Coblentz: *Astrophysical Journal,* 20, 1904.

[2] W. W. Coblentz: Scientific Paper of the Bureau of Standards, No. 418.

and vegetable oils, in the region of the near infra-red. In this paper he shows that because of the great similarity in the spectral curves of these oils, a study by means of infra-red absorption does not lead to a detection of adulteration of one oil with another.

But the region of the spectrum between the visible and 30,000 Å is filled with characteristic absorption bands in the case of organic compounds, and consequently makes a very interesting part of the spectrum to study. The writer is at present studying the absorption of many carbon compounds in this region by means of a spectro-thermograph designed by Professor E. P. Lewis of the University of California, under whose supervision this work is being done. There are certain advantageous features in the construction and use of this instrument.

The source of radiation is a 108 watt lamp made with a helix of tungsten wire for a filament. It has been found that the intensity can be increased by as much as forty per cent. by placing a concave mirror of about a ten centimeter diameter behind the lamp and focussing the rays on the slit through the lamp itself.

For dispersion two 30° flint glass prisms were used. Now flint glass gives a greater dispersion in this region than does quartz which is usually used in near infra-red work. Furthermore, it is almost as transparent as quartz, the limit of transmission for each being around 30,000 Å. The back of the second prism was silvered and the radiations caused to pass twice through each prism, thus doubling the dispersion. This gives a dispersion of between two and three times that obtainable with a single 60° quartz prism and between four and five times that obtained from a similar rock salt prism. The silvered prism was capable of rotation about the first prism so that the angle between these was equal to twice the angle of incidence necessary for minimum deviation of radiation falling upon the thermopile, which was used in series with a sensitive Leeds-Northrup galvanometer to detect the radiation. This rotation was accomplished by means of a small thumb-screw which projected through the black box which enclosed the system of mirrors and prisms. Thus it was possible to focus the eye upon the galvanometer scale aud, turning the prism, make an approximate analysis of a given substance in a few minutes.

This rapidity of locating either absorption bands or emission lines proved to be very helpful in the process of calibration of the instrument. Since no indices of refraction were obtainable for the glass prisms, the instrument was calibrated by observing certain metallic emission lines and solar absorption bands determined largely by Paschen with a grating. Coblentz states that emission lines may be used in calibrating up to 10,000 Å, but it was found that the following lines could also be detected when the proper salts were introduced into the carbon arc: Tl, 13,010 Å; Na, 18,460 Å; Ca, 19,800 Å. In locating the positions of the solar absorption bands, sunlight was reflected in from the window and focussed upon the slit. As the prism was rotated the galvanometer deflection would decrease to a minimum in the neighborhood of an absorption band. By approaching from both the long and the short wave-length sides a set of quite consistent values for the corresponding dispersion could be obtained. The highest calibration point was for the solar absorption band at 25,000 Å.

It has been mentioned in the earlier literature of the subject that all compounds that have a carbon atom united directly to a hydrogen atom have characteristic absorption bands in the neighborhood of 17,000 Å. In this present work this same band is found, and two others, at about 11,500 Å and 13,800Å, appear in every compound in which there is a C-H group. Twelve compounds have already been carefully analyzed, and an approximate determination of the positions of the absorption maxima has been made for some fifteen more. There are very prominent displacements of these absorption maxima in certain compounds. In some cases these shifts are toward the shorter wave-lengths and in other cases toward the longer wave-lengths.

The mapping of the spectral curves of certain groups of compounds is being continued, and an attempt will be made to ascertain whether the shifting of absorption maxima follows any definite laws.

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University of California

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THE DEPARTMENT OF MEDICINE AT THE PEKING UNION MEDICAL COLLEGE

The introduction of western medicine into China has been due, thus far, largely to the therapeutic success of surgery and the various surgical specialties. Internal medicine has lagged a long distance behind surgery both in the attention which it has received in the mission hospitals and in the extent to which it has influenced the Chinese people. One frequently hears it said that the Chinese "like western surgery, but they do not care for western medicine," and a corollary is that for "internal disease" they prefer to rely on the native system of practice. The fact is, however, that our western internal medicine has not yet been given a fair chance to demonstrate its worth. Practitioners of western medicine in China—for the most part, of course, missionaries—have found themselves confronted by an enormous number of surgical problems, many of them presenting direct emergencies, and it is natural that these cases should have received the first attention. Traumatic injuries, infections and large superficial tumors can often be easily and quickly alleviated, and their cure produces a profound impression on the patient and on his friends, but the diagnosis and treatment of strictly medical diseases is much more time consuming and the results are usually far less obvious and striking. With the days so full of pressing surgical problems and with the frequent lack of the facilities for modern medical diagnosis, it is not surprising that, with few exceptions, the medical patients have received somewhat scant attention. Even among the lower classes the Chinese often manifest great power of discrimination and an appreciation of careful, thorough attention, and if western internal medicine is to make its way with them it must be presented in the best possible manner.

Under these circumstances, it is of interest to watch the development at the Peking Union Medical College of a medical clinic which in its personnel and equipment would take high rank on any continent.

The Peking Union Medical College moved into its new quarters in the summer of 1921, and the department of medicine, with its wards, laboratories, offices and out-patient department, is centralized in the hospital and directly connected with the buildings of the medical school proper. It thus has the great advantage of being organically connected with the laboratories of the preclinical sciences, so that close association between clinical and preclinical workers is facilitated. In addition, the department of medicine is only a few steps from the library, which contains a considerable and well selected assortment of books as well as files of all the more important scientific journals. The medical wards occupy three floors in a large pavilion and contain 75 beds, only about half of which are now in use, in large and small rooms. In addition, there is an emergency isolation ward of six beds, and there are also medical patients, both Chinese and foreign, in the private pavilion. The general arrangements of the wards are exactly similar to what one finds in the best modern hospitals in America.

The nursing is at present carried on by a staff of Chinese and foreign graduate nurses, with Chinese male nurses under a woman graduate in the male wards, but a nurses' training school, based on the highest American ideals and standards, has been established, which admits only women as pupils, and it is hoped that before long most of the ward work can be carried on by the pupil nurses. Connected with each medical ward is a laboratory for routine clinical examinations. Adjoining the medical wards, on the ground floor, is the medical out-patient department with its waiting room, laboratory, and about a dozen rooms for the examination and treatment of patients, while on the two floors above are the offices, laboratories and class rooms of the department of medicine. Ample quarters and complete equipment are here provided for special study and investigation by the members of the department. Adjoining the office of the professor of medicine, on the third floor, are laboratories devoted to chemistry; and next to the associate professor's office are the laboratories for bacteriology. Across the hall is the laboratory of neuropathology, and an ample suite of rooms for the electrocardiograph, which is, in addition, wired to all the wards in the hospital. On the second floor is the laboratory of clinical pathology, with a large room for class instruction and smaller rooms in which the bacteriology and serology for the hospital is carried out, other laboratories for special workers, and a spacious room for clinical demonstrations. All the members of the staff of the department of medicine devote their time exclusively to hospital work and teaching, and the staff is large enough to allow each one to have fairly adequate time for study and investigation. The professor of medicine and chief of the medical service of the hospital is Dr. F. C. McLean (M.D. Rush Medical School) and the associate professor is Dr. O. H. Robertson (M.D. Harvard Medical School), both of whom were formerly connected with the Rockefeller Institute. Dr. Andrew H. Woods (M.D. University of Pennsylvania), who was formerly on the staff of the Canton Christian College, is associate professor of neurology. The other members of the department are Dr. C. W. Young, Dr. J. H. Korns, Dr. H. J. Smyly and Dr. R. H. P. Sia. The house staff is organized with a resident physician, three assistant resident physicians (at present all Chinese graduates of American medical schools) and a group of interns who are for the most part graduates of medical schools in China. When the new Peking Union Medical College has been longer in existence the majority of the interns will be graduates of this school because a fifth, or intern year, is required for the degree. Since the standards of instruction of the school are analogous to those of the best institutions in America, the graduates will make highly satisfactory interns. In the year 1921-22 there were only three classes under instruction. Instruction of a fourth year class will begin this fall.

Peking has a temperate climate, hotter than New York in summer, considerably colder than

New York in winter, and usually very dry. One does not find here, therefore, the strictly tropical diseases, except as they may be imported from central and south China. In general, the diseases usually met with in the medical wards are less different than one might expect from what is seen in the United States. Tuberculosis, and especially pulmonary tuberculosis, is very common. There are many acute infections of the respiratory tract, but lobar pneumonia is probably somewhat less common than in northern United States. Typhoid fever, in spite of much that is said about the Chinese having an inherited or acquired immunity to it, is common and the mortality is about what we expect in America. Syphilis abounds in all its manifestations. It has been repeatedly stated that syphilis of the central nervous system is rare among the Chinese, but more careful studies have disproved this point, and the extraordinarily interesting neurological clinic in Peking contains its full quota of syphilitic cases. Dysentery, both bacillary and amœbic, occurs with great frequency in the summer and autumn, and malaria, usually the tertian form, is not uncommon. Scarlet fever and small pox are seen often; relapsing fever and typhus fever are not at all unusual; and leprosy is sometimes seen. The infection which appears most often, however, and which is at the same time new to those of us educated in America, is kala-azar. Every patient with a large spleen is suspected of having kala-azar, and four to six patients undergoing treatment in the wards is not unusual. There are many cases of acute and chronic nephritis, similar to what we seen in the west, but one gets the impression that instances of essential hypertension are far less common in China than in America. Simple goitre is endemic in parts of the country around Peking and one sees enormous tumors, but exophthalmic goitre, while it occurs, is rather strikingly unusual. Diabetes, which was also formerly held to be very rare in China, is found quite frequently if routine examinations for sugar are made, but it usually occurs in patients past middle age and runs typically a mild course, the glycosuria disappearing with only slight alteration of diet. Heart disease is common, and the types met with are usually the chronic myocardial cases in older people, or cases on a syphilitic basis with an aortitis and perhaps a lesion of the aortic valve. Acute rheumatic fever is distinctly uncommon in Peking and as a result rheumatic heart disease is comparatively rarely seen. Cases of beri-beri come to the clinic occasionally, but they almost always occur in patients who have come from the south, for the disease does not seem to be indigenous in North China. Neoplasms, benign and malignant, of all varieties are common and one sees many of them in stages that are more advanced than we are accustomed to nowadays in the west. A cirrhosis of the liver with ascites, said to occur characteristically in farmers, is another interesting and new type of disease entity. Finally, in addition to many cases of organic neurological disease, there are numerous patients with all sorts of neuroses and psychoses. In general, therefore, the medical clinic in Peking is marked particularly by the great variety of disease. One finds most of the diseases that we are accustomed to see in America, and in addition a good many new types.

What makes the clinic especially stimulating and interesting, however, is the possibility of studying the cases carefully. The number of hospital beds available for medical patients is not nearly sufficient to allow all those who apply to the out-patient department and who are in need of institutional care, to be admitted, and a careful selection has to be made. Those who are particularly in need of hospital treatment are, of course, immediately referred to the wards, no matter what they are suffering from, but under other circumstances the principle which determines whether or not a patient shall be admitted depends on the fact that the hospital is essentially a teaching institution. The cases taken into the wards are, therefore, chosen in large part because they are particularly suitable for teaching purposes or because they offer problems for special investigation. The result of this method of selection, which is determined by the size and character of the hospital, is a medical clinic of unusually interesting cases. All of the patients are studied in great detail by the house staff and in many instances special observations are made by members of the senior staff who may be concerned with the problems presented by individual patients. The various aspects of the cases are then discussed at the daily visits when all the members of the medical department join the house staff in the wards. In addition to these exercises, of a strictly clinical nature, other opportunities are provided to enable the men to keep in touch with the work which is being done by their colleagues in Peking and elsewhere in the medical world. On Saturday mornings the whole staff meets for an hour in the laboratories while one of the members talks to them about his researches, or about some of the broader fields with which he is in close touch; once a fortnight the Medical Society meets for the more formal presentation of papers; and at a similar interval the "Review Club" discusses special topics from the medical literature. The fact that the faculty of the medical school is so large (about forty members, besides assistants in clinics and laboratories), that so much progressive scientific work is being carried on in all departments, and the relations between the departments are so intimate and harmonious, makes it almost impossible for one to be a member of the staff and fall by the professional wayside. To many people in America, China may seem to be remote and Peking an outpost of western civilization, but to those who know the situation the Peking Union Medical College is progressing hand in hand with the foremost medical schools of the world on the frontier of scientific medicine.

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A FIRST COURSE IN GENERAL CHEMISTRY[1]

The opportunity to take part in a discussion on the above topic is highly appreciated, particularly because during the past twenty years I have had an exceptional opportunity to try out certain ideas relating to the teaching of general chemistry to first year students at the Phillips Exeter Academy. Since Dr. Gordon stated that I could confine the discussion either to content or method or both I shall probably avail myself to the limit of this proviso.

Since my main criticism of the majority of papers thus presented has been that the statements have been too general, and that there has been too little of what was definite and capable of being carried away by the listener and put into immediate practice, perhaps I may be allowed to speak rather personally in parts, and to mention existing texts by name.

There stand before me on the desk fourteen of the more modern texts from which the secondary school teacher must usually choose the one to use with his classes. From these, three must reluctantly be dropped out of our consideration. The excellent "Text-book of Chemistry," by W. A. Noyes, is designed for use with college students, although it is so written as to be suitable for college students who have had no chemistry. As I interpret the subject before us to refer to the first year student in chemistry during his period of *preparation for* college, we must consider the large difference in the mental attitude of the student towards his subject manifested in the last years of secondary school and in the early years of college. Vivian's "Every-day Chemistry" and "Chemistry and Its Relation to Daily Life," by Kahlenberg and Hart, must be laid aside because, although they are designed for use in secondary schools, they are adapted particularly to students of agriculture and home economics. Students, should, however, have access to these two texts which show successfully how live and every-day a subject chemistry is.

In this connection it may be interesting to note that at a recent meeting of the New England Association of Chemistry Teachers a text-book survey was made. Of those present about one third used McPherson and Henderson's "Elementary Study of Chemistry," about one third used "Elementary Principles of Chemistry," by Brownlee and Others, while the remaining one third were divided among McFarland's "Practical Elementary Chemistry," Black and Conant's "Practical Chemistry" and Newell's "Chemistry" in about the ratio of 2 : 2 : 1, respectively. I shall have occasion to refer again to these five books, as well as incidentally to the other six before me.

I have never been able to understand why

[1] Paper read before the American Chemical Society at its meeting in April.

practically all texts written for the beginner in chemistry start in with oxygen, hydrogen, the gas laws, and water, to be followed soon with atoms, molecules, symbols, formulas and equation writing. It has always seemed to me more logical to start, not with gases, but with some solids, such as metals, with which the student may have had some slight acquaintance before entering the class. It is my belief that the ordinary student can at first get more tangible results from the more tangible substances, and that introducing him from the start to gases which he can hardly see, smell, taste, or handle is likely to discourage him from the start, particularly if these introductory substances are tangled up with that bugbear to so many students—the gas laws. A splendid opportunity is lost to tie the subject from the beginning in the student's mind to things that he has handled, or can handle, easily in every-day life.

My convictions were so strong that some years ago I worked out a scheme of experimentation in which the student started with such common metals as copper, zinc and iron, and followed these with magnesium, phosphorus and mercury. After a rather full study of the properties of the elements themselves, heating them in air introduced him to the subjects of oxidation and combustion. Without going into details, I might say that the first ninety experiments led him through sulfur, carbon and chlorine and the acids formed from these, the analysis and synthesis of water, and then sodium, potassium and calcium and their common compounds in such a way that each experiment grew naturally out of those preceding it and led up to an investigation of a (to him) unknown substance, namely, saltpeter, which he investigated by means of sulfuric acid and by appropriate experiments on the distillate, with the result that by this procedure he determined for himself the composition of both saltpeter and nitric acid. All of this work was completed without the mention of atom or molecule and without a symbol or a formula. It is my belief that the performing of these ninety experiments revealed to the student the methods of thought used by the chemical investigator in attacking his problem—the same method that he (the student) should use on a small scale in solving his own difficulties. I tried in this way to teach the student how to *think* his own way out of his difficulties.

You will probably be asking if no equations were used in these experiments. Yes, there were—the kind of equation that McPherson and Henderson hint at in their chapters on oxygen and hydrogen in both of their texts. Newell, Brownlee, Black and Conant and some others use the same device to a limited extent, but I developed that form of equation writing so that instead of using the names of the compounds with pluses and arrows, the student early got into the habit of representing each chemical reaction by an equation in which each compound was represented by the names of the elements which they had discovered that compound to contain, each compound being enclosed in a set of brackets. By this method the students acquired a very personal and first-hand acquaintance with the behavior of many chemicals with each other, and they got a very good conception, based upon actual laboratory work, that certain compounds contained such and such things, not because the formula was, for instance, Na_2SO_4, not because the book said so, but because they had proved it themselves. It must be admitted that such an attitude in the student's mind is not to be scoffed at. The main question that arises is: "Have we time nowadays for such a method, or is the subject so big that we must present the material in a pretabulated and almost in a predigested form?"

Of course this set of ninety experiments was simply introductory to text matter on the theory in chemistry with experiments to illustrate the laws and principles. Then came symbols and formulas and their use in equation writing, and finally considerable descriptive chemistry studied in the light of present theoretical conceptions, but with the spirit of the inductive method still an unconscious guide.

It is only fair to say that in those years each student performed probably 150 or more experiments, and that although it was my opinion that he was being taught *chemistry* rather than a *text-book,* the school year was not long enough in which to prepare him by this method for the examination set by the college entrance examination board, although these same students had little or no trouble in passing the Harvard chemistry paper as set at that time. As the business of our school is to fit students for the college examinations it will be evident that by working out this little piece of educational research I was sacrificing much and I reluctantly had to decide to replace my own text with one of the other texts already mentioned. But I satisfied myself that the chemical instruction as ordinarily practiced was susceptible of considerable improvement and that in my own mind I was on the right track.

As I look back at the experience now I suspect I overdid the laboratory side of the scheme, and it seems plausible that an abbreviated and modified presentation following my general outline might perhaps lead to a more generally accepted method of presenting our subject. I have gone into some detail on this method, not because I think it might offer the eventual solution, but incidentally to show what has been done and primarily as a protest against the stereotyped method of plunging the beginner into the intangibility of gases.

Bradbury's "Inductive Chemistry" is the only text I have seen that approximates the method I have outlined. This book starts the student on sulfur, leads on through compounds of sulfur with some familiar metals to some metals themselves, and then takes up carbon as an example of a non-metallic solid; he loses out, however, by making all this textual instead of the basis for laboratory work. Lest I give a wrong impression of this book let me add that succeeding pages deal with oxides, atomic theory, hydrogen compounds, the sodium group, the chlorine group, and oxy-acids and their salts.

The student should certainly have a clear conception of the terms and phrases he uses in talking about chemistry, but I doubt very much if the extreme niceties of definition and fine drawings of line that characterize Alexander Smith's books are likely to appeal to the beginner, however much the teacher may admire these qualities.

Blanchard and Wade's "Foundations of Chemistry" is a valuable addition to elementary chemistry literature, and agreeably attractive, too, but I always lay it down feeling sorry that so many things are not there. I have never been able to get really enthusiastic over Hessler and Smith's "Essentials of Chemistry"; the directions for the laboratory work look more satisfactory than the text itself. Perhaps the too frequent use of fine print leaves the impression that much of the material presented is not of prime importance. Dull's "Essentials of Modern Chemistry" strikes closer home. It makes me wish I were a student again and just beginning chemistry, although he too starts in with oxygen, hydrogen and water, and that conflicts with my pedagogical ideas.

For several years now we have been using at Exeter Brownlee's text, but we tie up with it McPherson and Henderson's "Laboratory Manual," as we consider this manual better worded for and better suited to the elementary student.

The chemistry syllabus of the college entrance examination board has been a valuable aid in indicating to secondary school teachers what topics should be covered in the first year's course. It has been noted by some teachers, however, that those who set the paper sometimes seem to feel that the paper they set should touch in some way on almost every topic in the syllabus. This fact, together with the large number of topics in the syllabus, make it necessary for the teachers to spend the whole year covering the topics in the syllabus. If a majority of the colleges could agree to be satisfied with a smaller number of topics but have these covered more thoroughly, perhaps the board would revise the chemistry syllabus accordingly. This would be a boon to many teachers in that they would have time to cover the essential parts more thoroughly and would have a little time left to dwell upon such special topics as they find appealing to their classes or appropriate to the localities where they teach. I feel sure that secondary teachers may be depended upon not to take advantage of such diminution in requirements. Those who might be thus guilty could with advantage to the profession be eliminated.

Elementary chemistry teachers are much indebted to the college men who have written chemistry texts for them and for the vast amount of time and thought they have spent in the preparation thereof. I often wonder, however, if the college teacher who lives and works among college students and does some research on the side can be expected to guage the needs of the secondary student and to put himself in the place of the secondary school teacher. If such a college man could have an opportunity to fill the position of a secondary school teacher of chemistry for a period of say five years, and have to make his living thereby, I'd welcome a text he might produce. Or must we wait till the profession of chemistry teaching in secondary schools has become sufficiently established to attract men of the requisite scholarship, knowledge of chemistry, acquaintance with what the colleges should require for entrance, and above all a close knowledge of the mental equipment of students of secondary school age before we can expect a solution of the problem: "What should be taught in first year chemistry and how should it be presented?"

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THE PHYSICO-CHEMICAL MECHANISM OF MUTATION AND EVOLUTION

It is the general rule in biology that descendants resemble parents, and that a parent organism can not pass on to offspring a factor which the parent did not receive from the germ-plasm of its immediate progenitors. Many apparent exceptions to this general rule have been traced to the existence in the parent gametes of recessive factors, which, while suppressed in the parent, may be liberated again in the offspring. Whether we accept the view of Darwin that large differences can represent the summation of small differences, or the more probable view of Bateson and others, that mutation or variation is a definite physiological event, no satisfactory explanation has been given as to the origin or source of these exceptions to the general rule of resemblance, although they constitute the steps by which evolution haltingly proceeds.

The crying need that we must find a chemical, physical or physico-chemical basis for mutation or variation has been voiced by many. Thus in his address before the British Association for the Advancement of Science (Australia, 1914, reprinted in *Smithsonian Report*, 1915, pp. 359-394), Sir William Bateson says: "Every theory of evolution must be such as to accord with the facts of physics and chemistry, a primary necessity to which our predecessors paid small heed. . . . Of the physics and chemistry of life we know next to nothing. Somehow the characters of living things are bound up in properties of colloids, and are largely determined by the chemical powers of enzymes, but the study of these classes of matter has only just begun. Living things are found by simple experiment to have powers undreamt of, and who knows what may be behind?"

Recently R. S. Lillie[1] (Science, 51, 525, 1920) has stressed the importance of physico-chemical investigation of protoplasm, and Alexander Forbes (Science, 52, 331, 1920) has called for closer cooperation between physicists and biologists in attacking biological problems.

An attempt will be made here to outline certain basic physico-chemical principles which affect the formation, development, growth and reproduction of living things, and to point out how it is possible for variation in some of the factors therein involved to account for important and transmissible variations or mutations in individual organisms.

At the outset let it be stated that no mysterious or special "vital force" will be evoked, but that the well-known forces that control inanimate matter seem quite sufficient for the purpose.

In nature, both animate and inanimate, the following basic factors tend to produce *symmetrical orientation or aggregation:* (1) Crystallization; (2) Diffusion, as in the formation of Liesegang's rings, agate, etc.; (3) Electric or magnetic fields of force; (4) Harmonious vibration as of air, water, etc. We here disregard mere chance and the conscious arrangement by man.

[1] See also Lillie's interesting papers in *Biological Bulletin*, 1917-1919, and *Scientific Monthly*, February, 1922.

The main factors modifying the crystallization of pure substances are: (1) Concentration; (2) Temperature; (3) Pressure; (4) Agitation; (5) The presence of other substances, especially of colloids, which may profoundly modify crystal forms by protective action; (6) Iso-colloidism. Some substances have the power of interfering with their own crystallization, because a portion, which first reaches the colloidal state, then protects the balance.

Deviations from normal crystalline forms produced by the presence of colloids are usually symmetrical, but may not appear crystalline. Changes in the nature or degree of dispersion of the colloid, or in its percentage, mixtures of colloids, variations in salt or H-ion concentration of the solution, must all have an effect on the resultant quasi-crystals. Enzymes may, of course, entirely change the nature of the colloid. The species-specificity of proteins seems to be maintained by degenerating food protein to simpler forms (polypeptids and amino-acids) and then building up the specific proteins from these.

Among the factors influencing diffusion, especially in gels, are the chemical nature and particle size of the gel, and the concentration and nature of the diffusing solution. Liesegang has pointed out that "enzoon," which has been considered to be the fossilized remains of primitive organisms, is due to the phenomenon that bears his name—the rhythmic banding resulting from diffusion in gels. In his chapter on "Growth, Metamorphoses and Development" Bechhold ("Colloids in Biology and Medicine," trans. by J. G. M. Bullowa, p. 252 *et seq.*, D. Van Nostrand Co., 1920) refers to some of the remarkable diffusion figures and osmotic forms produced by F. E. Runge and by Stéphane Leduc, some of which resemble algæ, fungi, seaweed, etc., and even show a cellular microstructure. While pointing out the great differences between these formations and the organized structures they simulate, Bechhold says: "The physical forces which produced these inorganic formations are the same as those which produce the growth and configuration of organized material membranes, osmotic pressure, diffusion."

Differences in diffusion speed mean variations in concentration that may affect the action of the enzymes, for, as T. B. Robertson showed, these may work analytically or synthetically, depending on the concentration.

A preliminary note of this character can not consider all of the points above referred to, and will therefore be limited mainly to a brief discussion of one of the most important factors controlling the form of organisms, namely, *the influence of colloids on crystallization,* and the changes in form that may be expected when the colloids are changed or the crystalizing substances varied.

Perhaps the most familiar instance of modified crystallization is to be found in the delicate frost tracery on window panes, the forms being probably influenced by the glass (itself a colloid) or by substances adsorbed at its surface. The writer has pointed out the powerful influence exerted by colloids such as gelatin, gum arabic and albumin on crystallization (*Kolloid Zeit.,* 4, 86, 1909), and R. E. Liesegang, looking at the question from the opposite standpoint, has described the power of crystalloids to give a form to colloidal jellies (*Kolloid Zeit.,* 7, 96, 1910). It may be said that with different salts or combinations of salts, various colloids or combinations of colloids, and variations in concentrations, temperature and speed of evaporation, will produce characteristic and generally reproducible forms on a microscope slide. A characteristic form of sodium chloride is a four pointed star with fern-like arms which cross at a slight angle.

A few slides made with solutions of common salts such as NaCl, $MgSO_4$, Na_2SO_4, etc., containing from 0.5 to 50 per cent. of gum arabic or gelatin (figured on the basis of the dry salt) will illustrate what is meant. When a drop of the mixed solution is allowed to dry on the slide without cover glass, changes of concentration and temperature occur, giving a field that changes progressively from rim to center of the drop. A solution of one part sodium chloride, one part sodium carbonate (dry) and one tenth part gum arabic or gelatin in ten parts of water, when dried, shows in some part of the field a "flowering plant," with graceful stems and characteristic four-petaled flowers.

To see that a marked change may be produced by modifying the colloidal state of the protective substance, a slide was made with a solution containing egg albumen as the colloid. The solution was then heated until the albumen began to show a milkiness, another slide was made, and after drying was compared with the first unheated specimen. The difference in crystallization is considerable.

Unusual crystalline forms such as sphero-crystals and sheaf-like groups which are so often seen in the crystals of substances derived from organisms, are very often consequent upon the protective action of some colloid from which they are not entirely purified. Another curious occurrence must be mentioned here, which may be termed *auto-protection* because it is due to iso-colloidism. Before reaching the ordinary visibly crystalline state, particles of every substance must pass through the colloidal zone, and the particles first reaching that state may interfere with the normal crystallization of the rest. Thus ammonium salts, even without the addition of protective colloids, are prone to assume feathery or fern-like forms. The phenomenon is marked in the oleates and is probably the underlying cause of the formation of myelins, although their formation is fostered by such lipoid protectors as cholestrin. According to J. G. Adami (Harvey Society Lecture, 1906), if certain simple soaps be dissolved by warming on a slide with water and then allowed to cool, they may show upon examination in the polarizing microscope a perfect rain of doubly refracting spherules, which, depending on the nature of the soap, may last for hours or days or else immediately give place to a brilliant white layer of formed crystalline plates. The fluid crystals of O. Lehmann are probably examples of auto-protection, and W. B. Hardy, E. Hatschek and others have described substances which form unstable gels that soon become crystalline.

An indication that the colloidal state is anomalous is given by the fact that, while the sun attracts microscopic particles, and even crystalloidally dispersed particles, it selectively repels colloidally dispersed particles, as in the tails of comets (See J. Alexander, "Colloid Chemistry").

The bio-colloids are so readily affected by salts, H-ion concentration (effective reaction), temperature, actinic (sun's rays) and traumatic (shaking, mechanical injury) effects, that it is more surprising that plants and animals should breed true, than that they should show variations. Therefore, although individuals may be much affected by such changes during their lives, it is evidently a rare occurrence that these changes are registered in the germ plasm by which alone they may be transmitted to offspring. The specificity of the germ plasm is evidently guarded by many factors, among which seem to be selective adsorption and differential diffusion of dissolved substances through its protecting walls or membranes. Nevertheless unusual influences must occasionally change it materially without destroying it, and along this line experiment may be directed. It may be that the germ plasm can be affected through the somatoplasm, as well as by direct means. And of all the variations, in nature only the beneficial changes survive.

With highly developed organisms the complications are enormous. We are just beginning to realize the importance of enzymes, hormones, internal secretions (endocrines), essential "impurities" like the vitamines, iodine and manganese, and the necessity of a sufficient variety of food to include enough of each of the essential amino-acids, outside of mere fat-carbohydrate-protein-calorie figures. Therefore, even if experiments with higher forms of life may yield more numerous results, it may be better to begin with the simpler forms where the results may be more readily traced to their causes. Nor must it be imagined that this will prove an easy matter; for filterable bacteria, invisible in the ordinary microscope and not resolvable by the ultra-microscope if visible in it, whose size is of the order of some of the protein molecules, are still capable of breeding true.

Consideration should be especially given to conditions that are apt to be met with in nature or which may have existed in geologic times. The effect of small quantities of substances such as manganese in plants and iodine in mammals should not be overlooked. Even strong acidity or alkalinity may be produced by volcanic action or by differential diffusion in the earth or in unorganized matter. The slime of some snails carries as much as three per cent. of free sulphuric acid. Temperature, light, water and CO_2 are potent factors.

While the actual experimental work is largely the province of biologists, they will gain much both in direction and interpretation by close consultation with the chemists and physicists.

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SCIENTIFIC EVENTS

ANIMAL EXPERIMENTS IN GREAT BRITAIN[1]

The annual return showing the number and nature of experiments on living animals during the year 1921 gives a list of all "registered places" where such experiments may be performed, the names of all persons who hold licenses during 1921, together with the registered place for which the license was in force and the number and nature of experiments performed. In the year 1921 twenty new places were registered for the performance of experiments and thirteen places were removed from the register. The total number of licensees was 812, of whom 219 performed no experiments. The experiments may be divided into two main groups, according to whether or not an anesthetic was used. It should be noted that the granting of a license only permits the licensee to perform experiments under an anesthetic, for the law declares "the animal must, during the whole of the experiment, be under the influence of some anesthetic of sufficient power to prevent the animal feeling pain; and the animal must, if the pain is likely to continue after the effect of the anesthetic has ceased, or if any serious injury has been inflicted on the animal, be killed before it recovers from the influence of the anesthetic which has been administered." To perform other experiments or even to observe the subsequent course of experiments undertaken with an anesthetic the licensee must be possessed of special certificates. Special certificates are also necessary for experiments on dogs, cats, horses, asses, mules and other large animals. The total number of experiments with anesthetics was 8,165, and of these 2,053 were simple inoculations into the skin of guinea-pigs, which were anesthetized in order to keep the animals motionless during the introduction of a minute quantity of the fluid to be tested for the purpose of standardization. Of the remaining 6,112 experiments, comprising all the cases in which any serious operation was involved, 2,751 were performed under the license alone, and were subject therefore to the restrictions above mentioned. In all operations, with the exception of a few special cases dealing with the efficiency of antiseptics, the law demands that the operation shall be performed antiseptically so that the healing of wounds shall, as far as possible, take place without pain. If the antiseptic precautions fail, and suppuration occurs, the animal must be killed. The following "pain condition" is attached to the license under special certificates: "If an animal, after and by reason of the said experiments, is found to be suffering pain which is either severe or is likely to endure, and if the main result of the experiment has been attained, the animal shall forthwith be painlessly killed. If an animal, after and by reason of the said experiments, is found to be suffering severe pain which is likely to endure, such animal shall forthwith be painlessly killed, whether the main result of the experiment has been attained or not. If any animal appears to an inspector to be suffering considerable pain, and if the inspector directs such animal to be destroyed, it shall forthwith be painlessly killed." The total number of experiments without anesthetics was 67,097. These were mostly simple inoculations and hypodermic injections, but included also some feeding experiments and administration of various substances by the mouth or by inhalation or by external application, and the abstraction of blood by puncture or simple venesection. In no instance was a certificate dispensing with the use of anesthetics allowed for an experiment involving a serious operation. The total number of experiments was 75,262, being 4,895 more than in 1920. The objects for which these experiments were performed were very diverse. A large number, almost wholly simple inoculations, were performed either on behalf of official bodies, with a view to the preservation of the public health or directly for

[1] *The British Medical Journal.*

the diagnosis and treatment of disease. Experiments conducted at a sewage farm to test the character of the effluent by its effect on the health of fish is an example of work carried out for the preservation of public health. Nearly 20,000 experiments were performed for the preparation and testing of antitoxin serums and vaccines and for the testing and standardizing of drugs. The several registered places were visited frequently by the inspectors, usually without previous notice, and they report that the animals were suitably lodged and well cared for, and the licensees generally attentive to the requirements of the act and the conditions attached to their licenses.

THE REPORT OF THE ENGINEERING COUNCIL ON WORK PERIODS

"The tendency throughout the world is toward the abolition of the twelve-hour shift," it is held by the report of the Committee on Work-Periods of the American Engineering Council of the Federated American Engineering Societies, which has been adopted after a long discussion by the executive board of the council in Boston. The report, in effect, finds that the two-shift day of twelve hours each is not an economic necessity in American industry.

"In almost every continuous industry," according to the report, "there are plants which are operating on an eight-hour shift basis in competition with twelve-hour shift plants." It is also shown that in practically all major continuous industry plants which have changed from twelve hours to eight hours have increased the quantity of production per man up to as much as twenty-five per cent. In a few cases, the report states, the increase has been much higher. In the steel and iron industry, which is made the subject of a special report, it was found that "the change from the twelve to the eight-hour day has secured results sufficient to compensate in whole or in part for the extra cost."

Other advantages of the eight-hour day in the steel and iron industry are described as increased efficiency, better morale, elimination of the "floating gang," which is maintained to give twelve-hour men a day off a week, and greater prestige of the industry with the public.

Professor Samuel McCune Lindsay, of Columbia University, representing the Cabot Fund of Boston, officialy styled the report as embodying the results of "the most important investigation of any industrial situation ever undertaken in this country." The Cabot Fund cooperated in the engineering investigation, which occupied nearly two years and covered practically every continuous industry in the United States. Professor Lindsay, who is president of the Academy of Political Science, authorized the statement that Professor Henry R. Seager, of Columbia, president of the American Economic Association, shared his general view.

The results of the industrial investigation, which will exercise a great influence on the general labor situation, were obtained through two lines of inquiry. One enquiry, embracing the steel and iron industry of the country, was directed by Bradley Stoughton, of New York, former secretary of the American Institute of Mining and Metallurgical Engineers and former adjunct professor of metallurgy in Columbia University.

The second enquiry was directed by Horace B. Drury, industrial investigator and former member of the faculty of Ohio State University. Each enquiry was made the subject of a separate report, the whole investigation being in charge of the council's Committee on Work-Periods, of which Dr. H. E. Howe, of Washington, is chairman. Dr. Howe presented the report to the board. His associates on the committee are J. Parke Channing, L. P. Alford, Fred J. Miller and Dwight T. Farnham, of New York; Morris L. Cooke, of Philadelphia, and L. W. Wallace, of Washington.

Presentation of the report by Dr. Howe caused a spirited discussion of two hours, during which President Cooley, urging adoption, asserted that the report was a remarkable contribution of the engineering profession toward the advancement of mankind. Others participating in the debate were Philip N. Moore, of St. Louis; Professor Joseph W. Roe, of New York University; Irving E. Moulthrop, of Boston; W. W. Varney, of Cleveland; Calvert Townley, of New York; E. S. Carman, of Cleveland; John A. Stevens, of Lowell; William Rolfe, of St. Louis, and Messrs. Channing, Alford and Wallace, representing the Committee on Work-Periods. The report was finally adopted by an overwhelming vote.

The Drury report was described as a general survey of all industries operating continuously twenty-four hours a day. The leading continuous industries investigated are divided into four groups as follows:

Group I: Iron and steel, non-ferrous metals, glass, Portland cement, lime, brick and pottery.

Group II: Heavy chemicals, fertilizers, explosives, dyes, industrial alcohol, wood distillation, refined corn products, soap, glue, drugs, etc., electro-chemical industries, sugar, table salt, petroleum, cottonseed oil and other oils.

Group III: Paper, flour, rubber, breakfast foods, automobiles, textiles and mines.

Group IV: Power, gas, water supply, ice, shipping, railroads, street railways, telegraph and telephone, mails and express, policemen, firemen and watchmen.

SCIENCE SECTION OF THE ASSOCIATION OF COLLEGES AND PREPARATORY SCHOOLS OF THE MIDDLE STATES AND MARYLAND

At the annual meeting of the Association of Colleges and Preparatory Schools of the Middle States and Maryland held at Swarthmore College on November 26, 1921, Science Section was organized. Dr. Bertha M. Clark, William Penn High School, Philadelphia, presided at the organization meeting. A constitution prepared by a committee consisting of Dr. H. J. Creighton, Swarthmore; Dr. James Barnes, Bryn Mawr; Dr. Ida A. Keller, Philadelphia High School for Girls; Dr. W. B. Meldrum, Haverford; and Dr. R. H. True, University of Pennsylvania, was presented and adopted by unanimous vote.

According to its constitution the Science Section has been organized to bring about active cooperation between the colleges and preparatory schools in improving the teaching of science. The following officers were elected to serve one year:

President: Dr. Thomas D. Cope, Randal Morgan Laboratory of Physics, University of Pennsylvania.

Vice-president: Mr. Charles E. Dull, South Side High School, Newark, N. J.

Secretary: Miss Margaretta Atkinson, Philadelphia High School for Girls.

Treasurer: Dr. Walter Steckbeck, Macfarlane Hall of Botany, University of Pennsylvania.

The following councillors were elected to serve two years:

Dr. Gellert Alleman, Swarthmore College.

Dr. Bertha M. Clark, William Penn High School, Philadelphia.

Dr. Raymond Brownlee, Stuyvesant High School, New York City.

The council has decided to hold the next meeting of the section at the time of the next annual meeting of the Association of Colleges and Preparatory Schools. This meeting will be held at the Tower Hill School, Wilmington, Delaware, during the Thanksgiving recess in 1922. An attractive program is being prepared and plans are being made to increase materially the membership of the section. Due announcement of the program will be made public.

HERSCHEL CENTENARY PILGRIMAGE[1]

The centenary of the death of Sir William Herschel, the first president of the Royal Astronomical Society, was commemorated on August 25 at Slough, where he lived and carried out so much memorable work. The Royal Astronomical Society, with Sir F. Dyson, the astronomer royal, made a pilgrimage to the chief places associated with Herschel's history, and were welcomed by the chairman (Mr. E. T. Bowyer) and other members of the District Council of Slough, and representatives of the Herschel family, in whose occupation the astronomer's house—Observatory House—still remains.

The first place to be visited was Old Upton Church, a competitor with Stoke Poges for the honor of having inspired Gray's *Elegy*. Herschel's body lies beneath the flags of the ancient chancel, on which there rested a star-shaped wreath of flowers. The church register records the date of his marriage with "Mary Pitt, widow, of this parish," May 8, 1788, and the baptism of his only son, John Frederick Wil-

[1] The London *Times*.

liam, who was afterwards also to contribute to the astronomical fame of the family. An old thatched barn, which Herschel used as a workshop, was visited next, and the party afterwards went through Upton Court, where his wife's first husband, John Pitt, lived. It belongs to Lord Harewood, and has been for some time untenanted. In the afternoon the visitors were welcomed to Observatory House by Miss Herschel. There they saw many interesting personal relics—some in the house itself, some in an adjoining cottage which has been made into a little museum, and some in the garden. Against the back wall of the garden, embowered in foliage, rests a section of Herschel's great telescope, 10 feet or 12 feet in length. A circular ridge on the lawn marks the place where the telescope formerly stood. In the hall of the house is one of two mirrors which were cast for the big telescope. The mirror and tube of the smaller telescope which Sir John Herschel took to the Cape to survey the heavens of the southern hemisphere were also shown.

At luncheon, which was served at the Old Crown Hotel, at one time part of the property of Sir William Herschel, the Reverend Sir John Herschel said that the great work of Sir William Herschel at Slough was his investigation of the structure of the heavens. He put forward the view that the whole visible universe was like a couple of soup-plates put face to face. That theory, he believed, still held the field. Another great discovery was that of nebulæ. Herschel at first thought they could be resolved into separate stars, but afterwards came to the conclusion that in certain cases these dull, fuzzy things were a shining fluid. That some of the nebulæ were resolvable into stars was proved later by Lord Rosse, and the hypothesis of the shining fluid was confirmed many years later by Huggins. Sir William Herschel was much before his age in his speculations. Though they fell into discredit for a time, he had since come into his own again and had been found to have made very few mistakes.

Sir Frank Dyson said he thought what Sir J. Herschel had said about Sir William Herschel was true. He was undoubtedly a very great man. In addition to the wish to fathom the heavens, he had the great mechanical and engineering skill which enabled him to make his telescopes. He had also the prodigious enthusiasm and energy needed to carry out his big surveys.

Dr. Dreyer added further instances of Sir William Herschel's clear insight. About the year 1785 he announced that the sun was traveling through space towards the constellation Hercules. Though the evidence was perhaps slender at the time, and nobody, he believed, took serious notice of the matter, the discovery was undoubted. He also first suggested the "grindstone theory" of the Milky Way—that there was a great layer of stars between two parallel planes.

THE INTERNATIONAL GEOLOGICAL CONGRESS

THE twelfth International Geological Congress was held in Belgium during the month of August with a large and influential delegation of some 500 geologists from all parts of the word, except former enemy countries. A number of geological excursions were organized covering the most interesting sections of Belgium, to which a large number subscribed. France was well represented by men like de Margerie, Lacroix, Gentil, Kilian, Bigot Lory, Haug, Cayeux, Fallot, Yung and others; while Switzerland had sent Lugeon and Argand, both masters of tectonics. Especially interesting was Argand's lecture on "The Tectonics of Asia," illustrated with a tectonic map of the Eurasian continent which no doubt marks an epoch in structural geology. This synthetic and clever graph of the Eurasian continent contained more than 3,500 geological sections, transferred in tectonic form and colors on the map which served to illustrate the opening public lecture of the congress.

Spain was well represented, and Director Cesar Rubio, of the Instituto Geologica de España, with a goodly contingent of geologists from the Iberian Peninsula, took part in the congress. The invitation given by Spain was accepted, so that the fourteenth International Congress of Geology is to be called for 1925 in Spain.

A large number of United States geologists attended the congress. Dr. David White, chief geologist of the U. S. Geological Survey, was there, representing the United States government and survey. Dr. R. A. F. Penrose, Jr., of Philadelphia, was also an official representative of the United States government, whilst Professor N. H. Winchell, ex-president of the American Institute of Mining and Metallurgical Engineers, was also an official delegate. Professors S. B. Matthews and W. H. Emmons, Dr. Quirke, Professor G. F. Cleland, E. O. Ulrich and many others took part in the meetings.

Dr. Frank Darwin Adams, of McGill University, president of the twelfth congress held in 1913 in Canada; Dr. Charles Causell, of Ottawa, deputy minister of mines; Dr. Reginald W. Brock, of Vancouver; Professors Coleman, T. L. Walker and W. A. Parker, of the University of Toronto; Professor E. M. Baker, of Queen's University, and the writer represented the Royal Society of Canada.

Great Britain, Italy, Poland, Czecho-Slovakia, Roumania, Denmark, Mexico, Argentina, Brazil, New Zealand, Australia, West Africa, Egypt and India were represented.

The tectonics of Africa formed one of the principal topics and what was formerly styled the dark continent is now supplying some of the brightest pages in our knowledge of the crust of the earth.

The consolidation or drafting of a constitution for the International Geological Congress occupied the attention of a number of European and American geologists, and, finally, at the last general meeting the statutes as discussed in council and approved by it were adopted with one dissenting vote.

H. M. A.

SCIENTIFIC NOTES AND NEWS

Dr. Alexander Smith, formerly professor of chemistry at the University of Chicago and Columbia University, has died at Edinburgh at the age of fifty-six years.

President Livingston Farrand, of Cornell University, has accepted an invitation to deliver an address at a joint meeting of the American Association for the Advancement of Science and the Society of the Sigma Xi to be held at the Boston convocation week meeting.

Dr. Hiram Bingham, professor of Latin-American history at Yale University, has been nominated by the Republican state convention of Connecticut for the office of lieutenant governor.

A cable message to the American Society of Mechanical Engineers announces the election by the engineers of Holland to honorary membership in the Koninkljik Instituut van Ingenieurs of Mr. Calvin W. Rice, secretary of the society. Mr. Rice is now in Rio de Janeiro as the representative of American engineering societies at the International Engineering Congress.

Mr. Jesse Merrick Smith, of New York, has been elected by the American Society of Mechanical Engineers delegate to the seventy-fifth anniversary of the Dutch Engineering Institute, with Mr. Hosea Webster, of New York, as alternate.

On the occasion of the annual dinner of the Royal Society of Medicine, presided over by Sir John Bland-Sutton, the Jenner Memorial Medal was presented to Dr. John C. McVail.

Professor Rafaele Issel has been appointed director of the biological work of the Italian government on the Adriatic. This work will now be concentrated at Rovigno.

Dr. Ernest B. Forbes has been appointed director of the Institute of Animal Nutrition at Pennsylvania State College to succeed the late Dr. Henry Prentiss Armsby. Dr. Forbes is specialist in nutrition in the Institution of American Meat Packers of Chicago, and was for thirteen years chief of the department of nutrition of the Ohio State Agricultural Experiment Station.

Lillian Segal Kopeloff has been appointed in charge of the newly established research department of biological chemistry at the Psychiatric Institute of the New York State Hospitals, Ward's Island, New York City.

Mr. H. K. Cummings has resigned an instructorship in mathematics at Brown University to accept a position in the Bureau of Standards at Washington.

Professor L. Winfield Webb, professor of psychology, has been named by President

Walter Dill Scott as director of the mental alertness tests which will be made by Northwestern University on the 1,000 freshmen that are expected to register during the week beginning on September 18.

The auxiliary schooner *Bowdoin*, bringing back to their starting point Donald B. MacMillan and the members of his Arctic expedition, was anchored on September 11 at Mohegan Island. Mr. MacMillan has announced that the expedition, which spent fourteen months exploring Baffin Land, proved that all maps of Baffin Land, were largely guesswork. G. Dawson Howell, of Boston, has remained behind to cruise around Hudson Bay to continue his observations in terrestrial magnetism for the Carnigie Institution. He expects to reach St. John's, N. F., about October 1.

Professor F. L. Washburn, of the University of Minnesota, accompanied by Mr. Cadwallader Washburn, sailed on the SS. *Tahiti* on September 8 for Tahiti and other South Sea islands. Professor Washburn is on sabbatical leave and will make a collection of insects for the university. Mr. Cadwallader Washburn, of New York and Mexico, expects, in addition to adding to his collection of canvases, to secure a representative collection of the eggs of birds found in the Marquesas Islands for the Museum of Comparative Oology of Santa Barbara, California.

A special press telegram to the London *Times* from Professor J. W. Gregory, of Glasgow University, reports his safe arrival at Talisu [? Talifu, Yunnan] after a successful journey in Tibet. Professor Gregory left at the end of March last on an expedition which had for its object the exploration of the mountain ranges of southwest China, and to make geological, zoological and botanical collections, specimens of which Professor Gregory intended to distribute between London and Glasgow museums. Professor Gregory and his son, Mr. Christopher Gregory (who was to act as surveyor), were to be the only Europeans in the party, the intention being to rely upon the services of a Chinese escort.

Miss Alice H. Armstrong, assistant chief of the radium section of the Bureau of Standards, will be absent from the bureau during the current academic year, pursuing special studies at Harvard University.

Iowa State College has granted Associate Professor J. T. Colpitts of the department of mathematics leave of absence for the coming year to study at Cornell University, and Assistant Professor E. C. Kiefer leave of absence to study at the University of Michigan.

Dr. Hermance Mullemeister, of the University of Washington, has been granted a year's leave of absence to study mathematics in Holland.

The French delegation sent to Rio de Janeiro for the celebration of the centenary of Brazilian independence comprises, among others, Dr. Pierre Janet, professor of the Collège de France, and Dr. Georges Dumas, professor of experimental psychology at the Sorbonne.

Dr. Charles K. Clarke, medical director of the Canadian National Committee for Mental Hygiene, and professor of psychiatry at the University of Toronto, has been asked to deliver the Maudsley lecture on psychiatry at the congress of the British Medico-Psychological Association in London in 1923.

Dr. Anton David Udden, instructor in physics in the University of Pennsylvania, during the last year McFadden fellow of the American-Scandinavian Foundation, studying with Professor Bohr in the University of Copenhagen, died in San Antonio, Texas, on September 5, at the age of thirty-five years.

Dr. Juan Santos Fernández, the ophthalmologist and hygienist of Cuba, has died at the age of seventy-five years. His seventieth birthday was celebrated at Havana in 1917 with great ceremony, and a gold medal was presented to him with many tributes.

The death is announced of Dr. Juan Guglielmetti, a leader in experimental medicine and instructor in physiology at the University of Buenos Aires, and professor at La Plata, aged thirty-three years.

The American Petroleum Institute has called a general conference of the transportation and mechanical sections of the oil industry, to be held at the Statler Hotel, St. Louis, September

27. One of the subjects which will be under discussion is the rail transportation of petroleum and its products.

The *Journal* of the American Medical Association states that the convention of the German Botanical Society and of the German Society for the Study of Heredity will be held in Vienna this month. The two societies have agreed to unite for the present sessions. A large number of papers will be presented, and representatives from Sweden, Switzerland, the United States, Norway, Italy and Czecho-Slovakia have already announced their intention to be present. Special attention centers in the proceedings of the German Society for the Study of Heredity, as reports on the latest achievements in this line will be made by Goldschmidt (Berlin), on the problem of mutation; Spemann (Freiburg), on the activation of the heredity-mass, and Rüdin (Munich), on the hereditary transmission of mental disturbances. Professor Wettstein will preside over the joint meeting.

We learn from the *Journal of Industrial and Engineering Chemistry* that the Public Health Institute of Chicago has undertaken to finance the cooperative research between the University of Wisconsin Medical School and the chemical department of Northwestern University, which in the past has been supported by appropriations from the United States Interdepartmental Social Hygiene Board. This research which has been devoted to attempts to improve the treatment of syphilis of the central nervous system has been directed by Dr. W. Lee Lewis and Dr. F. C. Whitmore, of Northwestern University, and Dr. A. S. Lovenhart and Dr. W. F. Lorenz, of the University of Wisconsin. The Public Health Institute has appropriated $21,600 for the use of both universities during the coming year.

Following the receipt of a message from M. Mowatt, of London, secretary of the British Institution of Mechanical Engineers, Charles F. Rand, chairman of the Engineering Foundation, has announced that the leading engineering societies of England have formed the Engineering Joint Council, to work with engineers of the United States and of Canada and other British possessions toward concerted action for world peace and the advancement of engineering ideals "for the good of mankind." Mr. Rand described the organization of British engineering bodies into a single unit as a step in the movement to form a world union of engineers, which already has gained headway in France, Italy and Czecho-Slovakia, direct contacts having been established by the engineering bodies of these countries with those of America. The organizations represented on the British council include the British Institution of Civil Engineers, Institution of Mechanical Engineers, Institution of Naval Architects and the Institution of Electrical Engineers. Coincident with Mr. Rand's announcement, Dean Mortimer E. Cooley, of the University of Michigan, announced that the Federated American Engineering Societies, of which he is president, has appointed a committee on affiliation with engineering societies outside of the United States. The chairman is Gardner S. Williams, of Ann Arbor, a former member of the Michigan faculty.

A Reuter's dispatch states that members of the Mount Everest Expedition have sent the Pope a fragment of rock taken from the highest point reached by them on the mountain. The fragment has been mounted on an ebony stand decorated with silver and having a carved dedication to the pontiff, who is himself an alpine climber of no mean prowess. The pope has sent General Bruce, the leader of the expedition, the golden medal of his pontificate, together with an autograph letter of thanks. In this he recalled that when he was elected pope the Everest Expedition, which had already begun the ascent, sent him a telegram of congratulation and good wishes addressed to "the Alpinist Pope."

The Province of Quebec has purchased from the U. S. Radium Corporation one gram of radium, valued at $100,000, for the use of its citizens in the treatment of cancer and other malignant diseases. The radium will be sent to the University of Montreal, where, under the supervision of Dr. J. A. Gendreau, it will be at the service of the people of Quebec Province.

A dispatch from *The Pas,* in Northern Manitoba, as reported in the London *Times,* says that Mr. Alfred Tremblay, Arctic explorer, with his party, is leaving shortly for Hudson Bay, whence he will journey to the Arctic Seas and continue his investigations in Baffin Land and at the Magnetic Pole. Mr. Tremblay was a member of Captain Bernier's Arctic expeditions of 1910-11, 1912-13. He was only nineteen years of age when he made his first trip into the north. On his last expedition he succeeded where several well-equipped expeditions had failed in reaching Igloolik and Fury and Hecla Strait for the first time since the visit in 1822-23 of Sir E. W. Parry. Mr. Tremblay covered over four thousand miles on foot in the depth of winter and afterwards, with the assistance of Mr. A. B. Reader, a native of New Zealand, mapped and re-mapped some three thousand miles of coast-line. He was the first white man to cross land from the head of Admiralty Sound to Fury and Hecla Strait and to make the long and dangerous crossing from Murray Maxwell Bay, across Cockburn Land to Milne Inlet. Mr. Tremblay is accompanied on this expedition by Messrs. Arthur Barbeau and C. Talbot. all being natives of Quebec. Hudson Bay will be followed to Fox Channel, whence the party will proceed along the northwest side of Baffin Land. After carrying out surveys and general exploration of the areas of Baffin Land which he did not examine on his last trip, he will proceed to the Magnetic Pole to take observations. Mr. Tremblay's party will be the first to attempt the journey which it is undertaking by canoe and on foot. His trip will occupy approximately two years.

THE Paris correspondent of the London *Times* writes that in its annual report, recently published, the Compagnie Nationale des Matières Colorantes, which was founded five years ago with government encouragement to guarantee the supply of dyestuffs to French industries, confesses its dependence upon the experience and assistance of its foreign competitors. The report says: "The work of even the best technicians must be sterile unless they are in possession of all the knowledge accumulated in the past—knowledge which is essential to success. All who understand the complexity of the manufacture of organic coloring matters will realize why we have been compelled to acquire the patents, the processes and the technical aid of our principal foreign competitors for exclusive use in France. Thus we have had at our disposal the results of fifty years of investigation, and processes minutely studied and methodically put into practice, and so we are immediately placed in a position equal to that of the most modern and most specialized firms in our industry." Certain sections of the French press affect to perceive in this statement confirmation of a rumor long in circulation that the Compagnie Nationale has entered into an alliance with its German rivals. It is recalled that not long ago the *Chemiker Zeitung* announced that an agreement had been entered into between the German and French dye industries, in which seven great German firms and the Compagnie Nationale des Matières Colorantes were associated, by which the German firms were to give the French company detailed technical assistance and full information concerning the processes of manufacture and to supply German chemists to supervise the application of the processes in French dye works. In return, it was stated, the Compagnie Nationale undertook to limit supplies of certain synthetic dye-stuffs to France and her colonies, and to allow the German firms a share of the profits.

Nature announces that proposals for closer cooperation amongst the leading British engineering institutions, which have recently been under consideration, have now received the approval of the institutions, the representatives of which met in conference, namely, The Institution of Civil Engineers, The Institution of Mechanical Engineers, the Institution of Naval Architects, and The Institution of Electrical Engineers, and that an engineering joint council composed of representatives of these bodies has been formed. Among the objects of the joint council will be, to improve the status of engineers, to secure the better utilization of their services in the country's interests and the appointment of properly qualified individuals to responsible engineering positions, and to prevent the unnecessary duplication of activities. It is anticipated that, at a later stage, the number of bodies represented on the joint council may be increased, but this at present remains a matter for future consideration for the joint council and the institutions concerned.

The medical correspondent of the London *Times* writes as follows: "It is worth noting that whereas the death rate in 1851-1860 was 3,841 per million (all forms of tuberculosis), it was only 1,352 per million in 1913. During the war there was an increase, but in 1919 a sharp fall occurred to a figure lower than any previously recorded. This fall continued in 1920; in 1921, taking into consideration the increase of population, the position was again satisfactory, though a slight increase over 1920 was recorded. This slight increase was almost negligible in males (from 998 to 1,002 per million), but in females it was more appreciable (756 to 777 per million). Both the number of deaths and the death rates for non-pulmonary tuberculosis were lower in 1921 than in 1920. Sir George Newman asks whether this slight check to the fall in the mortality of pulmonary tuberculosis bears any relation to the large amount of unemployment in 1920. It may well do so, for tuberculosis flourishes in conditions of malnutrition and poverty. In Germany, for example, the tuberculosis death rate increased from 1914 onwards until, in 1916, it was double the pre-war rate. In 1917 it was still higher. In 1918 there were 40,000 more deaths in Germany from tuberculosis than in 1913. A similar state of matters has been reported from Poland, where in 1917, in Warsaw, four out of every hundred persons were said to have died from this cause. The mortality decreased from the date of the departure of the German army and the cancelling of the rigorous food restrictions. These facts are of great importance. They tend to confirm the view that our gradual deliverance from this scourge is due to better feeding.

UNIVERSITY AND EDUCATIONAL NOTES

The will of the late Mrs. Harriet L. Cramer, widow of the late owner of the *Evening Wisconsin,* leaves $100,000 to the arts and science department of Marquette University and approximately $1,000,000 to Marquette University Medical School. This is the second million that the medical department of Marquette University has received in the past four years.

The Kyushu Imperial University, Fukuoka, Japan, has recently opened the departments of medicine and engineering to women students. Women are barred from attending the University of Tokyo.

Dr. Arthur Griswold Crane has been elected president of the University of Wyoming to succeed Dr. Aven Nelson, president since 1917 and previously professor of botany. Dr. Crane was major in the Sanitary Corps during the war.

The Reverend Albert C. Fox, S.J., former president of Campion College, at Prairie du Chien, Wisconsin, has been appointed president of Marquette University, succeeding the Reverend Herbert C. Noonan, S.J. Father Noonan assumes other administrative work in the Missouri province of the Jesuit Order.

Dr. William C. Rose, professor of biological chemistry at the medical school of the University of Texas, has been appointed professor of physiological chemistry at the University of Illinois.

Dr. Howard Bishop Lewis, instructor of physiological chemistry at the University of Michigan Medical School, has been appointed to a chair of physiology at the university.

Assistant Professor R. B. Robbins will return to the University of Michigan after two years' absence in actuarial work in the departments of insurance of Missouri and New York.

At the University of Colorado, Assistant Professor G. H. Light has been promoted to a full professorship of mathematics and Dr. Claribel Kendall to an assistant professorship.

DISCUSSION AND CORRESPONDENCE

TINGITIDÆ OR TINGIDÆ

The proper form to be used as the family-name for the Lace-bugs (*Hemiptera*) has been the subject of considerable correspondence between Professor Carl J. Drake and the writer of these lines.

The generic name *Tingis* was first employed in the *Hemiptera* by Fabricius ("Systema Rhyngotorum," 1803, p. 124). Fabricius named a number of genera in the Hemiptera employing ancient Greek names of cities, from which the insects which he was describing had, no doubt, come. *Tingis* is the Greek name of Tangiers in Morocco. It is also spelled by classic authors *Tingi* and sometimes *Tinge.* Strabo in his Geography, Part 1, 3, 1, § 140, speaks of Τίγγος and uses the genitive form Τίγγιος. This shows that the root or stem of the word is Τίγγι = *Tingi.* The adjectival form derived from the noun *Tingis* in Latin is *Tingitanus.* (*Cf.* Valpy's edition of the Delphin Classics, Vol. No. LXXXIX, p. 882, where comment is made upon the passage in Pliny's *Historia Naturalis,* Lib. V, 1, 1: *"Tingitana pertinet a freto Gaditano ad fines usque Marocani regni."* This adjectival form plainly indicates that the Latin root of the noun is *Tingit.*

In forming family names the fixed rule is to suffix *"idæ"* to the stem, and it is the rule that the Latinized form of Greek words should be employed. The Latin stem, as shown above, of the ancient name of Tangiers is "Tingit." Adding *"idæ"* to this we have the word *Tingitidæ.* The Greek stem, if the Latin is overlooked, is Τίγγι = *Tingi.* Suffixing *"idæ"* to this we should have form *Tingiidæ,* which has never been used.

The first time that a family name was given to the Lace-bugs was in 1833 when Laporte employed the term *Tingidites* (*Gallicism*). Westwood in 1840 used the word *"Tingidæ."* Amyot and Serville in 1843 employed the Gallicized form *Tingides;* Stål in 1873 employed the form *Tingitidæ* and was followed by Uhler, Champion, Horvath, Oshanin, Osborn, Drake and a number of others. Then Duzee in 1917 in his "Catalogue of the Hemiptera of America North of Mexico" employed *"Tingididæ"* as the family name, citing Laporte as his authority.

The writer of these lines having regard to etymology and the rules governing the construction of family-names is decidedly of the opinion that *"Tingitidæ"* is the correct form of the word, formed as it is by suffixing *"idæ"* to the Latin stem *Tingit.* Westwood's *"Tingidæ"* is in error, *first* because had he studied the classic Greek he would have discovered that the root is not *Ting* but *Tingi;* and *secondly,* because he did not follow the rule which calls for the employment of the Latinized form of the word. *Tingididæ* as used by Van Duzee is wholly in error, based, as it is, upon the mistake of Laporte who imagined that the genitive of *Tingis* was Τίγγιδος, instead of Τίγγιος as given by Strabo.

The conclusion of the matter in the mind of the writer is that the word *Tingitidæ* is not merely formed according to the requirements of scientific nomenclature, but according to classic use. It furthermore has in its favor the weight of authority, having been used by a number of eminent gentlemen, distinguished not merely for their entomological but for their philological attainments. They have already been mentioned. The question of priority can not be invoked as against the correct structure of language.

W. J. Holland

Carnegie Museum,
August 2, 1922

THE GLACIATION OF THE CORDILLERAN REGION

To the Editor of Science: Because of general interest in the subject of glaciation in the Cordilleran region and of recent discussion in Science of the origin of the Palouse soils the investigation of the writer in the twelve-months past in the region about Spokane, Washington, may merit the attention of your readers.

The investigation began with discovery of evidence of glaciation on the basalt plateau about Spokane some four or five hundred feet above the train of the valley glacier in Spokane Valley (described and mapped by Campbell, N. P. R. R. Guide-book of the U. S. Geol-Survey, 1916). Examination proved that all of these "prairies" (Pleasant Prairie, Five Mile Prairie, Sunset Prairie, Moran Prairie and Paradise Prairie) occupying this plateau bore evidence in the form of erratic boulders, gravel, sand and clay, of depths varying from nothing to fifteen feet or more, of ground ice on the level tops of the plateaux. In the valley of

Hangman Creek (Latah Cr.) in the southwest part of the city deposits are five or six hundred feet deep, the valley having been filled (as, presumably, was also the valley of Spokane River). As no evidence was found of the glacier having crossed the Spokane River to the east of the city limits and as what appeared to be a marginal moraine was found on the south side of the valley at the southeast corner of the corporation boundary (Pantops) it seemed that the valley of the Spokane must have been completely dammed, impounding the waters of the entire Columbia drainage basin. It was believed that such a volume of water even in a brief time must have cut an outlet which would be readily found. Such was found to be the case. In the gap between Mica Peak and Moran Peak, at the village of Mica, on the O. W. R. & N. Railway, twelve miles southeast of Spokane, at an elevation of about 2,460 feet, two outlets may be easily seen in the field or by examination of the topographic sheet of Spokane Quadrangle of the U. S. Geological map. These two streams join California Creek a short distance south of Mica and follow it to Hangman Creek (Latah Cr.). Apparently Hangman Creek was obstructed here also for the stream followed up Hangman Creek (Oakesdale Quadrangle) until it reached what is now the low land between Hangman Creek and the head of North Pine Creek, where it cut a channel some 200 feet in depth in the Palouse soil of that region, reaching and scouring the basalt beneath, thus opening an outlet to the southwest.

This glaciation was followed by a period when stream erosion cleared the valleys of Spokane River and Hangman Creek and perhaps eroded Spokane Valley almost 200 feet below the present floor (left at the time of the Wisconsin period of glaciation) as shown by the depth of Lake Cœur d'Alene and other lakes which occupy side branches of Spokane Valley. There is also some evidence collected of a glacier having almost reached Spokane from the north by way of the valley of the Little Spokane River. As this is about 400 feet lower than the glaciation on the "prairies" and extends some twenty miles south of what seems to be the terminal moraine of the Wisconsin period (the Wisconsin glaciation reaching Spokane came from the east), it will be seen that we have evidence of three periods of glaciation here. The earliest of these is responsible for "Lake Spokane"[1] and its Mica outlet by way of California, Hangman and North Pine Creeks.

It will be seen from this that a long period has elapsed since the cutting of this great trench through this soil and as yet the æolion deposits have not covered the bare rocks of its floor, though for eight miles between North Pine Creek and Hangman Creek there is no stream sufficient to account for removal of deposits.

(Mr. J. T. Pardee of the U. S. Geological Survey spent six weeks of May and June of this year making a careful study of glaciation and related subjects in northeast Washington and has secured data for what promises to be the most interesting of all recent reports on this subject. The appearance of his report is awaited with great interest. The writer is collecting further material on the shore line of L. Spokane and on the glaciation in Little Spokane Valley.)

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A SUGGESTION TO ZOOGEOGRAPHERS

Ranges of animals are most easily defined in terms of political divisions, cities near the limit of range, and such readily determinable points. This eminently practical method will doubtless always be used.

But ordinarily zoogeographers have not been content to use only this method, which, from its nature, explains nothing, and questions nothing.

There has been a constant search for some sort of scheme whereby ranges of animals might be reduced to a common denominator. Various schemes of this kind are in use at present and hereinafter shall be commented upon.

[1] The name "Lake Spokane" was given by the writer in a paper on "Glaciation and Vulcanism in the Spokane Region" read on November 3, 1921, before the Columbia Section of the American Institute of Mining and Metallurgical Engineers.

By far the most generally used of these philosophical methods is that of Realms, Regions and Zones. These are all based on the idea that large numbers of species have the same range, and that by picking out some of the conspicuous forms and mapping their ranges one has *ipso facto* a set of regions, to which other ranges may be referred, and with which other ranges should agree.

This is, in some degree, true, but in nearly every case in which the ranges of any two species agree, the agreement is due to the geographic factors and not to the zoologic factors.

It is obvious that the zoogeographical realms are nothing save and except the great land masses with lines drawn to correspond to the physiographic barriers. There is a great philosophical difference between such terms as Holarctic Fauna and Holarctic Region. In the first case we speak of zoological matters in terms of zoology, in the second of geographical matters in terms of mythology.

The Palearctic fauna is an aggregate of species and may invade (in fact *has* invaded) Australia without forfeiting its name.

It occupies, in the main, territory distinct from that of any other fauna, and this by virtue of the Sahara and the Himalaya, but in eastern China there is a broad area where Palearctic and Oriental faunas intermingle and where no line can be drawn which would delimit the range of more than a few species.

In Malaysia, Oriental and Australian faunas overlap in the same way. Van Kampen ("The Zoogeography of the East Indian Archipelago," *Amer. Nat.*, XLV, 1911, p. 537-560) has shown that Wallace's famous line is as mythical as the Jack of Diamonds.

All lines of this sort apply primarily to the animal on whose range they are based (and theoretically should be shifted when the range is extended); secondarily to its parasites, commensals, prey, etc.; and thirdly to animals of very similar constitution, origin, or habits.

Where zonal lines coincide with physiographic barriers there is a noticeable change in fauna within a few miles, where there is no barrier there is a broad region wherein each species is a law unto itself.

In no case can the boundary of a faunal zone, as such, be *seen*.

As, in cases where the zonal lines really mean a sudden change in fauna, there is also present a sharp change in topography, and as this topographical change can be *seen* with the greatest ease (and as, in cases where the zonal lines are based on ranges of a few species, and do not indicate a sudden change in fauna, there is no sharp change in topography), it seems high time to cease disputing about zones and to use terms which have some meaning.

The zones are frequently described as being based on temperature and the lines as corresponding to isothermal lines. Apart from the objection that no one can *see* an isothermal line, the temperature measurements for the zones are not the bases on which these areas are delimited, but are merely the temperatures for areas previously delimited by other means.

Once established the zones have persisted in spite of the extensions of the ranges of many animals on which the zones were originally based, and it is a question whether the range of any one species corresponds with the lines drawn on faunal zone maps.

A second method is the use of "major environments" and "minor environments," which was put forward with considerable diffidence in Shull, Larue and Ruthven, "Principles of Animal Biology," 1920.

These are essentially plant formations or forest areas. In some ways they are more serviceable than zones as plant formations can be *seen*. Also plants are somewhat more interdependent than animals and hence the ranges of more plants might reasonably be expected to coincide. Furthermore, plant formations play a large part in providing animal environment, as forest, prairie, etc., a part recognized in the term "major environment."

But, after all, the same objection holds in this case as in the case of the zones. Where there is a sharp change in plant formation there is usually a sharp change in topography or in soil conditions. Without such change there is no marked change in plant communities.

There is certainly an inherent absurdity in defining the range of animals whose range one knows, in terms of the ranges of plants and animals whose range one does not know.

Lutz' method of "Geographic Average" (1921, *Amer. Mus. Novitates,* 5) involves considerable calculation, which brings to light with great effort the astounding information that the "mid-range" of a northern species is north of the "mid-range" of a southern species.

He voices considerable discontent with the zones as being indefinite and indistinct. Whereupon he proceeds to define anew the undefinable and to redistinguish the indistinguishable.

Inasmuch as all sharp changes in fauna are dependent on similarly marked changes in topography, it would seem reasonable to adopt physiographic regions, instead of zones, "major environments," and "geographic averages."

For the United States this has been made remarkably easy by the publication of "Physiographic Divisions of the United States," by Nevin S. Fenneman, *Ann. Ass. Amer. Geog.,* VI, 1917, which is the result of long continued work on the part of a committee of the association.

The lines of these divisions in many cases agree with the zones and with the plant formations. This is to be expected for the ranges of many animals should logically stop at a physiographic break, or at a line of sudden change in temperature or moisture, and the former usually carries with it the two latter.

Furthermore the use of these physiographic regions clears the way for intelligent association of animal and plant ranges with the geology and soil conditions, and brings to light routes of dispersal.

For instance, this system makes clear the presence of the Connecticut valley and the Hudson-Champlain trough, in which many southern forms extend north, but to draw these on the map as Upper Austral, indicating faunal identity with Piedmont Virginia (also Upper Austral) is sheer falsehood.

The beauty of this method, however, is its ease of application. These regions can be *seen,* their boundaries can be *seen,* and there is seldom any doubt as to which region one is in or from which specimens came.

Of course, all animals do not respect physiographic boundaries, any more than all animals respect the lines drawn on maps to represent faunal zones.

None of our methods of indicating general distribution is perfect. None ever can be. Zoogeographers might well give some consideration to the results of the "new geography," and afford themselves some justification for their title.

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CLINKERTILL, A NEW METAMORPHIC ROCK

In view of the interest attached to the study and identification of tillite a note about a rather unusual form of till may be of interest. This occurrence has never been described so far as the writer is aware.

Capping the northern bluffs bordering the Missouri river in portions of sections 16, 17 and 18, Township 154 west, Range 95 north, Williams County, North Dakota, is a typical bowlder-clay. This till lies on the truncated edges of the gently easterly dipping, lignite bearing, Fort Union Beds. In the sections mentioned above a heavy bed of lignite, here known as the Williston bed[1] immediately underlies the drift. Here as elsewhere the Williston bed has burned back from the outcrop baking the overlying till in places to a thickness of 30 feet or 40 feet. The clinkertill so formed varies in color from salmon-pink to dark brown, brick-red being the common color. In selected spots the material is fused to a porous, scoria-like mass but in most part is only slightly indurated by the heat. This baked till so formed resists weathering and removal and forms the capping of steep bluffs and buttes or mesas.

The most common pebbles found in this clinkertill are granite and limestone. The granite pebbles appear to be unaltered by the heat and the limestone pebbles but slightly as they effervesce freely in hydrochloric acid.

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[1] Collier, A. J., "The Nesson Anticline," Bulletin 691 G., U. S. G. S., p. 213.

THE HOMING OF A DOG

In this month's issue of *The Review of Reviews* is a copy of some notes taken by Professor Herrick of Cleveland, Ohio, and published in *The Scientific Monthly.* This refers to the "homing" of certain cats. I have had much experience in this line myself in my earlier years and can confirm what he says. My greatest story of this instinct, however, is not with cats but with a collie dog still living and in my possession. Canon City is distant from Denver something like 160 miles by rail. The D. & R. G. road passes southeast forty miles, then turns north to Denver. This course is necessary on account of the range of mountains divided by the Arkansas River. This range consists of many lofty peaks in which Pike's Peak is included, almost directly in line between Canon City and Denver.

One of our neighbors directly across the street moved by rail to Denver, taking this dog less than a year old with him on the train. In less than a week he was back at the old premises and barking joyously as ever. We adopted him and now for six years past he has been one of the family. He has given so many evidences of intellectual power that whole pages could be written of him. Possibly the remembrance of this episode in his life is the reason he will never voluntarily ride in any kind of vehicle. With his three feet yet remaining (one lost in coyote trap) he will travel miles to keep us company in an auto and when we take him in forcibly will leap out regardless of any speed we may be making.

W. D. Harry

QUOTATIONS

CONTROLLING RESEARCH ENDOWMENTS

Men of wealth do not always show wisdom in their endowments of science. Sometimes their ideas are fantastic. The late Mr. Carnegie, for example, early in the nineties, learned with surprise that there was still dubiety about the descent of man. He suggested buying Darwin's house at Down, putting up a sum of money and "settling the matter one way or another" in the decisive fashion of business. Later on his wealth and his knowledge, or his capacity for taking competent advice, grew, and he founded the splendid Carnegie Institution of Washington, a large part of the funds of which have since been continuously engaged on the more general problems of evolution, to the great benefit of knowledge, but without yet "settling Darwinism one way or another"!

Endowments on a princely scale are able to run on their own lines and to adapt themselves to the changing needs of science. But smaller funds are less flexible, and are often attached to a purpose so precise that their real utility may cease. Even if the original testators had ideas that were vague and liberal, the lawyers whom they employed to devise the terms of the trust, and the subsequent lawyers who have had to interpret them, have generally contrived to secure the maximum of rigidity. For such is the way of lawyers, preferring the form to the substance.

ROYAL SOCIETY TRUSTS

Our own Royal Society, to take an example of the disabilities arising from the rigidity of bequests, has over thirty separate trust funds to administer. The total income is not large, but it is relatively large as compared with the income that can be applied to the general purposes of the society. Every year the council begs possible donors not to tie up their gifts or their bequests. They state that in their experience "the usefulness of the Society for the Advancement of Natural Knowledge has been greatly hampered by the lack of funds which they could freely use according to their own judgment." All over the country, attached to scientific societies and institutions or to universities, there are many similar rigid endowments, given doubtless for a purpose that was urgent at the time, but now wasting zeal in their administration, and failing to make continuous additions to the progress of science from their inappropriateness to present needs.

There are many immediate objects which may appeal to the taste or to the imagination of the wealthy, and which could be gained within a reasonable time. It might be useful were the leading societies from time to time to draw up lists of these, with estimates of the possible period within which they might be completed and of the sums of money which seemed necessary. A simple legal formula could be devised for the administration of such a specific bequest, with some provision against capitalization and the assignment of unexpended balances to some other object after a definite period. The donor's benevolence could be recorded in perpetuity, were the memoirs describing the results associated with his name.

THE AMERICAN PLAN

But there are also donors who wish to provide capital funds, large or small, for the perpetual benefit of science or of some branch of natural knowledge. One of the members of the National Research Council of America has proposed a scheme in which he hopes to have combined permanence with flexibility. In that western home of liberty a very large interference with what in Europe we still think the inalienable rights of the individual is not only advocated, but is accepted with docility, and I gather that the intention is to compel benefactors to wisdom.

It is proposed, in brief, that the board of trustees to whom is to be committed the administration of any permanent gift for the advancement of science should be elected at stated periods by a committee of electors. Of the latter, five are to be appointed annually, two chosen by the board itself, and three by some stable institution such as, for example, the National Research Council, which is a working organization of the National Academy of Sciences. The duration of office should be for five years, and a member would not be eligible for re-election for one year. The object is that every board of trustees should be chosen by persons a

majority of whom are approved representatives of the science or sciences named, fully conversant with the situation in the age in which they are acting, free from self-interest in the election, and, by virtue of their position, charged with responsibility for rendering this type of service.

The trustees so elected and so kept in continuous touch with the best interests of science should have full power in regard to the supervision of projects and expenditure of funds. But what is the vital element in the scheme is that they would have power to adapt the provisions of their original charter to what *they* conceive to be the object of the funds, so as to meet "changing conditions and needs in the spirit of the original intent of the donor." It is a very interesting proposal, which if carried out on a large scale would probably do much for the progress of science, and certainly increase to a very marked extent the power of the National Research Council. But *Quis custodiet ipsos custodes?* Is it quite certain that even a National Research Council will prove a perpetual fount of wisdom and impartiality?—London *Times*.

SCIENTIFIC BOOKS

An Advanced Course of Instruction in Chemical Principles. By Arthur A. Noyes and Miles S. Sherrill. Complete Revision. pp. XVIII + 310. The Macmillan Company, New York.

Perhaps in no other subject is the *method* which is employed for instruction more vital than it is in Physical Chemistry; for it is in that subject that the distinction between Power and Knowledge is probably most marked.

In striking contrast to the many books on this subject which are written from the purely descriptive point of view, books which are attractive because easy to read, but which leave the reader only with a vague knowledge of what has been done, and with no acquired power to apply the principles studied to the new questions of to-day and to-morrow, this book is intended primarily to make the principles and at the same time their general and specific application so clear, that the knowledge and the power to apply and use it practically are developed simultaneously. In other words, the problem-method of instruction, first introduced in Physical Chemistry by Speyers in his "Text-book," and amplified by the Reviewer in the second edition of his "Elements" (1902), is the method recognized in this work as the only one which will "give that intensive training which is essential for pursuing more specialized courses of scientific study, or for applying chemical principles to industrial problems."

It is to be regretted that the authors have not seen fit to include any journal-references in the text, either to the things directly considered, or to those which are expansions and continuations of them, for the student is thus confirmed in his bad habit of being satisfied with a statement from a text-book, rather than encouraged to seek the real source, the journal article. Another disadvantage arising from this lack of references is the very real danger that the reader will feel that at any point the last word had been said on the subject, whereas a glance at the original papers would show him in truth that it was only the first.

Since an international committee has already established a notation for use in Physical Chemistry, it would seem a pity that the authors in this text have adhered to a local one, for it will needlessly confuse the reader.

The fact that this is the final revision of the preliminary editions of 1917 and 1920 is assurance that few if any misprints or errors are likely to be found in the text.

A list of the chapter headings given below will show the general scope of the book:

Part I — *The atomic, molecular and ionic theories and properties of substances directly relating to these theories.*
The composition of substances and atomic theory. The molal properties of gases and the molecular and kinetic theories. The molal properties of solutions and the molecular theory. The atomic properties of solid substances. The electrolytic behavior of solutions and the ionic theory.

Part II — *The rate and equilibrium of chemical changes from mass-action and the phase view points. The rate of chemical changes.*
The equilibrium of chemical changes at constant temperature. Equilibrium of chemical systems in relation to the phases present.

Part III — *The energy effects attending chemical changes, and the equilibrium of chemical changes in relation to these effects.*
The production of heat by chemical changes. The production of work by isothermal chemical changes in relation to their equilibrium conditions. The production of work from isothermal changes by electrochemical processes. The effect of temperature on work producible by isothermal chemical changes and on their equilibrium conditions. Systematization of free-energy values.

J. Livingston R. Morgan

SPECIAL ARTICLES

SAND DROWN, A CHLOROSIS OF TOBACCO AND OTHER PLANTS RESULTING FROM MAGNESIUM DEFICIENCY

In connection with recent field investigations in the improvement of tobacco production conducted by the Bureau of Plant Industry in cooperation with the North Carolina Department of Agriculture attention was directed to a characteristic chlorosis of the leaves of tobacco plants on certain test plots. Investigation disclosed the fact that this disease often causes serious damage to the tobacco crop on certain types of soil, particularly in comparatively wet seasons. The popular name of this chlorosis is "Sand Drown," a term referring to the fact that the disease is likely to occur in aggravated form on the more sandy portions of the field after heavy rainfall. As a result of considerable field and laboratory study extending through several seasons this malady has been found to be due to an insufficient supply of magnesium in the soil or fertilizer. It has been found, further, that the ratio between the quantities of sulfur (sulfate) and magnesium contained in the fertilizer is a factor of importance, the symptoms of magnesium deficiency being intensified by increase in the quantity of sulfur applied to the soil. The details of the investigations will eventually appear in the *Journal of Agricultural Research* but because of considerable delay in publication resulting from temporary suspension of this journal it seems desirable to present at this time a brief outline of the principal facts established. The chlorosis in question usually begins at the tip and along the outer margins of the older leaves, advancing toward the leaf base and extending progressively to the upper leaves of the plant. In some cases, however, the chlorosis involves large portions of the leaf surface when first clearly recognizable. The veins and midrib of the leaf tend to retain their normal color. There is more or less complete blanching of the leaf lamina, both yellow and green chlorophyll pigments being affected (thus differing from the chlorosis caused by potassium deficiency in which the affected area acquires a dull yellow color with a bronze or copper overcast). The blanched tissues usually do not die as quickly as in potassium deficiency so that local specking or spotting of the leaf is commonly wanting except in advanced stages of the malady. In some instances, however, local dying of the tissues between the veins has been the first symptom. In plot tests conducted in several tobacco-growing districts, in which chemically pure sources of nitrogen, phosphorus, potassium, calcium and sulfur were used instead of the ordinary commercial fertilizer materials, the symptoms of magnesium deficiency have usually appeared where sandy and sandy loam soils were used and there was abundant rainfall. In all such cases addition of sulfate or chloride of magnesium to the fertilizer salts has prevented the chlorosis. In comparative tests, applications of the so-called high grade or relatively pure commercial forms of the sulfate and chloride of potassium have resulted in severe chlorosis while low grade sulfates and chlorides of potassium containing considerable quantities of magnesium, such as "double manure salt" and "kainit," have prevented the disease. In some cases use of the purer forms of sulfate of potassium has resulted in severer chlorosis than that caused by the chloride and, moreover, the severity of the chlorosis has been proportional to the quantity of sulfate of potassium used. Symptoms of the disease also have been prevented by applying dolomitic limestone to the soil while comparatively pure calcite has been ineffective. Certain organic fertilizer materials of vegetable origin which are commonly used as sources of nitrogen, notably cotton seed meal, tobacco stalks and stems and barn manure, tend to prevent the disease. These materials contain appreciable quantities of magnesium. Use of other common sources of fertilizer nitrogen which contain little or no magnesium, including nitrate of soda, dried blood and especially ammonium sulfate, has favored development of the disease. In pot cultures this chlorosis is readily induced by applying a nutrient solution containing all the usual plant food elements except magnesium, using an excess of the solution so as to produce a leaching action on the soil. Moreover, the disease if not too far advanced is readily cured by adding magnesium to the nutrient solution. In view of the relation of the sulfur supply to the symptoms of magnesium deficiency it is worthy of note that an inadequate supply of sulfur *per se* results in a mild, diffuse type of chlorosis of tobacco, affecting all green parts of the plant and thus differing from the symptoms of magnesium deficiency. Since more or less sulfur is constantly added to the soil through rainfall, while there is loss of magnesium through the leaching action of the rain water, it is to be expected that symptoms of magnesium deficiency will be especially pronounced in wet seasons. In dry seasons the likelihood of relative deficiency of sulfur is increased. Experiments with corn, a crop plant differing widely from tobacco in many respects, show that it also is subject to the "sand drown" disease, the symptoms and characteristics of the disease in corn corresponding rather closely with those found in tobacco. It seems likely, therefore, that other crop plants are subject to injury from an inadequate supply of magnesium in the lighter, more sandy type of soils. Apparently the quantity of magnesium required in the fertilizer to prevent the symptoms of magnesium deficiency is small, probably less than 50 pounds per acre. These investigations suggest that the element magnesium needs to be taken into account both in the general problem of liming and in the proper choice of commercial fertilizer materials for making up so-called complete fertilizers.

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TRANSFERENCE OF THE BEAN MOSAIC VIRUS BY MACROSIPHUM SOLANIFOLII

It has been assumed by pathologists that the virus of bean mosaic is transferred from diseased to healthy plants by insects. No experimental proof has been submitted to substantiate this claim. The only satisfactory explanation of the widespread occurrence of the disease in certain seasons seems to be that occasional plants which show mosaic early in the season serve as the sources of infectious material which is carried throughout the field by virus-carrying insects. The probability of this being the correct explanation is strengthened by the known facts concerning the spread by insects of mosaic diseases of other plants.

Indirect proof of the relation of insects to the dissemination of bean mosaic was obtained during the summer of 1921. Plantings in late May of seed collected from plants showing mosaic the previous season were made in rows four feet apart. Another plot was planted at the same time seventy-five feet away with seed from plants grown for two previous seasons under insect-proof cages. These plants had shown no symptoms of mosaic. By the middle of July, practically all of the plants in the mosaic seed plot were showing symptoms of the disease. None of the plants in the clean seed plot had developed any signs of mosaic up to the time of the appearance of the second pair of leaves. Weekly inspection was made and the first case of mosaic was found in one plant of the Long White variety on June 12. A count was made each week of the new plants which had developed mosaic and on September 17, when the results were summarized, 19.5 per cent. of the total number of plants in the plot, which included twenty varieties, were affected with the disease. On July 15, clean seed from the same source as the above was planted in hills between the rows of diseased plants in the mosaic plot, half of the seed under insect-proof cages. By September 1, every plant outside of the cages was affected with mosaic, while not a single diseased plant appeared in the cages up to the time the plants were killed by frost. The diseased and healthy plants at all times during their growth were sufficiently far apart so that they did not come in contact with one another. This experiment indicated that insects are directly responsible for the dissemination of the disease.

In May, 1922, a planting of beans in the greenhouse was found to be infested with aphids. Several of the plants had early shown symptoms of mosaic. Growing some distance from the aphid-infested plants were a group of bean plants in water cultures. Practically every plant in these cultures developed a severe case of mosaic, and examination showed that the aphids were also abundant on them. Golden Wax and Green Pod Stringless beans were planted in pots in the greenhouse and the pots placed in cages. Brittle Wax beans were planted in the field and three cages placed over a portion of the row. In addition, a twenty-foot row of the same variety was planted and left uncaged for observation as to freedom of the seed from mosaic. As soon as the greenhouse and field plants had developed the first pair of leaves, aphids from the mosaic plants were transferred by means of a camel hair brush to watch glasses, and then placed on the leaves of three plants in one of the field cages, and on five plants of Golden Wax and three of Green Pod Stringless in cages in the greenhouse. Two cages of plants in the field as well as the additional twenty foot row were held for field checks. A large number of plants in pots were held in separate cages in the greenhouse as checks. The plants were inspected daily. After five days, three plants of Golden Wax and one of Green Pod Stringless showed apparent symptoms of mosaic as water-soaked areas along the veins which gradually involved the entire leaf. In addition there was a distinct down-curling of the leaves, usually characteristic of mosaic. This was contrary to usual observations which have been that when mosaic is transferred to healthy plants by aphids, symptoms of the disease do not appear on the inoculated plant until the new leaves have developed. However, with both of the varieties used the mottling was very distinct on the original leaves. Contrary observations on other plants have probably been due to the fact that it is difficult to detect mosaic symptoms on old leaves. After twelve days new leaves had appeared and these showed marked mosaic symptoms. These plants were held for eighteen days and the succeeding leaves continued to present characteristic mosaic markings. None of the plants in the check cages had developed any signs of mosaic one month after the beginning of the experiment, when they were discarded.

After seven days one plant of Brittle Wax in the field cage reacted similarly to the plants in the greenhouse. When the second pair of leaves appeared, mosaic markings were not apparent and it was thought that weather conditions had checked the progress of the disease in the plant. However, upon examining the plants one week later, two plants of the three upon which the insects had been placed had developed typical mosaic symptoms. All of the plants in the check cages, as well as in the twenty-foot row outside of the cages, have remained healthy up to this time, one month from the time of the appearance of the first pair of leaves.

The species of aphid used in these experiments has been identified by Miss Eugenia McDaniel of the entomology department as *Macrosiphum solanifolii*. This species has been collected on beans at other times, especially early in the season. *Phaseolus vulgaris* is one of the known hosts of this very polyphagous species.

SUMMARY

The spread of bean mosaic was observed during 1921 under conditions which strongly suggested transfer by insects. The sudden appearance of the disease in the water cultures of beans growing in the greenhouse, and infested with aphids, indicated even more definitely the mode of dissemination. Definite proof of the transfer of the virus by *Macrosiphum solanifolii* was obtained under controlled conditions, both in the greenhouse and in the field.

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THE EXTENSION OF THE X-RAY INTO THE ULTRAVIOLET SPECTRUM

IT was found that when thermions liberated from a tungsten filament were accelerated and allowed to impinge on a metal grid maintained at a variable positive potential, secondary electrons were emitted from the grid. The number of such secondary electrons emitted were measured by means of a galvanometer in series with the grid and a plate maintained at a constant positive saturation potential.

On plotting the secondary current as a function of the accelerating voltage, acting on the primary electrons, a sudden change in the slope of the curve occurring at critical potentials was interpreted in the usual way. The energy-quantum relation V(volts) L (Å) = 12320 was used to compute the equivalent wavelengths.

The following table gives the preliminary results thus far discovered. The quantities bracketed are still doubtful. Those preceded by an (*a*) are not found by the usual breaks in the curves but are positions on the continuous curves where the ratio of the number of secondary (s) electrons per primary (p) were such as indicated in the s/p column. At present it appears as if the convergence wavelength (s/p = 3) for tungsten ended at 91.2 Å and is followed by an absorption band extending probably down to 14 Å. This is then followed by the Mα line, here extrapolated as 7.04 Å from the above measurements.

TUNGSTEN

Volts	Wave-length (Å)	S/P	Remarks
4.4	2800		Hull found 2700 shortest spark spectrum.
(17)	(725)		Suspected
35.0	352		
(60)	(205)		
135	91.2	3	Doubtful
144	*a*85.6	2.5	
181	*a*68.0	2.0	
295	*a*41.7	1.5	
435	*a*28.3	1.0	
( )	( )	0.0	
1750	7.04		Extrapolated X-ray data gives Mα = 7.007)

IRON

Volts	Wave-length	Remarks
3.3	3763	
8.5	1450	Millikan's iron spectrum shows 1430 and 1409.
10.4	1184.6	Also 1184.
24.3	507.0	Also 506 and 552.1. Intensity 7. Mα computed from Sanford's formula gave 484 Å.
45.8	269	Iron shows spectrum 271.6 Å.
( )	*a*( )	Doubtful.
200	*a*61.6	

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CONTENTS

SOME ASPECTS OF ANIMAL MECHANISM[1]

It is sometimes said that science lives too much in itself, but once a year it tries to remove that reproach. The British Association meeting is that annual occasion, with its opportunity of talking in wider gatherings about scientific questions and findings. Often the answers are tentative. Commonly questions most difficult are those that can be quite briefly put. Thus, "Is the living organism a machine?" "Is life the running of a mechanism?" The answer cannot certainly be as short as the question. But let us, in the hour before us, examine some of the points it raises.

Of course for us the problem is not the "why" of the living organism but the "how" of its working. If we put before ourselves some aspects of this working we may judge some at least of the contents of the question. It might be thought that the problem is presented at its simplest in the simplest forms of life. Yet it is in certain aspects more seizable in complex animals than it is in simpler forms.

Our own body is full of exquisite mechanism. Many exemplifications could be chosen. There is the mechanism by which the general complex internal medium, the blood, is kept relatively constant in its chemical reaction, despite the variety of the food replenishing it and the fluctuating draft from and input into it from various organs and tissues. In this mechanism the kidney cells and the lung cells form two of the main sub-mechanisms. One part of the latter is the delicate mechanism linking the condition of the air at the bottom of the lungs with that particular part of the nervous system which manages the ventilation of the lungs. On that ventilation depends the

[1] Presidential address delivered at the Hull meeting of the British Association on September 6.

proper respiratory condition of the blood. The nervous center which manages the rhythmic breathing of the chest is so responsive to the respiratory state of the blood supplied to itself that, as shown by Drs. Haldane and Priestley some years ago, the very slightest increase in the partial pressure of carbon dioxide at the bottom of the lungs at once suitably increases the ventilation of the chest. Dovetailed in with this mechanism is yet another working for adjustment in the same direction. As the lung is stretched by each inbreath the respiratory condition of the nervous center, already attuned to the respiratory quality of the air in the lungs, sets the degree to which inspiration shall fill them ere there ensue the opposite movement of outbreath. All this regulation, although the nervous system takes part in it, is a mechanism outside our consciousness. Part of it is operated chemically; part of it is reflex reaction to a stimulus of mechanical kind, though as such unperceived. The example taken has been nervous mechanism. If, in the short time at our disposal, we confine our examples to the nervous system, we shall have the advantage that in one respect that system presents our problem possibly at its fullest.

To turn therefore to another example, mainly nervous. Muscles execute our movements; they also maintain our postures. This postural action of muscles is produced by nerve-centers which form a system more or less their own. One posture of great importance thus maintained is that of standing, the erect posture. This involves due cooperation of many separate muscles in many parts. Even in the absence of those portions of the brain to which consciousness is adjunct, the lower nerve-centers successfully bring about and maintain the cooperation of muscles which results in the erect posture; for example, the animal in this condition, if set on its feet, stands. It stands reflexly; more than that, it adjusts its standin posture to required conditions. If the pose of one of the limbs be shifted a compensatory shift in the other limbs is induced, so that stability is retained. A turn of the creature's neck sidewise and the body and limbs, of themselves, take up a fresh attitude appropriate to the side-turned head. Each particular pose of the neck telegraphs off to the limbs and body a particular posture required from them, and that posture is then maintained so long as the neck posture is maintained. Stoop the creature's neck and the forelimbs bend down as if to seek something on the floor. Tilt the muzzle upward and the forelimbs straighten and the hind limbs crouch as if to look at something on a shelf. Purely reflex mechanism provides all kinds of ordinary postures.

Mere reflex action provides these harmonies of posture. The nerve-centers evoke for this purpose in the required muscles a mild, steady contraction, with tension largely independent of the muscle length and little susceptible to fatigue. Nerve-fibers run from muscle to nerve-center, and by these each change in tension or length of the muscle is reported to the activating nerve-center. They say "tension rising, you must slacken," or conversely. There are also organs the stimulation of which changes with any change of their relation to the line of gravity. Thus, a pair of tiny water-filled bags is set one in each side of the skull and in each is a patch of cells endowed with a special nerve. Attached to hairlets of these cells is a tiny crystalline stone the pressure of which acts as a stimulus through them to the nerve. The nerve of each gravity-bag connects, through chains of nerve-centers, with the muscles of all the limbs and of one side of the neck. In the ordinary erect posture of the head, the stimulation by the two bags right and left is equal, because the two gravity-stones then lie symmetrically. The result, then, is a symmetrical muscular effect on the two sides of the body, namely, the normal erect posture. But the right and left bags are mirror pictures of each other. If the head incline to one side, the resulting slip, microscopic though it be, of the two stones on their nerve-patches makes the stimulation unequal. From that slip there results exactly the right unsymmetrical action of the muscles to give the unsymmetrical pose of limbs and neck required for stability. That is the mechanism dealing with limbs and trunk and neck. An additional one postures the head itself on the neck. A second pair of tiny gravity-bags, in which the stones hang rather than press, are utilized. These, when any cause inclining the head has passed, bring the head back at once to the normal symmetry of the erect posture. These same bags also manage the posturing of the eyes. The eye contributes to our orientation in space; for example, to perception of the vertical. For this the eyeball, that is the retina, has to be postured normally, and the pair of little gravity-bags in the skull, which serve to restore the head posture, act also on the eyeball muscles. Whichever way the head turns, slopes, or is tilted, they adjust the eyeball's posture compensatingly, so that the retina still looks out upon its world from an approximately normal posture, retaining its old verticals and horizontals. As the head twists to the right the eyeball's visual axis untwists from the right. These reactions of head, eyes and body unconsciously take place when a bird wheels or slants in flight or a pilot stalls or banks his areoplane; and all this works itself involuntarily as a pure mechanism.

True, in such a glimpse of mechanism what we see mainly is how the machinery starts and what finally comes out of it; of the intermediate elements of the process we know less. Each insight into mechanism reveals more mechanism still to know. Thus, scarcely was the animal's energy balance in its bearing upon food intake shown comfortably to conform with thermodynamics than came evidence of the so-called "vitamins"—evidence showing an unsuspected influence on nutrition by elements of diet taken in quantities so small as to make their mere calorie value quite negligible; thus, for the growing rat, to quote Professor Harden, a quantity of vitamin A of the order of one five-hundredths milligram a day has potent effect. Again, as regards sex determination, the valued discovery of a visible distinction between the nuclear threads of male and female brings the further complexity that, in such cases, sex extends throughout the whole body to every dividing cell. Again, the asssociation of hereditary unit-factors, such as body color or shape of wing, to visible details in the segmenting nucleus seemed to simplify by epitomizing. But further insight tends to trace the inherited unit character not to the chromosome itself, but to balance of action between the chromosome group. As with the atom in this heroic age of physicists, the elementary unit once assumed simple proves, under further analysis, to be itself complex. Analysis opens a vista of further analysis required. Knowledge of muscle contraction has, from the work of Fletcher and Hopkins on to Hill, Hartree, Meyerhof and others, advanced recently more than in many decades heretofore. The engineer would find it difficult to make a motive machine out of white of egg, some dissolved salts, and thin membrane. Yet this is practically what nature has done in muscle, and obtained a machine of high mechanical efficiency. Perhaps human ingenuity can learn from it. One feature in the device is alternate development and removal of acidity. The cycle of contraction and relaxation is traced to the production of lactic acid from glycogen and its neutralization chiefly by alkaline proteins; and physically to an admirably direct transition from chemical to mechanical effect. What new steps of mechanism all this now opens!

But knowledge, while making for complexity, makes also for simplification. There seems promise of simplification of the mechanism of reflex action. Reflex action with surprising nicety calls into play just the appropriate muscles, and adjusts them in time and in the suitable grading of their strength of pull. The moderating as well as the driving of muscles is involved. Also the muscles have to pass from the behest of one stimulus to that of another, even though the former stimulus still persist. For these gradings, coadjustments, restraints, and shifts, various separate kinds of mechanism were assumed to exist in the nerve-centers, although of the nature of such mechanisms little could be said. Their processes were regarded as peculiar to the nerve-centers and different from anything that the simple fibers of nerve-trunks outside the centers can produce. We owe to Lucas and Adrian the demonstration that, without any nerve-center whatever, an excised nerve-trunk with its muscle attached can be brought to yield, besides conduction of nerve impulses, the grading of them. That is remarkable, because the impulse is not gradable by grading the strength of the stimulus. The energy of the impulse comes not from the stimulus, but from the fiber itself. But Lucas and Adrian have shown, however, that it is gradable in another way. Though the nerve impulse is a very brief affair—it lasts about one thousandths second at any one point of the nerve—it leaves behind it in the nerve-fiber a short phase during which the fiber cannot develop a second impulse. Then follows rapid but gradual recovery of the strength of impulse obtainable from the fiber. That recovery may swing past normal to supernormal before returning finally to the old resting state. Hence, by appropriately timing the arrival of a second impulse after a first, that second impulse may be extinguished, reduced, increased or transmitted without alteration. This property of grading impulses promises a complete key to reflex action if taken along with one other. The nervous system, including its centers, consists of nothing but chains of cells and fibers. In these chains the junctions of the links appear to be points across which a large impulse can pass, though a weak one will fail. At these points the grading of impulses by the interference process just outlined can lead, therefore, to narrowing or widening their further distribution, much as in a railway system the traffic can be blocked or forwarded, condensed or scattered. Thus the distribution and quantity of the muscular effect can be regulated and shifted not only from one muscle to another, but in one and the same muscle it can be graded by adding to or subtracting from the number of fibers activated within that muscle. As pointed out by Professor Alexander Forbes, it may be, therefore, that the nerve impulse is the one and only reaction throughout the whole nervous system, central and peripheral,—trains of impulses colliding and over-running as they travel along the conductive network. In this may lie the secret of the coordination of reflexes. The nerve-center seems nothing more than a meeting-place of nerve-fibers, its properties but those of impulses in combination. Fuller knowledge of the mechanism of the nervous impulse, many of the physical properties of which are now known, a reaction which can be studied in the simplest units of the nervous system, thus leads to a view of nervous function throughout the system much simpler than formerly obtained.

Yet for some aspects of nervous mechanism the nerve impulse offers little or no clue. The fibers of nerve-trunks are, perhaps, of all nerve-structures those that are best known. They constitute, for example, the motor nerves of muscle and the sensory nerves of the skin. They establish their ties with muscle and skin during embryonic life and maintain them practically unaltered throughout the individual's existence, growing no further. If severed, say, by a wound, they die for their whole length between the point of severance and the muscle or skin they go to. Then at once the cut ends of the nerve-fibers start regrowing from the point of severance, although for years they have given no sign of growth. The fiber, so to say, tries to grow out to reach to its old far-distant muscle. There are difficulties in its way. A multitude of non-nervous repair cells growing in the wound spin scar tissue across the new fiber's path. Between these alien cells the new nerve-fiber threads a tortuous way, avoiding and never joining any of them. This obstruction it may take many days to traverse. Then it reaches a region where the sheath-cells of the old dead nerve-fibers lie altered beyond ordinary recognition. But the growing fiber recognizes them. It joints them and, tunneling through endless chains of them, arrives finally, after weeks or months, at the wasted muscle-fibers which seem to have been its goal, for it connects with them at once. It pierces their covering membranes and reforms with their substance junctions of characteristic pattern resembling the original that had died weeks or months before. Then its growth ceases, abruptly, as it began, and the wasted muscle recovers and the lost function is restored.

Can we trace the causes of this beneficent yet so unaccountable reaction? How is it that severance can start the nerve re-growing. How does the nerve-fiber find its lost muscle microscopically miles away? What is that mechanism that drives and guides it? Is it a chemotaxis like that of the antherozooid in the botanical experiment drawn towards the focus of the dissolved malic acid? If so, there must be a marvelously arranged play of intricate sequences of chemically attractive and repellent substances dissolved suitably point to point along the tissue. It has recently been stated that the nerve-fiber growing from a nerve-cell in a nutrient field of graded electrical potential grows strictly by the axis of the gradient. Some argue for the existence of such potential gradients in the growing organism. Certainly nerve regeneration seems a return to the original phase of growth, and pieces of adult tissue removed from the body to artificial nutrient media in the laboratory take on vigorous growth. Professor Champy describes how epithelium that in the body is not growing, when thus removed starts growing. If freed from all fibrous tissue, its cells not only germinate, but, as they do so, lose their adult specialization. In nerve regeneration the nerve-sheath cells, and to some extent the muscle-cells which have lost their nerve-fiber, lose likewise their specialized form, and regain it only after touch with the nerve-cell has been re-established. So similarly epithelium and its connective tissue cultivated outside the body together both grow and both retain their specialization. The evidence seems to show that the mutual touch between the several cells of the body is decisive of much in their individual shaping and destiny. The severance of a nerve-fiber is an instance of the dislocation of such a touch. It recalls well-known experiments on the segmenting egg. Destruction of one of the two halves produced by the first segmentation of the egg results in a whole embryo from the remaining half-egg; but if the two blastomeres, though ligated, be left side by side, each then produces a half-embryo. Each half-egg *can* yield a whole embryo, but is restrained by the presence of the twin cell to yielding but a half embryo. The nerve severance seems to break a mutual connection which restrained cell growth and maintained cell differentiation.

It may be said that the nerve-sheath cells degrade because the absence of transmission of nerve impulses leaves their fiber functionless. But they do not degrade in the central nerve-piece, although impulses no longer pass along the afferent fibers. This mechanism of reconstruction seems strangely detached from any direct performance of function. The sprouting nerve-fibers of a motor nerve with impulses for muscular contraction can by misadventure take their way to denervated skin instead of muscle. They find the skin-cells the nerve-fibers of which have been lost, and on these they bud out twigs, as true sensory fibers would do. Then, seemingly satisfied by so doing, they desist from further growth. The sense-cells, too, after this misunion, regain their normal features. But this joining of motor nerve-fiber with sense-cell is functionless, and must be so because the directions of functional conduction of the two are incompatible. Similarly a regenerating skin-nerve led down to muscle makes its union with muscle instead of skin, though the union is a functional misfit and can not subserve function. Marvelous though nerve regeneration be its mechanism seems blind. Its vehemence is just as great after amputation, when the parts lost can of course never be re-reached. Its blindness is sadly evident in the suffering caused by the useless nerve-sprouts entangled in the scar of a healing or healed limb-stump.

There is a great difference, however, between the growth of such regeneration and the growth impulse in pieces of tissue isolated from the body and grown in media outside. With pure cultures, in the latter case, Professor Champy says the growth recalls in several features that of malignant tumors, for example, multiplication of cells unaccompanied by formation of a specialized adult tissue. A piece of kidney cultivated outside the body de-differentiates, to use his term, into a growing mass unorganized for renal function. But with connective-tissue cells added even breast-cancer epithelium will in cultivation grow in glandular form. New ground is being broken in the experimental control of tissue growth. The report of the Imperial Cancer Research Fund mentions that in cultivation outside the body malignant cells present a diffculty that normal cells do not. To the malignant cells the nutrient soil has to be renewed more frequently, because they seem rapidly to make the soil in which they grow poisonous to themselves, though not to normal cells. The following of all clues of difference between the mechanism of malignant growth and of normal is fraught with importance which may be practical as well as theoretical.

The regenerating nerve rebuilds to a plan that spells for future function, but throughout all its steps prior to the time when it actually reaches the muscle or skin, no actual performance of nerve-function can take place. What is constructed is functionally useless until the whole is complete. So similarly with much of the construction of the embryo in the womb for purposes of a different life after emergence from the womb; of the lung for air-breathing after birth; of the reflex contraction in the fœtal child of the eyelids to protect the eye long before the two eyelids have been separated, let alone ere hurt or even light can reach it; of the butterfly's wing within the chrysalis for future flight. The nervous system in its repair, as in its original growth, shows us a mechanism working through phases of non-functioning preparation in order to forestall and meet a future function. It is a mechanism against the seeming prescience of which is to be set its fallibility and its limitations. The "how" of its working is at present chiefly traceable to us in the steps of its results rather than in comprehension of its intimate reactions; as to its mechanism, perhaps the point of chief import for us here is that those who are closest students of it still regard it as a mechanism. If "to know" be "to know the causes" we must confess to want of knowledge of how its mechanism is contrived.

If we knew the whole "how" of the production of the body from egg to adult, and if we admit that every item of its organic machinery runs on physical and chemical rules as completely as do inorganic systems, will the living animal present no other problematical aspect? The dog, our household friend—do we exhaust its aspects if in assessing its sum-total we omit its mind? A merely reflex pet would give little pleasure even to the fondest of us. True, our acquaintance with other mind than our own can only be by inference. We may even hold that mind as an object of study does not come under the rubric of natural science at all. But this association has its section of psychology, and my theme of to-night was chosen partly at the suggestion of a late member of it, Dr. Rivers, the loss of whom we all deplore. As a biologist he viewed mind as a biological factor. Keeping mind and body apart for certain analytic purposes must not allow us to forget their being set together when we assess as a whole even a single animal life.

Taking as manifestations of mind those ordinarily received as such, mind does not seem to attach to life, however complex, where there is no nervous system, nor even where that system, though present, is little developed. Mind becomes more recognizable the more the nerve-system is developed; hence the difficulty of the twilit emergence of mind from no mind, which is repeated even in the individual life history. In the nervous system there is what is termed localization of function—relegation of different works to the system's different parts. This localization shows mentality, in the usual acception of that term, not distributed broadcast throughout the nervous system, but restricted to certain portions of it; for example, among vertebrates to what is called the fore-brain, and in higher vertebrates to the relatively newer parts of that forebrain. Its chief, perhaps its sole, seat is a comparatively modern nervous structure superposed on the non-mental and more ancient other nervous parts. The so-to-say mental portion of the system is placed so that its commerce with the body and the external world occurs only through the archaic non-mental remainder of the system. Simple nerve impulses, their summations and interferences, seem the one uniform office of the nerve-system in its non-mental aspect. To pass from a nerve impulse to a psychical event, a sense-impression, percept, or emotion is, as it were, to step from one world to another and incommensurable one. We might expect, then, that at the places of transition from its non-mental to its mental regions the brain would exhibit some striking change of structure. But it is not so; in the mental parts of the brain there is nothing but the same old structural elements, set end to end, suggesting the one function of the transmission and collision of nerve impulses. The structural inter-connections are richer, but that is merely a quantitative change.

I do not want, and do not need, to stress our inability at present to deal with mental actions in terms of nervous actions, or *vice versa*. Facing the relation borne in upon us as existent between them, however, may we not gain some further appreciation of it by reminding ourselves even briefly of certain points of contact between the two? Familiar as such points are, I will mention rather than dwell upon them.

One is the so-called expression of the emotions. The mental reaction of an emotion is accompanied by a nervous discharge which is more or less characteristic for each several type of emotion, so that the emotion can be read from its bodily expression. This nervous discharge is involuntary, and can affect organs, such as the heart, which the will can not reach. Then there is the circumstance that the peculiar ways and tricks of the nervous machinery as revealed to us in the study of mere reflex reactions repeat themselves obviously in the working of the machinery to which mental actions are adjunct. The phenomenon of fatigue is common to both, and imposses similar disabilities on both. Nervous exhaustion and mental exhaustion mingle. Then, as offset against this disability, there exists in both the amenability to habit formation, mere repetition within limits rendering a reaction easier and readier. Then, and akin to this, is the oft-remarked trend in both for a reaction to leave behind itself a trace, an engram, a memory, the reflex engram, and the mental memory.

How should inertia and momentum affect non-material reactions? Quick though nervous reactions are, there is always easily observed delay between delivery of stimulus and appearance of the nervous end effect; and there is always the character that a reaction once set in motion does not cease very promptly. Just the same order of lag and overrun, of want of dead-beat character, is met in sense-reactions. The sensation outlives the light which evoked it, and the stronger the reaction the longer the sensation persists. Similarly the reflex after-discharge persists after the stimulus is withdrawn and subsides more slowly the stronger the reaction. The times in both are of the same order. Again, a reflex act which contracts one muscle commonly relaxes another. Even so, with rise of sensation in one part of the visual field commonly occurs lapse of sensation in another. The stoppage is in both by inhibition, that is to say, active. Then again, two lights of opposite color falling simultaneously and correspondingly on the two retinæ will, according to their balance, fuse to an intermediate tint or see-saw back and forth between the one tint and the other. Similarly a muscle impelled by two reflexes, one tending to contract it, the other to relax it, will, according to the balance of the reflexes, respond steadily with an intensity which is a compromise between the two, or see-saw rhythmically from extreme to extreme of the two opposite influences.

Reflex acts commonly predispose to their opposites; thus the visual impression of one color predisposes to that of its opposite. Again, the *position* of the stimulated sensual point acts on the mind—hence the light seen or the pain felt is referred to some locus in the mind's space-system. Similarly the reflex machinery directs, for example, the limb it moves towards the particular spot stimulated. Such spots in the two processes, mental and non-mental, correspond.

Characteristic of the nervous machinery is its arrangement in what Hughlings Jackson called "levels," the higher levels standing to the lower not only as drivers but also as restrainers. Hence in disease underaction of one sort is accompanied by overaction of another. Thus in the arm affected by a cerebral stroke, besides loss of willed—that is higher level—power in the finger muscles, there is in other muscles involuntary overaction owing to escape of lower centers from control by the higher which have been destroyed. Similarly with the sensory effects; of skin sensations some are painful and some not, for example, touch. The seat of the latter is of higher level, cortical; of the former lower, sub-cortical. When cerebral disease breaks the path between the higher and the underlying level a result is impairment of touch sensation but heightening of pain sensation in the affected part. The sensation of touch, as Dr. Head says, restrains that of pain.

Thus features of nervous working resemble over and over again mental activities. Is it mere metaphor, then, when we speak of mental attitudes as well as bodily? Is it mere analogy to liken the warped attitude of the mind in a psychoneurotic sufferer to the warped attitude of the body constrained by an internal potential pain? Again, some mental events seem spontaneous; in the nervous system some impulses seem generated automatically from within.

It may be said of all these similarities of time-relation and the rest between the ways of the nervous system and such simpler ways of mind as I here venture on, that they exist because the operations of the mental part of the nervous system communicate with the exterior only through the non-mental part as gateway, and that there the features of the nerve-machinery are impressed on the mind's working. But that suggestion does not take into account the fact that the higher and more complex the mental process, the longer the time-lag, the more incident the fatigue, the more striking the memory character, and so on.

All this similarity does but render more succinct the old enigma as to the nexus between nerve impulse and mental event. In the proof that the working of the animal mechanism conforms with the first law of thermodynamics is it possible to say that psychical events are evaluated in the balance sheet drawn up? On the other hand, Mr. Barcroft and his fellow-observers in their recent physiological exploration of life on the Andes at 14,200 feet noted that their arithmetic as well as their muscles were at a disadvantage; the low oxygen pressure militated against both. Indeed, we all know that a few minutes without oxygen, or few more with chloroform, and the psychical and the nervous events will lapse together. The nexus between the two sets of events is strict, but for comprehension of its nature we still require, it seems, comprehension of the unsolved mystery of the "how" of life itself. A shadowy bridge between them may lie perhaps in the reflection that for the observer himself the physical phenomena he observes are in the last resort psychical.

The practical man has to accept nervous function as a condition for mental function without concerning himself about ignorance of their connection. We know that with structural derangement or destruction of certain parts of the brain goes mental derangement or defect, while derangement or destruction of other parts of the nervous system is not so accompanied. Decade by decade the connection between certain mental performances and certain cerebral regions becomes more definite. Certain impairments of ideation as shown by forms of incomprehension of language or of familiar objects can help to diagnose for the surgeon that part of the brain which is being compressed by a tumor, and the tumor gone the mental disabilities pass. Similarly those who, like Professor Elliot Smith and Sir Arthur Keith, recast the shape of the cerebrum from the cranial remains of prehistoric man, can outline for us something of his mentality from examination of the relative development of the several brain regions, using a true and scientific phrenology.

Could we look quite naïvely at the question of a seat for the mind within the body we might perhaps suppose it diffused there, not localized in any one particular part at all. That it is localized and that its localization is in the nervous system—can we attach meaning to that fact? The nervous system is that bodily system the special office of which, from its earliest appearance onward throughout evolutionary history, has been more and more to weld together the body's component parts into one consolidated mechanism reacting as a unity to the changeful world about it. More than any other system it has constructed out of a collection of organs an individual of unified act and experience. It represents the acme of accomplishment of the integration of the animal organism. That it is in this system that mind, as we know it, has had its beginning, and with the progressive development of the system has developed step for step, is surely significant. So it is that the portion in this system to which mind transcendently attaches is exactly that where are carried to their highest pitch the nerve-actions which manage the individual as a whole, especially in his reactions to the external world. There, in the brain, the integrating nervous centers are themselves further compounded, inter-connected, and re-combined for unitary functions. The cortex of the forebrain is the main seat of mind. That cortex with its twin halves corresponding to the two side-halves of the body is really a single organ knitting those halves together by a still further knitting together of the nervous system itself. The animal's great integrating system is there still further integrated and this supreme integrator is the seat of all that is most clearly inferable as the animal's mind. As such it has spelt biological success to its possessors. From small beginnings it has become steadily a larger and larger feature of the nervous system, until in adult man the whole remaining portion of the system is relatively dwarfed by it. It is not without significance, perhaps, that in man this organ, the brain cortex, bifid as it is, shows unmistakable asymmetry. Man is a tool-using animal, and tools demand asymmetrical, though attentive and therefore unified, acts. A nervous focus unifying such motor function will, in regard to a laterally bipartite organ, tend more to one half or the other and in man's cerebrum the preponderance of one half, namely, the left, over the other may be a sign of unifying function.

It is to the psychologist that we must turn to learn in full the contribution made to the integration of the animal individual by mind. But each of us can recognize, without being a professed psychologist, one achievement in that direction which mental endowment has produced. Made up of myriads of microscopic cell-lives, individually born, feeding and breathing individually within the body, each one of us nevertheless appears to himself a single entity, a unity experiencing and acting as one individual. In a way the more far-reaching and many-sided the reactions of which a mind is capable the more need, as well as the more scope, for their consolidation to one. True, each one of us is in some sense not one self, but a multiple system of selves. Yet how closely those selves are united and integrated to one personality. Even in those extremes of so-called double personality one of their mystifying features is that the individual seems to himself at any one time wholly either this personality or that, never the two commingled. The view that regards hysteria as a mental dissociation illustrates the integrative trend of the total healthy mind. Circumstances can stress in the individual some, perhaps lower, instinctive tendency that conflicts with what may be termed his normal personality. This latter, to master the conflicting trend, can judge it in relation to his main self's general ethical ideals and duties to self and the community. Thus intellectualizing it, he can destroy it or consciously subordinate it to some aim in harmony with the rest of his personality. By so doing there is gain in power of will and in personal coherence of the individual. But if the morbid situation be too strong or the mental self too weak, instead of thus assimilating the contentious element the mind may shun and, so to say, endeavor to ignore it. That way lies danger. The discordant factor escaped from the sway of the conscious mind produces stress and strain of the conscious self; hence, to use customary terminology, dissociation of the self sets in, bringing in its train those disabilities, mental or nervous or both, which characterize the sufferer from hysteria. The normal action of the mind is to make up from its components one unified personality. When we remember the manifold complexity of composition of the human individual, can we observe a greater example of solidarity of working of an organism than that presented by the human individual, intent and concentrated, as the phrase goes, upon some higher act of strenuous will? Physiologically the supreme development of the brain, psychologically the mental powers attaching thereto, seem to represent from the biological standpoint the very culmination of the integration of the animal organism.

The mental attributes of the nervous system would be, then, the coping-stone of the construction of the individual. Surveyed in their broad biological aspect, we see them carrying integration even further still. They do not stop at the individual; they proceed beyond the individual; they integrate, from individuals, communities. When we review, so far as we can judge it, the distribution of mind within the range of animal forms, we meet two peaks of its development—one in insect life, the other in the vertebrate, with its acme finally in man. True, in the insect the type of mind is not rational but instinctive, whereas at the height of its vertebrate development reason is there as well as instinct. Yet in both one outcome seems to be the welding of individuals into societies on a scale of organization otherwise unattained. The greatest social animal is man and the powers that make him so are mental; language, tradition, instinct for the preservation of the community, as well as for the preservation of the individual, reason actuated by emotion and sentiment, and controlling and welding egoistic and altruistic instincts into one broadly harmonious, instinctive-rational behavior. Just as the organization of the cell-colony into an animal individual receives its highest contribution from the nervous system, so the further combining of animal individuals into a multi-individual organism, a social community, merging the interests of the individual in the interests of the group, is due to the nervous system's crowning attributes, the mental. That this integration is still in process, still developing, is obvious from the whole course of human pre-history and history. The biological study of it is essentially psychological; it is the scope and ambit of social psychology. Not the least interesting and important form of social psychology is that relatively new one, dealing with the stresses and demands that organized industry makes upon the individual as a unit in the community of our day and with the readjustments it asks from that community.

To resume, then, we may, I think, conclude that in some of its aspects animal life presents to us mechanism the "how" of which, despite many gaps in our knowledge, is fairly explicable. Of not a few of the processes of the living body, such as muscular contraction, the circulation of the blood, the respiratory intake and output by the lungs, the nervous impulse and its journeyings, we may fairly feel, from what we know of them already, that further application of physics and chemistry will furnish a competent key. We may suppose that in the same sense as we can claim to-day that the principles of a gas-engine or an electromotor are comprehensible, so will the bodily working in such mechanisms be understood by us, and indeed are largely so already. It may well be possible to understand the principle of a mechanism which we have not the means or skill ourselves to construct; for example, we cannot construct the atoms of a gas-engine.

Turning to other aspects of animal mechanism, such as the shaping of the animal body, the conspiring of its structural units to compass later functional ends, the predetermination of specific growth from egg to adult, the predetermined natural term of existence, these and their intimate mechanism, we are, it seems to me, despite many brilliant inquiries and inquirers, still at a loss to understand. The steps of the results are known, but the springs of action still lie hidden. Then again, the "how" of the mind's connexion with its bodily place seems still utterly enigma. Similarity or identity in time-relations and in certain other ways between mental and nervous processes does not enlighten us as to the actual nature of the connexion existing between the two. Advance in biological science does but serve to stress further the strictness of the nexus between them.

Great differences of difficulty therefore confront our understanding of various aspects of animal life. Yet the living creature is fundamentally a unity. In trying to make the "how" of an animal existence intelligible to our imperfect knowledge we have, for purposes of study, to separate its whole into part-aspects and part-mechanisms, but that separation is artificial. It is as a whole, a single entity, that the animal, or for that matter the plant, has finally and essentially to be envisaged. We cannot really understand one part without the other. Can we suppose a unified entity which is part mechanism and part not? One privilege open to the human intellect is to attempt to comprehend, not leaving out of account any of its properties, the "how" of the living creature as a whole. The problem is ambitious, but its importance and its reward are all the greater if we seize and attempt the full width of its scope. In the biological synthesis of the individual it is concerned with mind. It includes examination of man himself as acting under a biological trend and process which is combining individuals into a multi-individual organization, a social organism surely new in the history of the world. This biological trend and process is constructing a social organism the cohesion of which depends mainly on a property developed so specifically in man as to be, broadly speaking, his alone, namely, a mind actuated by instincts but instrumented with reason. Man, often Nature's rebel, as Sir Ray Lankester has luminously said, can, viewing this great supra-individual process, shape his courses conformably with it even as an individual, feeling that in this case to rebel would be to sink lower rather than to continue his own evolution upward.

C. S. Sherrington

CAN WASTE OF MENTAL EFFORT BE AVOIDED

One of the most startling phenomena in the history of science and invention is the lack of economy of mental effort. As a rule the great discoveries in science have not been made once, but have been repeated several times. It is as though engineers had built several Panama canals when only one was needed, thereby producing financial waste. At the recent death of Alexander Graham Bell the daily press reminds us that he invented the telephone. But he was not the only one who accomplished this. On the very day that Bell patented his telephone, Elisha Gray applied for a patent for an instrument of similar kind. At an earlier date Phillip Reis sent a speaking machine to the emperor of Russia. The same is true in the invention of the telegraph. No historian of science can give Samuel Morse exclusive credit. Before him, Joseph Henry at Albany, by the attraction of an electromagnet, produced audible signals at a distance. Gauss and Weber sent messages by an electromagnetic device over wires connecting the Observatory and Physical Cabinet at Göttingen. The mental effort of inventing the telegraph and telephone was made, not once, but several times.

These are only two of the numerous illustrations which might be given of duplication in applied science. In pure science the situation is even worse. Waste of effort through repetition occurred in the discovery of the laws of gases, Ohm's law in electricity, the principle of the conservation of energy, logarithms, determinants, J. W. Gibb's equilibrium of chemical systems and Mendel's law. The full accounts of reproduction of scientific discovery and invention would fill a large book. The waste of gray matter has resembled the prodigality of the pine-tree which produces millions of pollen particles for every new plant that is actually started.

It may be argued that the waste occurs only in the records of centuries which are passed, that the number of scientific journals has now increased so greatly that scientific results can be published promptly. As a matter of fact, the greater number of journals has not brought effective relief. The danger of unnecessary repetition is still with us. Not only is the army of scientific workers tremendously augmented, so that even now the editorial desks are overloaded with able manuscripts and publication is not so prompt as some suppose, but the long list of scientific journals has greatly augmented the labor on the part of any one worker to ascertain what new results have been reached in his particular field of activity. Paradoxical as it may seem, the publications themselves, by their great mass, clog the worker's efforts to find what he desires.

It is still true that investigators are frequently unacquainted with results already reached by others. And so it frequently happens that the best brains are exercised to the utmost in discovering things already discovered by others. Creative genius is rare. There are in a generation few cubic decimeters of brains in a nation, capable of materially advancing science, and yet history shows that in the past a large part of these precious cubic decimeters of gray matter has been expended upon needless repetition.

Is it not possible to improve on the present wasteful methods of conducting research? There is indeed need of persistence in the endeavor that

> No subtle, bright and novel thought
> In this wide world shall come to naught;
> No germ of purest ray serene
> Shall scintillate by us unseen.

Can the pathfinders of the intellect conduct their inquiries as if organized in a team for a relay race, each individual carrying the torch of light from the point reached by his predecessor? Such a procedure would prevent repetition. But unfortunately the problem before us is too complex to admit of such simple solution. The impracticability of the relay plan is evident from the consideration that when A has announced some startling novelty, not only B, but also C, D and E may take up the further pursuit of the subject. And it is indeed well that it should be so, for not every B, C, D and E may be fortunate to travel in the right direction and reach desired results. The probability of further penetration into the unknown is increased when several able minds are at work simultaneously, rather than one alone. Moreover, several workers may expect to obtain a greater volume of new knowledge. Under these circumstances some duplication is quite certain and can not be avoided. But when a goal has been reached by one or more men, there should be an effective system of distribution of this knowledge that will stop all unnecessary intellectual endeavor.

In the prevention of waste the capitalist can play a leading rôle. A serious difficulty encountered in the United States at the present time is the lack of funds for prompt publication. In mathematics, for example, no new books in advanced fields have been issued in this country in recent years. Several manuscripts are awaiting publication. Moreover, the American periodicals devoted to research articles are financially unable to print articles except after long delay. Terminal stations for the distribution of scientific products are greatly congested. Moreover, there is a crying need for efficient and prompt bibliography and abstracts of scientific output. It is here that the sympathetic capitalist can contribute to the advancement of science almost as much as he could, were he himself one of the foremost research workers. He can contribute to a very essential phase of scientific progress, namely, the prompt distribution of new knowledge and the prevention of avoidable waste of effort. Essential agencies in the dissemination of knowledge are abstracts and bibliographies. Except in chemistry and medicine, the United States has been derelict in the discharge of its share of obligation in this regard. The Great War has disarranged what was being accomplished in Europe and the present international situation is much worse than that of eight years ago.

The need of the hour is not only adequate funds for printing, but also new, more instantaneous and effective methods of distribution. Some advance is desired which will accomplish for the twentieth century what the invention of printing achieved for the fifteenth century and photography for the nineteenth century. Scientific discovery should take up as one of its problems its own more efficient progress. Science should bend its efforts to devise new plans to accelerate its own rate of advancement. Is it not possible for progress to be made on the compound interest or the snowball mode of accretion? The printing press will not be superseded, but it should be supplemented by new agencies. The possibilities of the radiophone seem almost unlimited. It can be made to do what it is not yet doing. When John Smith has a new result, it lies theoretically within his power to transmit it instantaneously to his co-workers all over the world. And if such were done, the largest part of the waste of mental effort could be avoided. At present this method lends itself more readily to some fields of science than to others. As yet, it is difficult to see how the "radio" could be effectively used in diffusing advanced mathematics that is expressed, perhaps, in the notation of differential equations or in the Peano symbolism. "Radio" appeals, not to the eye, but to the ear. Moreover, it transmits a message that is not permanent, but vanishes as quick as wink. But, probably even in abstruse mathematics, modes of quick and permanent communication by wireless telegraphy will be found to lie within the range of practicability.

The instantaneous distribution of intelligence in the form of a permanent record will remove all avoidable waste of scientific effort.

Florian Cajori

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AN INSTITUTE FOR ACOUSTIC RESEARCH

THERE is much to be said against too elaborate an organization of scientific research. We carry our highly prized individualized democracy into our experimental endeavors and shun therein all actual or even apparent control "from above." And this attitude if not carried to an extreme is as it should be. We train our young graduate students, for example, to observe the dependence of their problems on past performances of others while at the same time we encourage them to obtain an orientation in the general history of science. It would not do much harm to go further in the latter direction than we do. But above all we unmistakably teach them also the power of self-reliance and attempt to inculcate in them the sense of aggressive initiative in connection with their problems of investigation. The young possessor of the doctorate is distinctly respectful of historical accomplishment and in that light he envisages the present. But from that point on he dares independently to face what lies before.

That assertiveness, displayed in the mature adventurer after truth as well as in the youthful pioneer, does not gainsay the need of cooperation. The problem in science is the same as that in political government: the individual needs the state, the state needs the union of states, and the union of states needs the world confederacy. So the individual investigator needs the stimulus of his colleagues. This extensive sort of organization we have already abundantly recognized in science in the combination of our specific scientific associations into state academies, sectional conferences, national bodies, and international councils.[1]

The present scope of scientific inquiry is developing to such an extent, however, that this type of extensive cooperation and organization is not the only desirable one, for we have already begun to establish what I should like to call an *intensive* form of scientific organization. To draw a comparison this time with industries in the commercial world, it appears that not only are there associations of insurance companies, of automobile manufacturers, of dry goods merchants, and the like, but between these establishments there are associations that group together only certain interests, *e. g.*, the employment managers, the credit men, the buyers, the salemen, *etc.* So as our scientific knowledge increases and our scientists of various persuasions are beginning to explore contiguous territory, we are finding it necessary to obtain an outlet for our common interests. Physicists, chemists, astronomers and mathematicians may to-day be at work on a kindred group of subjects, but from widely different angles of approach. An intensive cooperation among such workers affords often mutual respect, appreciative understanding of the several points of view, real fellowship, and above all more authentic results. It is noteworthy in this connection that many hospitals are inviting groups of scientists to cooperate in a similar way on specific problems presented in such institutions.

There is one field which to the writer's knowledge has already made pronounced progress in intensive cooperation. This is the field of optics and visual phenomena. The photographic and illuminating industries and professions have for some time enlisted the aid of men from several allied sciences. In one of the largest plants for the manufacture of electric incandescent lamps a physicist, a physiologist, and a psychologist have cooperatively undertaken and completed significant problems. While these problems are rarely conjointly solved, there is ample opportunity for mutual consultation. Illuminating engineers are consulting some of the best trained men psychology has to offer; some are entered as regular members of the staff. One of the largest manufacturing concerns of photographic appliances and supplies employs a group of men representing several sciences including psychology.[2]

[1] Dr. W. R. Whitney, director of the Research Laboratory of the General Electric Company, has ably brought out the international character of research in a brief article entitled, "Science—A World Partnership," published in the *Scientific American*, 127, 1922, 100 (August).

[2] Other instances of cooperative research that

Public attention is just now attracted, moreover, to the field of another sense-department, one which, indeed, has usually followed vision both in historical discussions and genetically in the race, *viz.*, hearing. We have lately witnessed an immense development in the photographic and cinematographic industries; now comes the prospect of an even wider application of wireless telephony. With its problems added to the problems that are already facing us in acoustics, it would be wise, it appears to the writer, to provide a sort of clearing-house for work done in acoustics by the various sciences. There are constantly occurring phases of problems and partial problems that need to be referred to the authority of those whose training and equipment guarantees satisfactory envisagement and promises sound conclusion. Not only would the various sciences have something to contribute to an acoustic symposium, but with closer cooperation, a pace could be set, an impetus given, toward more intensive investigation. With this we do not want the type of overhead organization that will throttle endeavor and spontaneous effort, but we need the kind that will inspire research and provide intelligent aid.

Already there are a considerable number of institutions where work of a highly valuable nature is being done in the auditory field. Some of this is cooperative. The acoustical laboratory at the Case School of Applied Science has become an outstanding post of research under the direction of Professor D. C. Miller. At the State University of Iowa Dean C. E. Seashore has for many years done noteworthy work in supervising research in several branches of the auditory field and has recently enjoyed the cooperation of Professor G. W. Stewart in some of these undertakings. At Harvard the late Professor W. C. Sabine contributed largely to an understanding of the auditory properties of architectural interiors, a problem which Professor F. R. Watson, of the University of Illinois, has also largely and ably devoted his attention. The psychological laboratories of Clark, Cornell, Illinois, Missouri, Ohio State have added considerably to our store of knowledge on the subject, while Professor G. E. Shambaugh, of the University of Chicago, stands among those who have done original work in connection with the physiological theory of audition. The private laboratory of Colonel Fabyan at Geneva, Ill., has busied itself to a large extent with auditory phenomena, and a number of industrial enterprises, like the phonographic laboratories, have carried on investigations allied to their work. This brief résumé is doubtless inadequate but serves to show many of the separately organized establishments in acoustic research.

Some of the problems that would lend themselves advantageously to cooperative investigation are summarized below:

(1) *Sound localization.* Further investigation of intensive and qualitative factors in the binaural ratio as applied to the detection of the direction of the source of tones and noises throughout the ranges of intensity and quality; experimental study of sound localization through all three types of media, gaseous, liquid and solid; phantom sounds; polarized sound.

(2) *Qualitative and quantitative thresholds of sound.* Careful scrutiny of the liminal values for both tones and noise; standardization of intensive units of sound; re-investigation of the upper and lower pitch limits of tone with carefully calibrated instruments.

(3) *The attributes of tone and noise.* Systematic review of the tonal manifold with an empirical attempt at classification of the variable characteristics; distinction between noise and tone; question of vowel tones.

(4) *Consonance and dissonance.* Working out the higher difference and summation tones; further analysis of harmony; question of beat-notes.

occur to the writer are: (1) the Mellon Institute of the University of Pittsburgh; (2) the Research Bureau for Retail Training and the Bureau of Personnel Research, both at the Carnegie Institute of Technology at Pittsburgh; (3) the American Institute of Baking of Chicago, and (4) the newly organized Department of Engineering Research at the University of Michigan. Some of these undertakings are entirely, some only in part, financed by commercial corporations which are interested in the problems investigated. In addition mention should be made of a considerable number of industrial fellowships of various descriptions that are maintained by industrial concerns at our larger universities.

(5) *Membranous sound production and transmission.* Improvement in the fidelity of sound production through telephonic and phonographic reproducers; reduction of inherent membraneous tones and noises; problem of sibilants and aspirates.

(6) *The acoustic qualities of confined areas.* Question of preventing leakage of sound through ventilating systems and wall-supports; reflecting and absorbing qualities of various building materials to be used from time to time; acoustic properties of halls, rooms, etc.; "sound-proof" rooms.

(7) *Auditory theory.* Further investigation of the human auditory mechanism and its pathology; intracranial conduction of sound; tonal gaps and "islands."

Specifically, then, it is the opinion of the writer that there exists in this field a threefold need:

I. There should be a closer affiliation of workers in acoustics. An association of those interested might be assembled under some such title as the American Acoustical Society.

II. A journal with this society as sponsor would become an outlet for the publication of papers on the general topics of acoustics.

III. If in the course of events progress is recorded, an endowment fund should be raised with perhaps industrial assistance for the purpose of erecting a central laboratory or institute where apparatus would become available for precise and intensive work. It would save the expense of multiplying elaborate research pieces in our various laboratories where they frequently lie idle for long periods of time. It might serve further for the exchange and loan of apparatus under a system of adequate guarantee against mishandling and breakage.

A number of our leading men working together at such an institute would not only lend zest to their own endeavors, but would offer a place for the training of younger men in the field. The institute would, moreover, provide for the industries that are concerned in the manufacture of acoustical apparatus a fund of information for their guidance and an attentive and trained "ear" for problems that arise in their practical work.

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PROPOSED FEDERATION OF AMERICAN BIOLOGICAL SOCIETIES

A conference was held in Washington in April, 1922, at which a number of biological organizations were represented, to discuss plans for a federation of American biological societies. This meeting was held in pursuance of instructions given by the several societies at their annual meetings at Toronto and elsewhere in 1921. The Washington conference, after some debate, affirmed its belief in the desirability and feasibility of a federation of biological societies, and adopted a general plan in accordance with which such a federation might be established. An outline of this plan has already been published in this journal[1]. A committee was raised to work out the details of the plan and to prepare a constitution embodying these details.

This committee, which consisted of F. R. Lillie, C. W. Greene, I. F. Lewis, C. E. McClung, A. Franklin Shull, R. W. Thatcher, H. B. Ward, and B. E. Livingston representing the American Association, met in Woods Hole, Massachusetts, August 4 and 5, 1922. Professor Herbert Osborn substituted for Professor Livingston at this meeting.

For its own guidance, after some deliberation, the committee adopted certain fundamental principles upon which, in its opinion, any federation should be based. These principles are stated in the following resolution which was adopted by the committee.

Resolved, That it is the judgment of the society representatives considering the formation of a federation of biological societies that certain principles should be observed in setting up relations with existing organizations. These principles are:

1. The federation should, for its benefit, utilize other organizations in accordance with their nature and purposes.

2. The federation should, on the other hand, so direct its policies and methods as to strengthen the efforts of organizations with which it is affiliated.

3. The federation should avoid unnecessary duplication of effort and expenditure.

[1] Science, Vol. LVI, p. 184.

The concrete application of these principles in the development of a constitution was one of the principal tasks of the committee. How to use such organizations as the National Research Council and the American Association most effectively and in turn how to be of the greatest service to those organizations in the furtherance of the interests of biological science were problems that elicited much discussion. The committee believes that a satisfactory solution of these problems is contained in the constitution given below. This instrument will be submitted to the various societies for ratification or rejection at their annual meetings late in 1922, and it is important that all members of the biological societies which have been concerned in formulating plans of federation should become familiar with its provisions. The proposed constitution of the federation is as follows:

Proposed Constitution
for a
Federation of American Biological Societies

Article I. Preamble

In view of the existence of many biological societies in America, each preoccupied with its own special affairs and problems, in view of the assured interest of all these societies in the broader and more general aspects of the promotion of biological science, and especially in view of the need for improved means of contact and mutual aid between the pure and the applied branches of biological science, this Federation is established to facilitate constructive and mutually advantageous cooperation among the several special biological societies and to promote the major interests of biology.

Article II. Name

The name of this organization shall be the Federation of American Biological Societies.

Article III. Objects

The objects of the Federation shall be to stimulate investigation in the field of biology, to organize and promote the interests of bibliography and publication, to deal with questions of general interest in the field of biology, and in general to promote the solution of those broad problems which the specialized societies are not in a position to support effectively, and to do anything else which may serve these ends.

Article IV. Membership

Section 1. The membership of the Federation shall be by societies and not by individuals.

Section 2. The original members of the Federation shall be all those organizations that were concerned in the Preliminary Conference on Federation held in Washington, D. C., April 23, 1922, provided that each member society shall officially accept membership in the Federation.

Section 3. Any other organization working in the field of biology may become a member of the Federation upon invitation by the Council of the Federation and acceptance of membership.

Section 4. Any Society may terminate its membership in the Federation by official notification to the Council and completion of its obligations to the Federation.

Article V. Delimitation of Authority

The constituent societies of this Federation retain their complete autonomy.

Article VI. Council

Section 1. The management of the Federation shall be vested in a body to be known as the Council of the Federation of American Biological Societies. Each original member society shall be entitled to be represented in the Council by two representatives that the society may officially designate.

Section 2. The Council shall establish its own organization and enact its own rules and by-laws.

Section 3. The Council shall establish regulations governing the admission of additional organizations to membership in the Federation and shall determine their representation in the Council.

Section 4. The Council shall receive and decide questions referred to it by member societies; it may also independently promote the objects of the Federation.

Section 5. The Council shall act in close cooperation with existing agencies, such as the American Association for the Advancement of Science and the National Research Council.

Section 6. The Council shall appoint an Executive Committee, which shall have such duties and powers as the Council may prescribe.

Section 7. The Council shall appoint a Committee on Bibliography and Publication, with such duties and powers as the Council may prescribe. This committee shall act in cooperation with similar committees that may be appointed by the National Research Council and the American Association for the Advancement of Science.

Section 8. The Council shall arrange places and times for its own meetings. The Council shall assist the American Association for the Advancement of Science in making arrangements for meetings of any member society or group of member societies, when officially requested by the member societies to do so.

Article VII. Finances

The financial affairs of the Federation shall be controlled by the Council, which may receive and administer funds for the promotion of the purposes of the Federation. The current expenses of the Council shall be met by contributions, and by assessments on member societies. The Council may recommend but not impose such assessments.

Article VIII. Reports

The Council may make an annual report to each of the member societies, setting forth the nature and extent of what has been accomplished by the Federation during the past year, and also pointing out, as far as possible, the general lines along which the activities of the Federation are to be directed during the coming year. The annual report of the Council shall include a financial statement.

Article IX. Amendments

Section I. Amendments to the Constitution shall require the approval of a majority of the Council and of two-thirds of the member societies.

Section 2. Amendments may originate in member societies or in the Council.

Section 3. Notice of proposed amendments must be presented to the Secretary of the Council and mailed to all members at least one month before the meeting at which they are to be considered by the Council. Notice of approval of any amendment by the Council shall be submitted to the Secretaries of the Societies for action. On receipt of notice of the approval of any amendment by two-thirds of the member societies, the Secretary of the Council shall give notice of its adoption in writing to all member societies.

A. FRANKLIN SHULL,
Secretary of the Executive
Committee *pro. tem.*

SCIENTIFIC EVENTS

BUST OF CHESTER S. LYMAN[1]

MR. CHESTER W. LYMAN, of the class of 1882, Yale College, has presented to the trustees of the Scientific School a portrait bust in marble of his father, the late Professor Chester S. Lyman. This piece of sculpture, made by Mr. James T. Porter, of New York, is a beautiful work of art and the artist has not only succeeded in depicting in the marble a likeness which is striking but has caught the essence of the subject's personality. The bust will stand in the faculty room, where it will perpetuate within the walls of the school not only the features but the spirit as well of one whose life was largely devoted to its welfare during the early years of its struggle for existence.

Chester S. Lyman was one of the early professors in the Sheffield Scientific School, having been appointed as professor of industrial mechanics and physics in 1859. In 1884 his chair was limited to astronomy, physics being made a distinct chair, and Dr. Charles S. Hastings was appointed at that date to fill this position. Professor Lyman was retired as professor emeritus in 1889 and died in 1890.

Dr. Hastings, now professor of physics emeritus, has kindly written the following appreciation of the late Professor Lyman's work:

The admirable portrait bust of the late Professor Chester S. Lyman, presented to the Sheffield Scientific School, gives the welcome opportunity to an old and grateful pupil to record some memories of his enviable place as a teacher.

A most interesting sketch of his remarkably intellectual, and even adventurous, life was printed in *The Popular Science Monthly* of September, 1887, by his son, Chester W. Lyman. The present note may, therefore, best confine itself to somewhat personal reminiscences.

In 1867 an acquaintance began which was of inestimable value to the present writer and which continued until the end of Professor Lyman's life. The kindness with which the freshman was received, the generous manner in which his letters of introduction were accepted, served to establish a friendship which is rarely equaled between teacher and scholar. The teaching was by no means confined to the classroom, but extended even to an unrestricted use of his private observatory and convenient little machine shop.

At that time the equipment of the department of physics was very meager. Notwithstanding this fact, such was the ingenuity of Professor Lyman in making necessary apparatus, his clearness of exposition, his profoundly philosophical feeling for the essentials of science, that there was certainly no better school for the earnest student of physics in the country. It was during this period, or a little earlier, that he invented and constructed his water-wave apparatus, which still seems to me the most perfect and remarkable

[1] From the *Yale Alumni Weekly*.

apparatus ever designed for the explanation of a highly complex phenomenon.

In 1869 Professor Lyman, accompanied by his colleague, the eminent astronomer, Professor Newton, went to Europe to purchase physical and mechanical apparatus from a fund given for that purpose by Peter Collier, of the class of 1861, Yale College. Aside from the requisite and familiar instruments of the physical cabinet not already at command, a remarkably full collection of acoustic apparatus was included. The recent discoveries of Helmholtz in the field of sound sensations had enormously enhanced the interest of physicists in that of acoustics, and Professor Lyman utilized this portion of the equipment not only in the classroom but also in a number of public lectures. It was in these lectures that he first made public his ingenious apparatus for compounding pendulum motions at right angles to each other. The enthusiasm with which his audiences received his clear expositions and admirably chosen illustrative experiments left an enduring impression on the memory of his assistant.

A mind so richly stored with the experiences of a singularly varied life could not be otherwise than stimulating in the highest degree to his more thoughtful students, but more than any other teacher known to the writer he awakened a personal affection among all of them which was as freely expressed as it was unusual.

EFFECTS OF FOREST FIRES ON FOOD AND GAME FISHES

The *Fisheries Service Bulletin* calls attention to the fact that everyone is more or less familiar with the loss of valuable timber sustained each year from forest fires, but there are other serious losses of valuable natural resources from this cause that have received but comparatively little attention. We refer to the wild life of the woods and streams, and particularly to the game and food fishes. Based on a monetary valuation the loss of wild life from forest fires may appear insignificant compared with the loss of timber, but when we consider that the U. S. Forest Service estimates that some 6,000,000 people annually visit our natural forests, many or most of them interested in the fish and game, we become aware to some extent of the importance of the wild life of our forests. Any game and fish commission or conservation commission will be able to vouch for the real value of good fishing to a community.

In line with the growing tendency to place a large portion of the responsibility of conserving our natural resources on those who reap the greatest benefits therefrom, it seems proper to invite the attention of those persons who find pleasure and healthful recreation in fishing in the waters of our forests to the destructive effects of forest fires on the fish. There is a deplorable lack of reliable information and very few recorded observations on the subject. A few of the most immediate effects detrimental to fish life that may be expected to follow forest fires are a sudden rise in the temperature of the water, a lowering of its oxygen content, a change in its chemical properties, and destruction of shade. The slightly acid condition natural to most forest streams, and recognized as suitable for trout, is changed to alkaline from the ash deposited therein. A large amount of ash in the water may be expected to have a deleterious mechanical effect on the fish aside from the chemical changes.

These are but a few of the more obvious and immediate results of fires, and they take no cognizance of the most far-reaching though not immediately apparent effects that probably occur—the destruction of food, increased turbidity, decreased protection against floods and drought, etc. Reliable information on the subject is meager, though an appreciation of the loss of fish from this cause and a record of intelligent observations thereon are of importance. It will be appreciated if persons having knowledge of such occurrences will communicate it to the Bureau of Fisheries.

CONFERENCE ON WORLD METRIC STANDARDIZATION

No less than twenty-seven national scientific societies were represented in the Conference on World Metric Standardization which was held at the Carnegie Institute of Technology on September 6, simultaneously with the Pittsburgh meeting of the American Chemical Society. Dr. E. C. Bingham, of Lafayette College, presided, and opened the discussion.

The conference was called because it was deemed advisable to take cognizance of the organized opposition to the spread of the metric system which has developed in certain quarters.[1] The delegates, however, devoted very little time to consideration of the relative merits of the metric system and the English system, since the superiority of metric measurements seemed to be conceded by every one present. Discussion turned rather on questions of the best methods of furthering general adoption of the metric system. Representatives spoke on behalf of such diverse fields as architecture, astronomy, chemistry, civil engineering, education, electricity, medicine, optometry, pharmacy, physiology, public health, and other branches of pure and applied science.

Physicists, chemists and pharmacists, on the one hand, reported that the metric system is already in general use and the battle won as far as their portions of the field are concerned. Representatives of the medical societies, on the other hand, reported a surprising inertia on the part of physicians to make use of gram and milligram units instead of apothecaries' weight in writing prescriptions, although only metric units are used in recent editions of the pharmacopœia. Better instruction and drill in the actual use of metric units was demanded of all schools, and in particular of the medical schools.

The civil engineers and the architects stand apparently in a passive attitude, content to continue in the use of the English system until a demand on the part of the public indicates a greatly reduced inertia with reference to the abandonment of inches, feet and miles.

As far as the writer knows, this is the first conference at which the relative merits of *gradual* adoption of the metric system *vs.* compulsory universal adoption have been debated by a group of scientific men who have then gone definitely on record as favoring the policy of gradual adoption. The opposition has proceeded upon the assumption that the change to the metric system must be completed suddenly, or else it can not be made at all. As a result they conclude that the change must be made at an appalling cost to industry. The conference went on record unanimously as of the opinion that the gradual introduction of the metric system is practicable. The question of how legislation may be used to assist in bringing about the gradual change was not taken up at this conference.

[1] See this journal, June 23, 1922, "Are Scientists Encouraging Popular Ignorance?"

Dr. W. A. Noyes read a paper by Dr. T. C. Mendenhall representing the National Academy of Sciences. In it Dr. Mendenhall combated with historical facts many of the fallacious arguments which have recently been advanced against the spread of the metric system. The paper will appear in full in SCIENCE.

Formal action was taken by the conference on four points, as follows:

1. *Voted,* that it is the sense of this meeting that we favor the gradual adoption of the metric system wherever practicable.

2. *Voted,* that this body take up with the United States Bureau of Education and other agencies, a plan for the better teaching of the metric system in the schools.

3. *Voted,* that the United States secretary of commerce be asked to secure information as to the extent to which the metric system is actually used at present in those countries which have made its use compulsory by law; and also in those countries where its use is not obligatory.

4. *Voted,* that the system of double-marking all goods be encouraged. (This vote was adopted by only a small majority.)

W. V. BINGHAM,
Secretary of the Conference
CARNEGIE INSTITUTE OF TECHNOLOGY

ACTIVITIES OF THE ROCKEFELLER FOUNDATION

THE *Journal* of the American Medical Association reports that the minister of education has accepted on behalf of the Japanese Government an invitation from George E. Vincent, president of the Rockefeller Foundation, New York, to name and send a commission of Japanese medical scientists to visit the medical institutions of the United States and Canada, as guests of the Rockefeller Foundation. This idea originated from the success that attended the visits to America of similar commissions from Great Britain, Brazil and Belgium. The commission will consist of four or five men, well known as representatives of the important branches of medical science and of the principal medical universities and institutes of the country. The spring of 1923 has been selected as the most suitable time for this visit, which will last about three months.

According to the agreement between the Rockefeller Foundation and the government of Honduras, a hookworm disease section and a public health department were organized in that country. The Foundation will bear 66 per cent. of the expenses during the first year and 34 per cent. during the second, and the Honduras government will assume all expense from the third year on.

In a report from Geneva, August 17, it was stated that the hygiene committee of the League of Nations had decided to accept the offer of the Rockefeller Foundation, amounting to the sum of $60,000 a year for three years, to allow an interchange of staff in the public health services of various countries, and a sum of $30,000 yearly for five years for the development of an international office for distributing information as to epidemics. After the necessary documents are signed, the plan will be put into action at once, and the interchange of staff will begin in October. For a period of two weeks, functionaries of various nationalities—a Bulgarian, two Belgians, two Czechs, five Italians, five Poles, five Russians and two Serbians—will pursue an intensive short course at Brussels, following which they will spend two months in the public health services of different countries.

SCIENTIFIC NOTES AND NEWS

Sir Ernest Rutherford, Cavendish professor of physics at the University of Cambridge, has been elected president of the British Association for the Advancement of Science in succession to Sir Charles S. Sherrington. The meeting next year will be at Liverpool, and it is expected that the meeting the following year will be in Canada.

Professor W. L. Bragg, of Manchester University, who, together with his father, Sir William Bragg, was awarded the Nobel Prize for physics in 1915, delivered on September 6 the lecture in Stockholm as prescribed by the statutes of the Nobel Institution.

Engineer Vice-Admiral Sir George Goodwin, K. C. B., late engineer-in-chief of the fleet, and Dr. James Colquhoun Irvine, C. B. E., F. R. S., vice-chancellor and principal of St. Andrews University, have been appointed to be members of the advisory council to the committee of the privy council for scientific and industrial research.

Dr. Willard Rouse Jillson, director and state geologist of the Kentucky Geological Survey, was elected an honorary member of the Natural Gas Association of America at its recent meeting in Kansas City.

Dr. Henry Fairfield Osborn, president of the American Museum of Natural History, has sailed from Seattle on the *President Grant* of the Admiral Line for Yokohoma. From Yokohoma Dr. Osborn will go to Korea and thence by rail to Peking to the headquarters of the museum, where he will meet the members of the Third Asiatic Expedition. During his stay in Peking, Dr. Osborn plans to make a trip to the edge of the Gobi Desert, where the expedition has found beds of Cretaceous and Tertiary deposits. From Peking, he will go to the Philippine Islands and from there to India to visit the fossil-bearing formations in the Siwilik Hills, where Mr. Barnum Brown is collecting for the museum.

At the Pittsburgh meeting of the American Chemical Society, the Division of Industrial and Engineering Chemistry elected D. R. Sperry, chairman, W. A. Peters, Jr., vice-chairman, E. M. Billings, secretary, and the following were elected members of the executive committee: W. F. Hillebrand, Edward Mallinckrodt, Jr., F. M. deBeers, A. Silverman, H. C. Moody, and C. E. Coates.

Norman Snyder, a member of the scientific staff of the Radio Laboratory of the Bureau of Standards, left the bureau June 1 for a leave of absence of several months to work in the research laboratory of the General Electric Company at Schenectady on electron tube problems.

F. W. Stavely, Ph.D. (Chicago, '22), has accepted a position with the Firestone Tire and Rubber Company at Akron, Ohio.

DR. C. S. LEONARD, who has for the past year been working with Dr. A. S. Loevenhart at the University of Wisconsin upon synthetic arsenicals, has accepted a position as a pharmacologist in the Hygienic Laboratory, U. S. Public Health Service, Washington, D. C.

THE following have joined the staff of the research laboratory of the Eastman Kodak Company: Dr. Helge Schibsted, formerly with the Atmospheric Nitrogen Company; Clyde Brockett, Massachusetts Institute of Technology, 1922; Alasco Burgess, Bates College, 1922; D. Henry Harris, Massachusetts Institute of Technology, 1922; Roger P. Loveland, Grinnell College, 1919.

DR. LEWIS M. HULL, who for several years has been engaged in studies of electron tubes in the radio laboratory of the Bureau of Standards, has resigned to accept a position as director of research of the Radio Frequency Laboratories, Inc., of Boonton, N. J.

MISS GUDRUN CARLSON, assistant in the department of foods and cookery at Teachers College, has been appointed home economics expert in the publicity department of the Institute of American Meat Packers.

MR. ERIC R. JETTE, who recently completed his work for the Ph.D. in chemistry at Columbia University, has sailed for a year of study in Stockholm. He has an American-Scandinavian fellowship for the year 1922-23.

DR. ROLAND E. KREMERS has resigned as assistant professor of chemistry in Vanderbilt University, and has returned to the University of Wisconsin, where he will be in residence this year under a National Research Council fellowship. He will work on the peppermint oils and on azulene.

DR. F. L. STEVENS, professor of plant pathology in the University of Illinois, has returned from a summer spent in collecting fungi in British Guiana. Collections were made on the coast and in Demerrara, Essequibo and Potaro Rivers.

PROFESSOR C. A. NOBLE, of the department of mathematics, University of California, has been granted a term's leave of absence, which he will spend in Europe.

DR. KNUD STEPHENSEN, of the Zoological Museum at Copenhagen, known for his studies on the Crustacea, is visiting the scientific institutions of the United States.

DR. WILFRED T. GRENFELL, known for his work in Labrador, has sailed for Europe and will lecture twice in London. Lord Milner will preside at one of these lectures.

AT the Pittsburgh meeting of the chairmen and secretaries group of the American Chemical Society, a plan was launched by which Professor E. C. Franklin, of Leland Stanford University, will give a series of lectures before several of the local sections of the society. These will be given near the time of the spring meeting, that is, the latter part of March and the early part of April. The following sections have asked Dr. Franklin to speak before them on this trip: Chicago, Detroit, East Lansing, University of Michigan, Purdue, Cleveland, New Orleans, West Virginia, Pittsburgh, Buffalo, Rochester, Syracuse and Philadelphia. If there are other sections of the American Chemical Society or other scientific bodies who would like to have Dr. Franklin speak before them, information can be obtained by writing to E. M. Billings, Kodak Park, Rochester, N. Y.

MR. A. CHASTON CHAPMAN, F.R.S., honorary treasurer in England of the Pasteur Commemoration Fund, writes to the *British Medical Journal* that a sum of £848 14s. 6d. has been subscribed to this fund, in addition to sums which had previously been sent to France in response to earlier and direct appeals. In accordance with a resolution passed at a recent meeting of the Pasteur Commemoration Committee, presided over by Sir Charles Sherrington, P.R.S., a draft for the above amount is being forwarded to Monsieur Héring, the general treasurer, at Strasbourg, with an intimation that should the amount prove more than the French committee desires to expend upon the monument the excess should be devoted to some other form of permanent memorial of Pasteur in the University of Strasbourg.

THE Prince of Wales has consented to unveil on November 3 the memorial tablet of the late Professor Sir William Ramsay which is being placed in Westminster Abbey. The tablet has been executed by Mr. Charles L. Hartwell, A.R.A., and was exhibited at the Royal Academy this summer.

Dr. Horatio R. Storer died at his home in Newport on September 18, at the age of ninety-two years. Dr. Storer was a distinguished gynecologist, who, after an infection from an operation, retired from active practise in 1872. He continued to be active in many scientific movements, having been the founder and life-president of the Newport Natural History Society.

UNIVERSITY AND EDUCATIONAL NOTES

By the will of Dr. William S. Halsted, lately professor of surgery in the Johns Hopkins University, the residue of his estate, valued at approximately $100,000, is left to the university, subject to the payment annually to his widow of five per cent. of the value of the legacy. The bequest is to be devoted to research in medicine, preferably in surgery.

On September 6, the old chemical laboratory of the Massachusetts Agricultural College was destroyed by fire. The building was one of the oldest on the campus, having been built in 1867, and occupied more or less completely by the department of chemistry since that time. About four thousand dollars' worth of apparatus, including all the platinum, was recovered. A new laboratory was provided for during the last legislature by an appropriation of $300,000. This building is now being erected and will be ready for occupancy in August, 1923.

By action of the board of trustees of the Ohio State University on June 19, supplemented by further action on July 11, the College of Homeopathic Medicine, which had been a part of the university since 1914, was abolished.

Dean D. W. Morehouse, for twenty-two years professor of physics and astronomy at Drake University, Des Moines, Iowa, has been elected dean of the liberal arts college and acting president. President Arthur Holmes is on leave of absence, his resignation taking effect on June 1, 1923. Dr. Morehouse was awarded the Donahue Comet Medal in 1908 for discovery of the Morehouse comet.

Dr. W. N. Steil, of the University of Wisconsin, has been appointed professor of botany in Marquette University, the former department of biology having been divided into the separate departments of botany and zoology. Dr. Edward J. Menge, former director of the department, automatically becomes director of the department of zoology.

Dr. Martin C. E. Hanke has been appointed instructor in physiological chemistry at the University of Chicago.

W. J. Kostir, who during the past year has been instructor in zoology at Columbia University, returns this fall to Ohio State University as assistant professor of zoology and entomology.

Dr. L. E. Miles, of the Mississippi Plant Board, has become associate professor of plant pathology and associate plant pathologist in the Alabama Polytechnic Institute and Experiment Station.

Professor H. R. Dean, of the University of Manchester, has been appointed professor of pathology at the University of Cambridge in succession to the late Sir German Sims Woodhead.

Captain George Paget Thomson, lecturer in mathematics at Corpus Christi College, Cambridge, has been appointed to the chair of natural philosophy in the University of Aberdeen, in succession to Professor C. Niven, recently retired. Mr. Thomson, who was unanimously elected by the court out of seventeen applicants, is the only son of Professor Sir J. J. Thomson, master of Trinity, Cambridge. He has had a distinguished academical career, and is only thirty years of age.

DISCUSSION AND CORRESPONDENCE

GROWTH OF PLANTS IN ARTIFICIAL LIGHT FROM SEED TO SEED

During the past winter the author has succeeded in producing good seed from plants grown in artificial light entirely. Since no reference to the growth of plants from seed to seed without sunlight has been found in the literature this preliminary report of the first successful attempt may be of use to plant breeders and agronomists in northern regions.

A great variety of plants including several varieties of wheat, oats, barley, rye and potatoes, buckwheat, lettuce, beans, peas, clovers, radishes, flax and a number of common weeds were grown from seed to seed entirely in artificial light. The seed produced was of good quality, full of starch, and germinated well.

Light for the experiment was obtained from tungsten filament nitrogen filled lamps which were burned for twenty-four hours each day. The lamps are rated to burn 1,000 hours but they averaged 3,000-4,000 hours under continuous use. One set of lamps was found to be more than sufficient to produce an ordinary crop such as the cereals, since the time to head is much decreased by continuous illumination. Spring wheats produced ripe seed in about 90 days. At this rate it ought to be possible now to grow three generations from a cross within one year. The growth of valuable plants in artificial light should be of considerable advantage in northern regions where the light in winter is of short duration and low intensity.

All of the plants tested, except cabbage, have bloomed and each variety does not seem to require any particular period of illumination to cause blooming as found by Garner and Allard.[1]

Four ranges of light intensity were used and a number of plants bloomed in all of them, although the illumination was continuous. The tests were performed in three unheated basement rooms. It was unnecessary to supply any heat other than that produced by the lamps even in the coldest winter weather. For cereals the temperature was controlled automatically at 14° C. by blowing in cold outside air. The energy used in heating the ordinary greenhouse in Minnesota during the winter would be ample for both light and heat in such experiments as these since nearly all the energy of the light finally goes to heat and thus is made to serve a double purpose.

R. B. Harvey
University of Minnesota

[1] Garner, W. W., and Allard, H. A.: *Jr. Agr. Res.*, 18: 553-606: 1920.

THE PREPARATION OF CLEAR BEEF AGAR

A clear beef agar with a p_H reading from 6.6 to 7.0 being desired and the usual method for the preparation of such media proving unsatisfactory, inasmuch as a cloudiness often developed in the cleared agar on sterilization, the following procedure has been adopted and has proved uniformly reliable.

The formula is as follows:

Beef extract (Liebig's)	3 grams
Peptone ("Bacto")	10 grams
Sodium chloride	5 grams
Agar Agar	15 grams

These ingredients are dissolved in one liter of distilled water by flowing steam. As suggested by the directions for the preparation of beef bouillon, given by James McIntosh, M.D., and William A. M. Smart, B.Sc.Land.,[1] the resultant nutrient agar is adjusted to a p_H of about 8.2 with an approximately normal solution of sodium hydroxide. After cooling to 45°-50° C., the beaten whites of two fresh eggs are added. Soluble egg albumin powder may be substituted for the fresh eggs, 5 grams beaten up in 50 cc. of distilled water proving satisfactory. If more than one liter is being made, the beaten white of one egg or a proportional quantity of egg albumin powder should be used for each additional liter. After mixing thoroughly by pouring from one container into another, the agar and egg are autoclaved for 15 minutes at 15 pounds pressure, filtered through paper or, preferably, through absorbent cotton by suction, and the filtrate adjusted to the desired p_H with an approximately normal solution of hydrochloric acid. It is then autoclaved for 5 minutes at 15 pounds pressure to insure the complete precipitation of any fine particles remaining in suspension and filtered through paper. After tubing, it is finally sterilized for 20 minutes at 15 pounds pressure. This beef agar remains

[1] James McIntosh and William A. M. Smart: "The Adjustment of the Reaction of Bacteriological Media," *Lancet*, Vol. CXCVII, No. 5017.

clear after sterilization and has given excellent results as a bacteriological medium.

Franklin W. Marsh
U. S. Department of Agriculture

THE EFFECT OF FEEDING VELVET BEANS TO PIGEONS

Three groups of three mature pigeons each were fed as follows:

Pen I: Ground velvet beans.

Pen II: Ground velvet beans plus aqueous extract of rice bran.

Pen III: Ground velvet beans plus aqueous extract of rice bran plus 10 per cent. butterfat.

The beans were fed dry and at the start were eaten readily. Pens II and III were given an aqueous extract of rice bran as the sole source of drinking water.

On the second day after feeding the beans, all birds showed ruffled feathers and a drawn-up, sleepy appearance. On the fourth day, one bird in Pen I and one in Pen II died. The remaining birds were in very poor condition. The loss in weight averaged about 80 grams.

Check birds receiving polished rice made slight gains during the same period, and were apparently in thrifty condition. On the fourth day the feed was changed to polished rice in all pens. One bird in Pen III was too weak to eat and was hand-fed on polished rice. Recovery was rapid in all cases.

Two pigeons were then fed ground velvet beans from another source. They rapidly developed the appearance of the birds in the former test. Both died on the eighth day.

Ground velvet beans were forced into the crops of two pigeons that had developed symptoms of severe polyneuritis. A decided improvement in condition was noticed. The birds died, however, on the following night in one case and on the second day in the other.

An aqueous extract of velvet beans furnished as the sole source of drinking water to pigeons receiving polished rice, apparently delayed the onset of polyneuritis, but did not entirely prevent it. The difference in appearance of the birds receiving the extract and of check birds receiving polished rice alone was striking. The feathers of the former remained smooth and glossy, while those of the latter soon became dry and rough looking. These results seem to indicate at least a small amount of water soluble B in the beans.

An effort will be made to ascertain the cause of the ill effect.

W. D. Salmon
South Carolina Experiment Station,
Clemson College, S. C.

A CHEMICAL SPELLING MATCH

A unique modification of the old-time spelling bee was staged at the West Virginia University last May with rather remarkable success.

At the suggestion of the writer the chemical faculty of the university arranged to hold a contest among the 376 students taking the course in general inorganic chemistry, and this contest was to be a public match for the spelling of chemical formulæ of such compounds as are ordinarily included in a first year's college course in chemistry.

These students are normally divided into sixteen quiz sections, and it was evident that so many could not be brought on the floor at the same time for spelling. Therefore, eight preliminary matches were held at seven o'clock in the evening of the final match, where two sections, in charge of two instructors, spelled against each other, and then a number chosen from each of these groups, representing one out of every eight students, who became eligible to the final match.

The preliminaries lasted about one hour, after which all the students assembled in the armory and the winners lined up for the final contest. Professor Samuel Morris pronounced the words, and three well-known chemists, not connected with the department, acted as judges. For example, ortho phosphoric acid was given, and the student whose turn it was replied by saying "H_3PO_4."

Upwards of 700 formulæ were prepared for the instructors' use at the preliminaries, and then 50 to 60 additional formulæ in case of emergency for the final match. As a prize, Mr. J. F. Cadden, the winner, was presented with a copy of Mellor's "Modern Inorganic Chemistry." The last five students to spell down were presented with attractive certificates bearing the university seal.

A great deal of enthusiasm and rivalry between quiz sections was manifested, and the different sections came as units to boost their representatives. The students had had three or four weeks in which to prepare for the contest, and nearly all of them had been working hard for it. Our instructors are all agreed that the students participating derived great benefit from this match.

In addition to these benefits, the contest brought out the fact that our chemical nomenclature is not yet above reproach. A few instances of ambiguity might be cited: Sodium thiosulphate, $Na_2S_2O_3$, is sometimes named sodium hyposulphite and so labelled by a few manufacturers of chemicals. The latter name, however, is represented by the formula $Na_2S_2O_4$. Potassium fluosilicate and potassium silicofluoride are both used to represent the same substance. Potassium sulphocyanide and potassium thiocyanate are two names in use for KCNS. Then, again, we say hydronitric acid, or triazoic acid, or azoamide, when we mean a substance with the composition N_3H.

If these spelling bees were to be adopted by a considerable number of educational institutions it would doubtless tend to unify chemical nomenclature so that finally we should have one name only to represent a chemical compound having a definite composition. Spelling matches of this sort could also be profitably arranged between classes in organic chemistry, mineralogy and perhaps other departments of science. The contests appeal to students because they combine the elements of sport and competition. The benefits derived therefrom are incalculable, and we are now planning to make the chemical spelling match an annual event at the West Virginia University.

C. A. Jacobson

Morgantown, West Virginia

SCIENTIFIC BOOKS

Proteins and the Theory of Colloidal Behavior. By Dr. Jacques Loeb, member of the Rockefeller Institute for Medical Research. New York: McGraw-Hill Book Co., 285 pp. 1922.

In this volume the author has collected the results of his extensive investigations upon the properties of protein solutions and has attempted to found upon them a general theory of colloids. The book falls naturally into two sections. The main argument in the first half is that proteins are amphoteric electrolytes and that consequently, when hydrogen ion concentrations are duly measured and considered, proteins are found to combine with acids and alkalies according to the stoichiometrical laws of classical chemistry. This argument is illustrated and supported by numerous tables and diagrams. In the second part of the book the conclusion is established that all of the experimental results recorded can be logically explained upon the basis of Donnan's theory of membrane equilibria.

The far-reaching significance of the author's contentions may be summarized in the statement that, if justified, they dispose of colloid chemistry as a special branch of the science, with laws different from those of general chemistry. This does not, as is pointed out in the preface, detract from the importance of colloïdal behavior for physiological and technical problems, but it completely changes the theoretical treatment of the subject.

A revolution in our current conceptions of colloidal solutions is hereby threatened, equal in importance to that brought about by van't Hoff and Arrhenius a generation ago in the field of crystalloidal solutions, and it seems probable, from certain reviews that have already appeared, that the battle between the new and the old points of view will be waged with equal bitterness. It is interesting to note in this connection that the veteran fighter Armstrong, now president of the Society of Chemical Industry in England, went out of his way in his recent Messel Memorial Lecture at Glasgow to refer to Loeb's "praiseworthy efforts to raise the character of the proteins from mere indeterminate lumps of jelly to a status of definite materials behaving in a simple and definite, orderly manner, if only put under comparable conditions." Since, however, he indulged in the course of the same address in his customary diatribes against the Scandinavian Ikon Arrhenius and his High Priest Ostwald, remarking that "hydrogen ion concentration is pure gibberish," his conversion to Loeb's theory is obviously incomplete. As he so appositely puts the case himself: "We all have partially permeable intellects."

At this stage, indeed, it is altogether premature to express an opinion as to the outcome of the struggle. What is certain is that Loeb has made, in this volume, a brilliant thrust which his adversaries will find it difficult to counter. There are many points of detail in his experimental work which will curdle the blood of any analytical chemist, yet it appears on close examination that the errors introduced are, after all, insufficient to affect the main issue. The opponents of Loeb's views, in any case, cannot restrict themselves to attacking the weak points of his presentation; he has already succeeded so far as to put them definitely on the defensive. To quote from his own preface: "Any rival theory (of colloidal behavior) which is intended to replace the Donnan theory must be able to accomplish at least as much as the Donnan theory, *i. e.*, it must give a quantitative, mathematical and rationalistic explanation of the curves expressing the influence of hydrogen ion concentration, valency of ions, and concentration of electrolytes on colloidal behavior; and it must explain these curves not for one property alone but for all the properties, electrical charges, osmotic pressure, swelling, viscosity, and stability of solution, since all these properties are affected by electrolytes in a similar way."

This quotation may be supplemented by another, from the final page of the book, indicating the importance of Loeb's work outside of chemistry. "If Donnan's theory of membrane equilibria furnishes the mathematical and quantitative basis for a theory of colloidal behavior of the proteins, as the writer believes it does, it may be predicted that this theory will become one of the foundations upon which modern physiology will have to rest."

Every so-called colloidal chemist will evidently be forced to read Loeb's book in self-defense. Those also who are only indirectly interested in colloidal phenomena cannot fail to find it stimulating.

James Kendall

SPECIAL ARTICLES

MOSAIC CROSS-INOCULATION AND INSECT TRANSMISSION STUDIES

Whether or not the plant disease known as mosaic is transmissible to plants of different orders, and the rôle of insects as agents in such transmission, are questions of fundamental importance. It is generally held that mosaic of the Cucurbitaceæ, Solanaceæ and Leguminaceæ are all quite specific and with few exceptions transmissible only to species within the same family. Certain mosaic diseases have been described indicating that even among species within the same family there may be two or more types of the disease. Allard[1] in 1916 described a specific mosaic disease on *Nicotiana viscosum* distinct from the mosaic disease of *Nicotiana tabacum*. Jagger[2-3] in 1917 and 1918 reports three specific mosaic diseases of the cucurbits. The tendency has thus been to divide mosaic into types which are distinct in their host range.

As opposed to the evidence indicating that there are a number of types of mosaic which are specific to a narrow host range, we have evidence showing that mosaic will cross to species belonging to other families and orders. Jagger[4] in 1918 published results of cross-inoculation studies where he succeeded in transferring mosaic from the Cucurbitaceæ to species of two other families of the Order Campanulales. Doolittle[5] has shown that mosaic of cucumber is transmissible to *Martynia louisiana*, a species belonging to the Order Polemoniales.

Cross-inoculation experiments by the writer have shown that the mosaic diseases of the Cucurbitaceæ, Solanaceæ and Leguminaceæ are inter-transmissible. Four petunia plants inoculated with mosaic from crookneck squash became infected while an equal number of checks remained healthy. The inoculations were made by inserting mosaic tissue into the stem with a sterile scalpel. An experiment in which juice from mosaic plants was inoculated hypo-

[1] *Journ. Agr. Research*, 7: 481-486, 1916.

[2] *Phytopathology*, 7: 61, 1917.

[3] *Phytopathology*, 8: 74-75, 1918.

[4] *Phytopathology*, 8: 32-33, 1918.

[5] *U. S. D. A. Bull.* 879, 1-69, 1920.

dermically resulted in 100 per cent. infection. Using this method, four crookneck squash plants were inoculated with mosaic from tomato, and four with mosaic from tobacco. All of these plants became infected. Similarly, a tobacco and two tomato plants were inoculated with juice from mosaic crookneck squash leaves and became infected. The number of plants kept as checks greatly exceeded the number of inoculated plants. All checks remained healthy. In an attempt to cross-inoculate tomato with mosaic from crookneck squash by the hypodermic needle method, two out of five plants became infected while the ten checks all remained healthy. In another experiment where mosaic crookneck squash leaf tissue was inserted into the midribs of five tobacco plants, the result was 100 per cent. infection. At the same time five tobacco plants were similarly inoculated with mosaic cucumber tissue and one of the five became infected. These inoculations were made using a sterile flamed scalpel. In order to further check whether or not the inoculations were being made under sterile conditions, healthy leaf tissue was inserted into the midribs of ten tobacco plants. In addition, 30 plants were kept as checks. No mosaic developed either on the inoculated or on the uninoculated checks. An attempt to inoculate tomatoes with mosaic from catnip, *Nepeta cataria,* resulted in three of the five plants inoculated becoming infected while an equal number of checks remained healthy.

The investigations made by the writer with mosaic of the legumes have been mainly with cow pea, *Vigna Catjang.* Although the cow pea has not been reported susceptible to mosaic, this species has been found susceptible under greenhouse conditions. Symptoms include mottling and distortion of the leaves, and stunting of the whole plant. Inoculation by means of transferring aphis (species undetermined) from the mosaic plants to healthy plants was shown clearly that this mosaic is a transmissible disease. Two pots containing 38 cow pea seedlings were infested with aphis from the mosaic cow pea plants and were placed in insect proof cages. One hundred per cent. infection occurred in both pots while all checks remained healthy.

In addition to aphis being carriers of mosaic, numerous experiments have shown that the mealy bug (*Dactylopus sp.*) also transmits this disease. This has been found especially true where mealy bugs caused mosaic infection of cow peas and soy beans. Cross-inoculation experiments using mealy bugs which had been transferred from mosaic infected solanum and cucurbit plants to healthy cow pea seedlings, have resulted in infection in both cases. Experiments have shown that soy bean plants are susceptible to mosaic from cow peas where mealy bugs served as carriers. Mealy bugs with a portion of the mosaic plant on which they were feeding were transferred to the pot containing the seedlings. The result of an experiment in which mealy bugs from a mosaic crookneck squash plant were transferred to two pots containing a total of 33 cow pea plants gave 100 per cent. infection. All checks remained healthy. A pot of cow pea plants was inoculated by means of mealy bugs from mosaic infected egg plant and of 38 plants 100 per cent. became infected. At the same time aphis from mosaic potato were transferred to another pot containing 36 cow pea seedlings, 28 of which developed the disease. Out of 60 plants held as checks no case of mosaic has appeared. Mealy bugs were transferred from mosaic infected cow pea to soy bean seedlings with the results that a large per cent. of the soy bean plants developed mosaic.

Data and observations in the greenhouse indicate that mealy bugs may transmit mosaic to solanums. Two tobacco plants and one tomato plant have thus been infected with mosaic from crookneck squash through the agency of mealy bugs.

The results obtained indicate that the mosaic with which we are working is inter-transmissible between species of Cucurbitaceæ, Solanaceæ and Leguminaceæ. To what degree this will hold true under field conditions has not been determined. Judging from observations, the writer believes that infection with mosaic is to a large degree determined by the growth condition of the plant. Experiments testing this point have shown that the optimum condition for mosaic infection is an unchecked, vigorous growth of the plant. Inoculations of mosaic within the Solanaceæ or within the Cucurbitaceæ have, as a rule, been more easily accomplished than the cross-inoculations between members of the Solanaceæ and members of the Cucurbitaceæ. Successful cross-infections between members of different families are more easily obtained with plants growing under very favorable conditions than with plants growing under unfavorable conditions.

O. H. Elmer

Iowa Agricultural Experiment Station

SPERMATOGENESIS OF THE GARTER SNAKE

Up to the present no work has been published on the spermatogenesis of the snakes. The only Reptilia which have been studied in any detail have been the lizards, and the recent work of Dalcq and Painter has definitely pointed out that an accessory element exists in this group. The work on the spermatogenesis of this species of snake (*Thamnophis butleri*) has progressed far enough to make it advisable to publish a few of the details, although the work has not yet been completed.

The species on which this study is being made was collected in the vicinity of Ann Arbor, Michigan, and was identified by Drs. A. G. Ruthven and F. N. Blanchard. It has one of the narrowest ranges of any of the garter snakes but is abundant in that locality.

The material has been fixed in Flemming's strong and Flemming's strong plus .5 per cent. urea at both room temperature and cold, and in Allen's modification of Bouin. The best results have been obtained with cold Flemming plus urea, fixed for twenty-four hours, sectioned at six micra and stained with Heidenhain's Iron Hæmx. by the short method of Lee.

The material shows thirty-seven chromosomes in the spermatogonial equatorial plates in the best counts and this is what would be expected from a study of the spermatocyte divisions. There is a border of large bent rod shaped chromosomes and an inner group of short rods and round chromosomes.

In the late prophase and side views of the equatorial plate of the first spermatocytes the accessory elements form a tripartite body. Polar views of the first spermatocyte show seventeen autosomes and either one or two accessory chromosomes depending on the way the plate is turned. At the first division, the tripartite body divides, two parts going to one pole and one to the other, the double part remaining more or less fused. A polar view of the first spermatocyte shows five quite large bivalents, two of which are slightly smaller than the other three, eleven medium sized and two microsomes, making eighteen as the haploid number. If the double accessory happens to be turned toward the observer, one of the three large ones gives the double appearance. There is little indication of an earlier division of the accessory elements though at times the double one may be seen lying closer to the centrosome, indicating that it has divided earlier. The first division is the differential division, the two daughter cells receiving the following: one, seventeen autosomes and the double accessory, and the other, seventeen autosomes and the single accessory.

The second spermatocyte division then becomes an equational one so far as the accessory chromosomes are concerned and give rise to two classes of spermatozoa.

Oogonial counts have not yet been made to determine whether the single or the double is the X chromosome, but it might be expected, in light of what has been found in the lizards by Painter, that the double one is the X and the single the Y and that oogonial counts should yield thirty-eight chromosomes. It would seem in this species of snake, at least, that the accessory chromosomes are found as three separate ones in the spermatogonia, which bears out what Painter has already described for the lizards.

Examination of some slides of snake testis of an unknown species has revealed a condition of the chromosomes more like the lizards as described by Painter. This material shows in the first spermatocyte division equatorial plates with approximately nine very large and eleven very small chromosomes as the haploid number. Before the complete results are published, a comparative study of other genera and families will be made in order to determine whether the behavior of the accessory chromosomes in snakes falls in line with what Painter has already described for lizards.

Lloyd E. Thatcher

University of Michigan

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CONTENTS

THE ORGANIZATION OF RESEARCH[1]

THE principles of science are to-day widely spread; systematic scientific training has found an honorable place in the schools and in the colleges; above all, there is the realization that much of human progress is based on scientific inquiry, and at last this is fostered and, in part, financed as a definite unit of national educational policy. Public funds are devoted to provide facilities for those who are competent to pursue scientific investigations, and in this way the state, acting through the Department of Scientific and Industrial Research, has assumed the double responsibility of providing for the advancement of knowledge and for the application of scientific methods to industry. Scientific workers have been given the opportunities they desired, and it remains for us to justify all that has been done. We have to-day glanced briefly at the painful toil and long years of preparation; now it falls to us to sow the first crop and reap the first harvest.

Thanks to the wisdom and foresight of others, it has been possible to frame the government policy in the light of the experience gained with pre-existing research organizations. The pioneer scheme of the kind is that administered by the commissioners of the 1851 Exhibition, who since 1890 have awarded research scholarships to selected graduates. When in 1901 Mr. Carnegie's benefaction was applied to the Scottish universities the trustees wisely determined to devote part of the revenues to the provision of research awards which take the form of scholarships, fellowships and research lectureships. These have proved an immense boon to Scottish graduates, and the success of the venture is sufficiently testified by

[1] From the address of the president of Section B—Chemistry, British Association for the Advancement of Science, Hull, September 7, 1922.

the fact that the government research scheme was largely modeled on that of the Carnegie Trust.

In each of these organizations chemistry bulks largely, and the future of our subject is intimately connected with their success or failure. The issue lies largely in our hands. We must not forget that we are only at the beginning of a great movement, and that fresh duties now devolve upon us. It was my privilege for some years to direct the work of a chemistry institute, where research was organized on lines which the operation of the government scheme will make general. If, from the very nature of things, my experience can not be lengthy it is at least intimate, and I may perhaps be allowed to lay before you my impressions of the problems we have to face.

Two main objectives lie before us: the expansion of useful learning and the diffusion of research experience among a selected class. This class in itself will form a new unit in the scientific community, and from it will emerge the "exceptional man" to whom, quoting Sir James Dewar, "we owe our reputation and no small part of our prosperity." When these words were uttered in 1902 it was a true saying that "for such men we have to wait upon the will of Heaven." It is still true, but there is no longer the same risk that the exceptional man will fall by the way through lack of means. Many types of the exceptional man will be forthcoming, and you must not imagine that I am regarding him merely as one who will occupy a university chair. He will be found more frequently in industry, where his function will be to hand on the ideas inspired by his genius to the ordinary investigator.

I have no intention of wearying you by elaborating my views on the training required to produce these different types. My task is greatly simplified if you will agree that the first step must be systematic experience in pure and disinterested research, without any reference to the more complicated problems of applied science. This is necessary, for if our technical research is to progress on sound lines the foundations must be truly laid. I have no doubt as to the prosperity of scientific industries in this country so long as we avoid hasty and premature specialization in those who control them. We may take it that in the future the great majority of expert chemists will pass through a stage in which they make their first acquaintance with the methods of research under supervision and guidance. The movement is already in progress. The government grants are awarded generously and widely. The conditions attached are moderate and reasonable, and there is a rush to chemical research in our colleges. Here, then, I issue my first note of warning, and it is to the professors. It is an easy matter to nominate a research student; a research laboratory comfortably filled with workers is an inspiring sight, but there are few more harassing duties than those which involve the direction of young research chemists. No matter how great their enthusiasm and abilities, these pupils have to be trained, guided, inspired, and this help can come only from the man of mature years and experience. I am well aware that scorn has been poured on the idea that research requires training. No doubt the word is an expression of intellectual freedom, but I have seen too many good investigators spoiled and discouraged through lack of this help to hold any other opinion than that training is necessary. I remember, too, years when I wandered more or less aimlessly down the by-paths of pointless inquiries, and I then learned to realize the necessity of economizing the time and effort of others.

The duties of such a supervisor can not be light. He must possess versatility; for although a "research school" will doubtless preserve one particular type of problem as its main feature, there must be a sufficient variety of topics if narrow specialization is to be avoided. Remember, also, that there can be no formal course of instruction suitable for groups of students, no common course applicable to all pupils and all inquiries. Individual attention is the first necessity, and the educative value of early researches is largely derived from the daily consultations at the laboratory bench or in the library. The responsibility of becoming a research supervisor is great, and, even with the best of good will, many find it difficult to enter sympathetically into the mental position of the beginner. An unexpected result is obtained, an analysis fails to agree, and the supervisor, out of his long experience, can explain the anomaly at once, and generally does so. If the pupil is to derive any real benefit from his difficulties, his adviser must for the moment place himself in the position of one equally puzzled, and must lead his collaborator to sum up the evidence and arrive at the correct conclusion for himself. The policy thus outlined is, I believe, sound, but it makes severe demands on patience, sympathy, and, above all, time.

Research supervision, if conscientiously given, involves the complete absorption of the director's energy and leisure. There is a rich reward in seeing pupils develop as independent thinkers and workers, but the supervisor has to pay the price of seeing his own research output fade away. He will have more conjoint papers, but fewer individual publications, and limitations will be placed on the nature of his work by the restricted technique of his pupils.

I have defined a high standard, almost an ideal, but there is, of course; the easy alternative to use the technical skill of the graduate to carry out the more laborious and mechanical parts of one's own researches, to regard these young workers as so many extra pairs of hands. I need uot elaborate the outcome of such a policy.

There is another temptation, and that, in an institution of university rank, is for the professor to leave research training in the hands of his lecturers, selecting as his collaborators only those workers who have passed the apprenticeship stage. This, I am convinced, is a mistake. Nothing consolidates a research school more firmly than the feeling that all who labor in its interests are recognized by having assigned to them collaborators of real ability.

I am not yet done with the professor and his staff, for they will have other matters to attend to if research schools are to justify their existence and to do more than add to the bulk of our journals. In many cases it will be found that the most gifted of the young workers under their care lack what, for want of a better expression, is known as "general culture." Remember, these graduates have just emerged from a period of intensive study in which chemistry and the allied sciences have absorbed most of their attention. For their own sake and in the interests of our subject, they must be protected from the criticism that a scientific education is limited in outlook and leads to a narrow specialism. The research years are plastic years, and many opportunities may be found in the course of the daily consultations "to impress upon the student that there is literature other than the records of scientific papers, and music beyond the range of student songs." I mention only two of the many things which may be added to elevate and refine the research student's life. Others will at once occur to you, but I turn to an entirely different feature of research training, for which I make a special plea: I refer to the inculcation of business-like methods. You will not accuse me, I hope, of departing from the spirit of scholarship or of descending into petty detail, but my experience has been that research students require firm handling. Emancipated as they are from the restrictions of undergraduate study, the idea seems to prevail that these workers ought to be excused the rules which usually govern a teaching laboratory, and may therefore work in any manner they choose. It requires, in fact, the force of a personal example to demonstrate to them that research work can be carried out with all the neatness and care demanded by quantitative analysis. Again, in the exercise of their new freedom young collaborators are inclined to neglect recording their results in a manner which secures a permanent record and is of use to the senior collaborator. As a rule, the compilation of results for publication is not done by the experimenter, and a somewhat elaborate system of records has to be devised. It should be possible, twenty years after the work has been done, to quote the reasons which led to the initiation of each experiment, and to trace the source and history of each specimen analyzed, or upon which standard physical constants have been determined. I need not enter into detail in this connection beyond stating that, although a system which secures these objects has for many years been adopted in St. Andrews, constant effort is required to maintain the standard.

One of the greatest anxieties of the research supervisor is, however, the avoidance of extravagance and waste. The student is sometimes inclined to assume a lordly attitude and to regard such matters as the systematic recovery of solvents as beneath his notice. My view is that, as a matter of discipline as much as in the interests of economy, extravagant working should not be tolerated. There is naturally an economic limit where the time spent in such economics exceeds in value the materials saved, and a correct balance must be adjusted. It is often instructive to lay before a research worker an estimate of the cost of an investigation in which these factors of time and material are taken into account. As a general rule it will be found that the saving of material is of greater moment than the loss of time. The point may not be vitally important in the academic laboratory, but in the factory, to which most of these workers eventually migrate, they will soon have the lesson thrust upon them that their time and salary bear a small proportion to costs of production.

You will see I have changed my warning from the professor to the student. A student generation is short. In a few years, when almost as a matter of course the best of young chemists will qualify for the doctor of philosophy degree, it will be forgotten that these facilities have come to us, not as a right, but as a privilege. Those who reap the advantages of these privileges must prove that the efforts made on their behalf have been worth while.

Looking at the position broadly, if one may criticize the research schemes of to-day, it is in the sense that the main bulk of support is afforded to the research apprentice, and the situation has become infinitely harder for the supervisor in that new and onerous tasks are imposed upon him. To expect him to undertake his normal duties and, as a voluntary act, the additional burden of research training is to force him into the devastation of late hours and overwork. The question is at once raised —Are we using our mature research material to the best advantage, and is our policy sufficiently focussed on the requirements of the experienced investigator? I think it will generally be agreed that members of the professor or lecturer class who join in the movement must be relieved in great measure of teaching and administrative work. I am decidedly of the opinion that the research supervisor must be a teacher, and must mingle freely with undergraduates, so as to recognize at the earliest possible stage the potential investigators of the future and guide their studies. To meet this necessity universities and colleges must realize that their curriculum has been extended and that staffs must be enlarged accordingly. There could then be definite periods of freedom from official duties for those who undertake research training as an added task. Opportunities must also be given to these "exceptional men" to travel occasionally to other centers and refresh themselves in the company of kindred workers. It is evident that our universities are called upon to share the financial burden involved in a national research scheme to a much greater extent than possibly they know.

I may perhaps summarize some of the conclusions reached in thinking over these questions. The first and most important is that in each institution there should be a board or standing committee entrusted with the supervision of research. The functions of such a body would be widely varied and would include:

1. The allocation of money voted specifically from university or college funds for research expenses.

2. The power to recommend additions to the teaching staff in departments actively engaged in research.

3. The recommendation of promotions on the basis of research achievement.

4. The supervision of regulations governing higher degrees.

Among the more specific problems which confront this board are the following:

1. The creation of research libraries where reference works can be consulted immediately.

2. The provision of publication grants, so that where no periodical literature is available the work will not remain buried or obscure.

3. The allocation of traveling grants to en-

able workers to visit libraries, to inspect manufacturing processes, and to attend the meetings of scientific societies.

There is one thing which a research board should avoid. It is, I am convinced, a mistake for a governing body to call for an annual list of publications from research laboratories. Nothing could be more injurious to the true atmosphere of research than the feeling of pressure that papers must be published or the department will be discredited.

What I have said so far may seem largely a recital of new difficulties, but they are not insurmountable, and to overcome them adds a zest to life. It would have taken too long to go more fully into details, and I have tried to avoid making my address a research syllabus, merely giving in general terms the impressions gained during the twenty years in which the St. Andrews Research Laboratories have been in existence.

I have confined myself to the first stage in the research development of the chemist. His future path may lead him either to the factory or to the lecture-room, and in the end the exceptional man will be found in the director's laboratory or in the professor's chair. However difficult these roads may prove, I feel that with the financial aid now available, supported by the self-sacrificing labors of those who devote themselves to furthering this work, he has the opportunity to reach the goal. It is the beginning of a new scientific age, and we may look forward confidently to the time when there will be no lack of trained scientific intellects to lead our policy and direct our efforts in all that concerns the welfare of the country.

J. C. Irvine

THE UNITED STATES FUNDAMENTAL STANDARDS OF LENGTH AND MASS

The recently published volume containing the testimony submitted to the Senate Committee on Manufactures, in favor of and against the passage of Senate Bill 2267 "To fix the Metric System of Weights and Measures as the Single Standard of Weights and Measures for Certain Uses," contains a mass of information and misinformation of great interest to students of metrology.

The opponents of the metric system were very active in marshalling their full strength at the numerous "hearings" before the subcommittee, about half of the volume being devoted to the evidence which they furnished, either in writing or in the form of personal testimony.

These are the pages which the well informed reader will certainly find most interesting, because of the remarkably illogical arguments introduced, the total disregard of historic facts and the apparently complete ignorance of the fundamental principles of the science of metrology.

This is especially true of the testimony of Mr. C. C. Stutz who, born in Italy of Swiss parents, seems to have been thought particularly fit to be chosen as the representative of the opposition, being the secretary of the American Institute of Weights and Measures, an organization created, as the secretary declares, "for the purpose of defending the existing American system of weights and measures against pro-metric propaganda,"—and also for the improvement of the same, though evidence of the latter objective seems yet to be forthcoming.

Mr. Stutz is especially agitated because, as he says, "the impression has been spread throughout the United States and abroad that the meter and not the yard is the legal standard here"—discussing that question at great length on pages 173-4-5-6 and again pages 318-19-20 of the Report of the Hearings. He creates an imaginary American "inch," contending that it is exactly the same as the English inch and hence the English yard and the American yard are identical.

In reference to this particular part of Mr. Stutz's voluminous testimony the statement of a few facts that are well known to most metrologists may be useful.

The constitution of the United States declares that Congress shall have power "to fix the standard of weights and measures," but Congress has never exercised that power, except in a few isolated instances, the most important being the adoption of the decimal system for the coinage and currency of the United States in 1785—with the subsequent adoption in 1828 of a material standard "troy pound" for the regulation of the coinage, and the "act to define and establish the units of electrical measure," which became a law on July 12, 1894.

The failure of Congress to act when the importance of action was especially urged by Washington in a message to the first Congress, as it was later by Jefferson, Madison and Adams, was due to the general recognition of the unscientific character of the clumsy and burdensome system or systems then in use in the colonies (mostly derived from the then very imperfect English system) and a strong desire on the part of the "early fathers" (who seem at this distance to have been as wise as they were early) to put into our weights and measures the same simplicity of decimal ratio that has made our system of currency the best in the world.

In the absence of congressional action many of the states acted separately, establishing their own standards, thus creating much confusion. Some states took no action at all, the business of exchange of commodities by weight and measure being based upon units that had no authority except tradition and continued use.

In the mean time important work was to be done by the government itself, in which standards of authority and precision were required. By far the greater part of this, the collection of revenue and the survey of the coasts and the country as a whole, was under the jurisdiction of the Treasury Department, and to a bureau of this department, the Coast and Geodetic Survey, was assigned the duty of obtaining and caring for such standards of precision as could be obtained in Europe.

Among them was a brass bar, eighty-two inches in length, made by Troughton, of London, which was graduated in inches and tenths with a degree of accuracy probably as high as was at that time attainable. A careful examination of the divisions, however, revealed a considerable degree of irregularity, but it was finally decided (1830) that when the temperature of this bar was sixty-two degrees Fahrenheit the distance between the twenty-seventh and the sixty-third inch lines should be regarded as the standard yard by all of the various government bureaus in which measures of length were used.

It is important to note that there was no congressional action, no law passed, the fixing of this standard being done by the secretary of the treasury, on the recommendation of the superintendent of the coast survey, acting in the capacity of superintendent of weights and measures.

Its authoritative use, therefore, was restricted to operations in which the United States government was concerned. At the same time, as the result of the discovery of great discrepancies among the weights and measures actually in use at the principal custom houses, standards of mass and volume were established, the validity of which was restricted in the same way.

In order to reduce the confusion of standards in and among the several states, in 1836 the secretary of the treasury caused a complete set of all weights and measures adopted for use in the collection of revenue to be delivered to the governor of each state, hoping that through their adoption by state legislatures a good degree of uniformity might be secured. In many cases this followed and in some instances the treasury standards were accepted without legislation.

To recur now to the standard yard as represented on the Troughton scale, and its relation to the English standard: It was doubtless a copy, though not an exact copy, of what had been adopted by the English parliament in 1826 as the imperial yard of Great Britain. This was a bar on which the yard was engraved, made in 1760 by a mechanician named Bird and kept in the custody of the clerk of the House of Commons.

In 1834 the burning of the Parliament House destroyed this and other imperial standards stored therein, and thus the immediate ancestor of the Troughton scale disappeared.

It was found impossible to reproduce it with any degree of accuracy by finding the period of vibration of a pendulum as had been originally provided and recourse was had to several copies of it which had been made and deposited elsewhere. In this way was created the imperial yard which is at present the standard of length in Great Britain.

Here, therefore, are two outstanding facts: First, assuming for the moment that the Troughton scale has some legal standing as a standard yard of the United States, it is *not* a copy of the standard yard of Great Britain and it is well known that it is not in agreement with that standard. Hence our inch can not be the same as the English inch.

Second, the Troughton scale has not and never had legal standing as a standard of length, authoritative over the whole country, and furthermore, it may be well to repeat that Congress has never passed an act to establish a standard yard or a standard inch, except indirectly, as will be explained later.

Thus the claim made by Mr. Stutz and his followers that the inch of the United States is identical with that of Great Britain has no foundation whatever in fact.

The use of the metric system of weights and measures throughout the United States was legalized by act of Congress in 1866 and it is an interesting fact that it is thus far the only general system of weights and measures that has full legal (though not compulsory) standing throughout the whole country.

The history of the so-called "Mendenhall Order" which seems to be so disturbing to the peace of mind of Mr. Stutz and others opposed to metrological reform is briefly as follows: a copy of what is known as the "Metre of the Archives" and also a copy of the kilogramme, both of platinum, came into the possession of the Coast Survey in 1821, through the interest of Albert Gallatin, and as years passed other standard measures were added to the collection, including copies of the imperial yard. The inferior character of the earlier standards as compared with those of later date led to the practical abandonment of their use wherever work of the highest degree of precision was attempted. Every metrologist knows that a material standard may have the backing of legal authority and at the same time be so crude and imperfect as to be useless for refined work.

Without going into the history of the International Bureau of Weights and Measures and the production of beautiful copies of the international standards, it is sufficient to say that on the receipt of the two copies allotted to the United States it was resolved to formally abandon the Troughton scale as a standard of length and adopt the international metre as the final standard of reference, for only in this way could work of high precision then being done in the United States (this included not only the operations of the Coast and Geodetic Survey and other bureaus of the government but practically all research work done at colleges and universities or by independent scientific workers) be "tied up" with that done in Europe, for even in England the metric system was and still is in universal use among scientific men.

In recognition of the really great importance of the event, it was arranged to have the seals (which had been put upon the containers of these standards before they left Paris) broken by the President of the United States.

This was done in the cabinet room of the executive mansion on the second of January, 1890, in the presence, also, of the Secretary of State and the Secretary of the Treasury, together with a number of invited guests, representatives of engineering and scientific societies and others especially interested in the science of metrology.

Thus Metre No. 27 and Kilogramme No. 20 were formally adopted as the national prototype metre and kilogramme.

In connection with the World's Fair in Chicago in 1893 there was held an International Electric Congress, associated with which was a "Chamber of Delegates" officially organized for the purpose of coming to an international agreement upon the definitions of units for electrical measure.

In view of the probable success of this movement and of the certainty that such definitions would be built upon a metric foundation, it was deemed wise to have definite recognition of these national prototypes as the fundamental standards of reference in all metrological operations in which the United States Government was concerned.

This was accomplished by the preparation and publication of Bulletin No. 26 of the Coast and Geodetic Survey, which became authoritative on the approval of the Secretary of the Treasury which it received on April 3, 1893.

The "bull's eye" of that announcement is found in the following sentence: "In view of these facts and the absence of any material normal standards of customary weights and measures, the office of weights and measures, with the approval of the Secretary of the Treasury, will in the future, regard the international prototype metre and kilogramme as fundamental standards, *and the customary units, the yard and the pound, will be derived therefrom* in accordance with the Act of July 28, 1866."

Mr. Stutz in his testimony before the committee quotes this sentence several times, referring to the last phrase, "in accordance with the Act of July 28, 1866," as evidence that the metre and kilogramme are not thus made fundamental units but are to be considered as dependent upon the inch and the pound, according to his personal interpretation of the Act of 1866. But by some unhappy chance, by accident or otherwise, he has invariably omitted the words italicised above, "the customary units, the yard and pound, will be derived therefrom," which nullify and completely reverse his argument.

His quotations are apparently made from a circular, No. 47 of the Bureau of Standards in which, according to his own words, it was not intended to reproduce the order as a whole. It is possible, therefore, that these very important words were omitted in that circular and Mr. Stutz shall have the benefit of the doubt, but if he had consulted the original order he would have found them.

There can be no doubt of their meaning and it is a fortunate thing that the legal relations established by the Act of 1866 are so very nearly correct that for all ordinary purposes of comparison (and there can be no other) they are sufficiently accurate.

Recalling the fact that when this Act was passed Congress had never defined the yard or the pound (except the Troy pound for use in the mint); that these words had, throughout the country as a whole, no definite meaning; and the further fact that at that time the metric system of weights and measures was in almost universal use, except in Great Britain and the United States, and that it was represented by precise material standards, it seems more probable than otherwise that the Act of 1866 itself put the country upon a metric basis, supplemented and completed as it was by the receipt and adoption in 1890 of the national prototypes.

In any event there can be no possible doubt as to the effect of the issue of Bulletin No. 26 in making them the fundamental standards for all metrological operations in which the national government is in any way concerned.

The opponents of the metric system are strangely silent regarding another Act of Congress, much more far-reaching and vastly more effective in putting the country upon a metric basis than anything which preceded it.

It is the Act of July 12, 1894 which defines the units of measure by means of which transactions amounting to many hundreds of millions of dollars annually are adjusted, furnishing the sole method of measuring output and consumption of one of the very largest and most important industries of the present day. No one has had the courage to suggest a revision or repeal of that Act, so as to put into it the sacrosanct inch and one of the numerous pounds, in place of the centimetre and the gramme. Watt, kilowatt, volt and ampere are now familiar terms. The great war produced an almost universal interest in metric units and caused many manufacturers to regret that their use had not been made compulsory long ago.

And now space above and around us is almost constantly disturbed by waves, the length of which, measured only in metres, is of vital interest to tens of thousands of people, old and young, rich and poor, who are finding out what a metre is and what goes with it, so that, take it all in all, it seems certain that the opponents of metrological reform are engaged in a hopeless task.

In their own words, "they have beaten it once," and perhaps they may beat it again, *but not many more times.*

T. C. Mendenhall

Ravenna, Ohio
September 2, 1922

SCIENTIFIC EVENTS

THE HERSCHEL CENTENARY

William Herschel died 1822 August 25. A hundred years later a party of Herschels of the third, fourth and fifth generations, astronomers and members of the Slough Urban Council made a pious pilgrimage to Upton Church, Slough, where he lies buried; and, after lunching together at the Crown Hotel, which once formed part of William Herschel's property, proceeded to Observatory House—in which two of his granddaughters still live,—where they saw many manuscripts and the other relics of the great astronomer. They saw, for instance, the copy of Locke "On the Human Understanding," the first English book he purchased in order to study our language; and they saw also Caroline Herschel's "Bills and Receipts of My Comets," which was her manner of labeling papers relating to her cometary discoveries; they saw a piece of the old 40-foot tube, and one of the 4-foot mirrors made for it, and discussed with Miss Herschel the possible whereabouts of the other mirror, which may be buried in the garden, and still to be excavated. It is wonderful to think how Herschel's work, old though it is, touches our modern work almost at every point. If we take the half-dozen great advances mentioned by Professor Eddington in his centenary address to the Royal, we are reminded by the measurements of stellar parallax how Herschel's attempts in this direction led to the recognition of binary stars; the discovery of Neptune depended essentially on Herschel's previous discovery of Uranus; one of the early uses made of the spectroscope was to confirm Herschel's view of the gaseous nature of nebulæ; in photography the first glass negative was taken by his own son, and the subject was the scaffolding of his great 40-foot, and even in our modern advances the two-stream hypothesis is only a development of Herschel's investigation of the sun's movement among the stars; and the measurement of the disc of Betelgeuse reminds us not only of his careful scrutiny of objects for any signs of a disc, but of his investigations in optics and his splendid engineering work in the making of great telescopes. How he would have enjoyed himself in the great factory at Mt. Wilson, or discussing problems of cosmogony with the mathematicians of today! Undoubtedly he was a great man, and it was fitting that his memory should be thus honored, so soon after the centenary of the society which had the honor of having him for its first president.—From an Oxford Note-Book in *The Observatory*.

AMERICAN ORNITHOLOGISTS' UNION

The fortieth stated meeting of the American Ornithologists' Union will convene in Chicago, from October 24 to 26. The public meetings will be held in the lecture halls of the Field Museum of Natural History, from 10 A.M. until 4:30 P.M. each day.

The reading of papers will form a prominent feature of the meetings. All classes of members are earnestly requested to contribute, and to notify the secretary before October 15, as to the titles of their communications, and the length of time required for their presentation, so that a program for each day may be prepared in advance.

Business sessions will be held at the University Club of Chicago. Public sessions will be held in the Field Museum of Natural History, Roosevelt Road and Lake Michigan. Hotel headquarters will be at the Auditorium Hotel. According to custom, a dinner will be held on Wednesday evening, October 25, for fellows, members, associates and guests. Luncheon will be served daily at 1 P.M. in the museum, October 25, 26, 27. On Friday, October 28, an excursion will be conducted to the Indiana Sand Dunes, fifty miles southeast of Chicago. Particulars in regard to these features will be found at the registration desk on the opening day.

An exhibition of bird paintings and photographs will be held in connection with the meeting, to which every one is invited to contribute. Original paintings, drawings and sketches in color or black and white are desired, not only from the artists, themselves, but from owners who may be willing to loan them.

PUBLIC LECTURES AT THE CALIFORNIA ACADEMY OF SCIENCES

The California Academy of Sciences announces a course of six free public lectures on the general subject of "Science and Health," to be given at three o'clock on Sunday afternoons, in the auditorium of the Academy's Museum in Golden Gate Park, San Francisco, as follows:

October 1. The Experimental Method in Animal Psychology: Dr. Samuel J. Holmes, professor of zoology, University of California.

October 8. Equilibration of Animals and Aviators: Dr. Samuel S. Maxwell, professor of physiology, University of California.

October 15. The Use of Animals in the Diagnosis and Prevention of Disease: Dr. Carl A. L. Schmidt, associate professor of biochemistry, University of California.

October 22. Animal Experimentation: Dr. T. D. Beckwith, professor of bacteriology, University of California.

October 29. Animal Foes of the Human Body and How to Control Them: Dr. Charles A. Kofoid, professor of zoology, University of California.

November 5. What Animal Experimentation Has Done for Childhood: Dr. E. C. Fleischner, clinical professor of pediatrics, University of California.

These lectures are all masters in their respective subjects. What they have to say will not only be authoritative and up to date, but will be presented in a popular and convincing manner. These lectures, which will be illustrated, are offered by the California Academy of Sciences, free to the public, as one of the several educational activities in which it is engaged.

THE SILLIMAN LECTURES OF YALE UNIVERSITY

This year's Silliman Memorial Lectures at Yale University will be delivered by Dr. August Krogh, professor of zoophysiology in Copenhagen University. Professor Krogh has taken for his general topic "The Anatomy and Physiology of Capillaries," and will speak on the following subjects on the dates given:

October 5: "The Distribution and Number of Capillaries in Selected Tissues. The Evidence of Their Independent Contractility.

October 6: "The Histological Structure and Innervation of the Capillary Wall."

October 9: "The Reactions of Capillaries to Stimuli. The Hormonel Control of Capillary Circulation."

October 10: "The Mechanism of Some Capillary Reactions, especially in the Human Skin."

October 11: "The Exchange of Substances through the Capillary Wall."

October 12: "Some Problems of Capillary Physiology and Pathology."

Professor Krogh has a large amount of entirely new material to present which should prove of importance to all those branches of science which concern the circulation of the blood. At the time of the award of the Nobel Prize to Dr. Krogh in 1920 his work on capillaries was regarded as only beginning, and since that time his researches in this field have been pushed ahead with rapidity and success. The results of these researches will be made public for the first time in the Silliman lectures.

In a recent article in *The Scientific Monthly*, Dr. W. R. Miles, of the Nutrition Laboratory of the Carnegie Institution of Washington, gave the following résumé of Dr. Krogh's career to date:

> Dr. Krogh is scarcely forty-five years old. He received his educational and scientific training in Denmark and is a son of whom that country can well be proud. For a number of years after receiving his degree and serving as laboratory assistant to Professor Christian Bohr no suitable teaching or research position opened to him in Denmark. However, he refused to accept such a position in any other country. He made two expeditions to Greenland, the first to study the tension of carbon-dioxide in ocean water and the second to investigate the respiratory metabolism of the Eskimos. Thus, without any laboratory facilities, he literally plunged into research. A study on the expiration of free nitrogen from the body was recognized as so important as to receive the Seegen Prize of the Imperial Academy of Sciences in Vienna. He was appointed a lecturer in physiology under the science faculty of the Copenhagen University in 1908 and was provided with a small laboratory in the fall of 1910. It is in this laboratory that most of his scientific work has been done. A visitor will gain the impression that his laboratory facilities are rather meager as regards both room and equipment and that he does not have adequate assistance. Certainly it would be a most worth while investment to provide such a man with all the assistance he can comfortably direct. His researches have covered a wide range and have been singularly concise and complete. He is a master technician, a

scientific explorer by nature, a skilled interpreter and critic of scientific facts, and he has much facility in writing. Most of his recent work is published in English. About his personality there is a quiet humility which strongly attracts advanced students and begets confidence in Dr. Krogh's scientific results. His mental attitude can well be illustrated by a sentence from a recent letter to an American colleague: "The Nobel award came as a perfect surprise to me and when it was first told me by a journalist, I declined to believe it because, in my opinion, my work on the capillaries was so far only a promising beginning."

APPOINTMENTS AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The Massachusetts Institute of Technology announces a number of additions to its faculty and instructing staff. Chief among these are the appointments of W. Spencer Hutchinson to the professorship of mining, Dr. G. B. Waterhouse to the professorship of metallurgy and Dr. Frederick G. Keyes to be acting head of the department of chemistry.

Professor Hutchinson graduated from the institute in 1892, after having studied in the civil engineering and mining departments. During his career he has examined and managed a number of mining properties in the United States. He is known as an authority on mine valuation and taxation, and has done much professional work in Mexico, South America and Australia. For several years he has been consulting engineer for the Vanadium Corporation of America, which has extensive mines in Peru. He has been a consultant mining engineer in Boston.

Professor Waterhouse was born in England forty years ago, and educated at Sheffield, where he received the degree of bachelor of metallurgy. He came to the United States in 1900, and later studied at Columbia University, where he obtained the degree of doctor of philosophy in 1906. He is the author of numerous original scientific papers and the translator of a great number of French and German works on metallurgy. His specialty is the metallurgy of iron and steel. From 1908 until the present time he has been technical director of the Lackawanna Steel Company in Buffalo.

Professor Keyes, the acting head of the department of chemistry, is a graduate of Rhode Island State College and of Brown University. During the war he was stationed at Puteaux as director of the Research and Control Laboratory, with the rank of major in the A. E. F. In 1920 he was made director of the Research Laboratory of Physical Chemistry at the institute, following the resignation of Professor A. A. Noyes. A short time ago Professor H. P. Talbot resigned as head of the department of chemistry to become dean of students on the retirement of Professor Burton, and Professor Keyes was appointed as acting head of the department until Professor Talbot's permanent successor is chosen.

SCIENTIFIC NOTES AND NEWS

At the Hull meeting of the British Association, Mr. F. E. Smith, director of scientific research at the Admiralty, and secretary of the Physical Society, was elected one of the general secretaries, to succeed Professor H. H. Turner, of the University of Oxford. Professor J. C. Shields and Professor J. C. McLennan presented the invitation to meet in Toronto in 1924, which was accepted. It was announced that a grant of about $50,000 would be available for the meeting and for defraying the expenses of visiting members.

Professor J. H. Jeans, secretary of the Royal Society, who was professor of applied mathematics at Princeton University from 1905 to 1909, received the doctorate of science from Oxford University on the occasion of his delivery of the Halley lecture.

Professor E. T. Whittaker, formerly royal astronomer for Ireland and secretary of the Royal Astronomical Society, has been elected a foreign member of the Reale Accademia dei Lincei.

The honorary degree of doctor of science has been awarded by the University of Leeds to Professor A. F. Holleman, of the University of Amsterdam.

In recognition of the notable services rendered by Dr. Bernhard E. Fernow to forestry in America, the trustees of Cornell University have given the name Fernow Hall to the university building devoted to instruction in forestry. The formal unveiling of the tablet bearing Dr. Fernow's name took place October 5, when addresses commemorative of his achievements were delivered by Dr. Livingston Farrand, president of the university, Dean Albert R. Mann, of the New York State College of Agriculture, and Professor Ralph S. Hosmer, head of the department of forestry. Dr. Fernow organized at Cornell University in 1898 the first school of forestry in America.

At a recent meeting of the corporation of Yale University a letter was presented from Dr. Lawrason Brown, president of the National Tuberculosis Association, in which appreciation was expressed of the work of Professor Treat B. Johnson and Mr. Elmer B. Brown, who had been associated with Dr. Esmond R. Long, of the University of Chicago, in research in the fundamental nutrition of the tubercle bacillus. The corporation passed a vote of thanks to the National Tuberculosis Association for its further appropriation for the work in which Professor Johnson and Mr. Brown will continue to be associated.

The Treasury Department has announced that Dr. J. W. Scherechewsky, assistant surgeon general, U. S. Public Health Service, has been commissioned to conduct an investigation into the cause of cancer; the headquarters of this investigation will be established in Boston.

Professor H. B. Merrill, of Carroll College, has resigned to take up chemical work in the research laboratory of the A. F. Gallun & Sons Company, Milwaukee.

Dr. A. R. Fortsch, of the Iowa State University, will become research chemist in the laboratory of the Standard Oil Company at Whiting, Indiana.

An Associated Press despatch from Honolulu, dated September 20, states that, as the result of burns received while experimenting with radium, Dr. Hideljich Kinoshita, professor of science at the Imperial University of Tokyo, may lose his eyesight.

The governors of the Harper Adams Agricultural College, Newport, England, have accepted with regret the resignation of Mr. P. Hedworth Foulkes, who has held the post of principal since the opening of this college twenty-two years ago.

George A. Seagle, who had been for thirty-eight years superintendent of the Wytheville (Va.) station of the Bureau of Fisheries, has retired from active service.

Mr. W. H. Fry, petrographer in the Bureau of Soils, U. S. Department of Agriculture, for a number of years past, has resigned and will remove to Fayetteville, N. C.

Dr. O. A. Reinking has resigned from the University of the Philippines to take a position as plant pathologist, in Honduras, for the United Fruit Company. Dr. Reinking recently received his doctorate at the University of Wisconsin, where he has continued researches, begun in the Philippines on coconut bud-rot. He obtained leave from the University of the Philippines about a year ago and returned to this country by way of British North Borneo, Java, Italy, Germany, France and England, visiting mycological and pathological institutions.

Dr. Barton Warren Evermann, director of the Museum of the California Academy of Sciences and of the Steinhart Aquarium, has been appointed by the National Research Council as its representative at the Commercial Conference to be held at Honolulu from October 25 to November 8, under the auspices of the Pan-Pacific Union, where he will present a paper on "The Conservation of the Marine Life of the Pacific." Dr. Evermann will sail for Honolulu on the *Maui* on October 18.

Professor S. R. Williams, head of the department of physics of Oberlin College, has been granted a year's leave of absence and will spend the year in research work at the California Institute of Technology as research associate.

Professor George Grant MacCurdy has returned to Yale University after a year's stay abroad as first director of the American School in France for Prehistoric Studies.

Dr. Alonzo E. Taylor, of Stanford University, sailed for Europe on September 23.

According to English journals, an expedition headed by Captain F. Hurley has left

Sydney for Port Moresby with the object of exploring New Guinea from the air. The party includes an ethnologist and a naturalist. Two seaplanes are being taken and will be used in a four months' air survey of the western portions of British New Guinea. Meanwhile the scientific section of the expedition will navigate the Fly River in a ketch. The cost of the seaplanes is being borne by Mr. L. Hodson, of Sydney.

The courses offered by the New School for Social Research, New York City, include "The Significance of Modern Philosophy," by Professor John Dewey, Columbia University; "Behavior Psychology," by Dr. John B. Watson, of the J. Walter Thompson Company; "Psysiology and Conduct," by Professor Arthur R. Moore, of Rutgers College, and "Biology and its Social Implications," by Professor Otto Glaser, of Amherst College.

The Harveian Oration will be delivered before the Royal College of Physicians of London by Dr. Arnold Chaplin, on October 18. The Bradshaw Lecture will be delivered by Sir Maurice Craig, on "Mental symptoms in physical disease," on November 2. The Fitz-Patrick Lectures will be delivered by Dr. R. O. Moon, on "Philosophy and the post-Hippocratic school of medicine," on November 7.

A celebration of the one hundredth anniversary of the birth of Louis Pasteur will take place in Philadelphia on December 27. Tentative plans call for a meeting in the afternoon at the Academy of Music, and a banquet in the evening at the Bellevue Stratford Hotel, at both of which there will be distinguished speakers. A general committee, comprising Drs. Edgar Fahs Smith, Ernest Laplace, Francis X. Dercum, Charles A. E. Codman Wilmer Krusen, McCluney Radcliffe, secretary, Judson Daland, treasurer, and William Duffield Robinson, chairman, and an honorary advisory committee from all parts of the country have been appointed.

Dr. Alice Robertson, for several years professor of zoology in Wellesley College, known for her work on the Bryozoa, especially of the Pacific Coast of North America, died at Berkeley, California, on September 14. Although Dr. Robertson had not been in good health for several years, she had kept at her scientific work, and death followed a sudden illness, which a surgical operation failed to relieve.

Miss Mary A. Booth, formerly editor of *Practical Microscopy,* has died at her home in Springfield, aged seventy-nine years. She was a member of the American Microscopical Society, the New York Microscopical Society, and the Brooklyn Institute of Arts and Sciences and a fellow of the American Association for the Advancement of Science and of the Royal Microscopical Society of London, England.

David Sharp, F.R.S., formerly curator of the Museum of Zoology at the University of Cambridge and editor of the *Zoological Record,* died on August 27, at the age of eighty-one years.

Tadeusz Godlewski, professor of physics in the School of Technology at Lwów, has died at the age of forty-four years. He is known for his work on radioactive and electrochemical problems.

Dr. T. Ichikawa, president of Momoyama Hospital, Tokio, died on September 19 from typhoid fever contracted while experimenting with typhoid serum.

The organization founded to promote the welfare of the University of Bonn has endowed the university with an institute for research with the roentgen rays. Professor Grebe is in charge and it is expected that the institute will be inaugurated this fall.

A scientific conference on problems relating primarily to the Pacific region will be held in Australia during August or September of next year. Plans are now being made for this event by the Australian National Research Council, supported by a commonwealth grant of £5,000 under the leadership of Professor Sir T. Edgeworth David. This will be the second conference on Pacific problems. The first was organized by the Committee on Pacific Investigation of the American National Research Council and met in Honolulu in August, 1920. The scientific men and scientific agencies interested in studies of the Pacific have not yet formed any definite organization except a committee which has acted informally to facilitate continuity of effort. Although some form of organization may be adopted at the meeting in Australia, it is expected that each conference will be autonomous and independent and that the organization and program for each conference will be in the hands of the country that issues the invitation.

We learn from *Nature* that the centenary of the Yorkshire Philosophical Society, which was founded in 1822, was celebrated on September 20. The members of the society and its guests were received in the gardens of the Yorkshire Museum by the president, Mr. W. H. St. Quintin, and a number of congratulatory addresses from national as well as local learned bodies were read by the representatives. Later, the gathering went in procession to the Minster, where a short service was held and an address delivered by the Bishop of Beverley.

The third international conference of "Psychotechnique appliqué à l'orientation professionnelle" will meet this year at Milan on October 2 to 5. According to the announcement there were to be discussions on the following subjects: (*a*) What is meant by vocational aptitudes? (Lahy); (*b*) Natural aptitudes and acquired aptitudes (Décroly, Patrizi); (*c*) The psychological analysis of work (Gemelli, Lipmann); (*d*) Vocational guidance and Taylorism (Bauer); and (*e*) An international unification of tests and individual ratings (Claparède, Mira, Myers).

A health survey of the printing trades has been authorized by the International Joint Conference Council, representing both employers and employees. The survey is intended to cover two years and will be nation-wide. The work will include a thorough study of printing processes in their relation to health and of printing house conditions, possibly more or less detrimental to health and life. The investigation will be carried on in cooperation with a large number of governmental, scientific and corporate organizations, including the United States Bureau of Labor Statistics, which will have charge of the major portion of the social and economic inquiries. A large measure of cooperation is expected from the insurance companies, but especially from Harvard Medical School, Yale Medical School, the Public Health School of Johns Hopkins University and a number of state health and labor departments. Particular emphasis will be placed upon methods of ventilation, air-pollution, lighting, eye-strain, posture and physique. The investigation will be under the immediate direction of Dr. Frederick L. Hoffman, dean of the advanced department of the Babson Institute, Wellesley Hills, Massachusetts, and consulting statistician to the Prudential Insurance Company of America.

We learn from the London *Times* that the Rowett Institute of Research in Animal Nutrition, which is conducted by a joint committee of representatives of the University of Aberdeen and the North of Scotland College of Agriculture, was opened by Queen Mary on September 12. The buildings forming the institute are situated about a mile from Bankhead, Aberdeen. The capital outlay on the scheme was about £50,000. Of this sum the Treasury, on the recommendation of the Development Commission, promised £20,000 provided an equal sum was obtained from other sources. At this stage Mr. John Quiller Rowett, LL.D., who has shown great interest in scientific research, offered £10,000 to allow the work of building the institute to proceed. Impressed with the necessity of leaving the institute room for expansion, Dr. Rowett made a further offer to provide, in addition to his first generous gift, sufficient funds to purchase the farm of Bridgefood and the croft of Redpool. The institution has been organized to include departments dealing with physiology, biochemistry, bacteriology and pathology, and to have an animal husbandry department, which is carrying out feeding and other experiments on a practical scale. All these departments afford mutual assistance to each other, and all the work, both purely scientific and practical, is organized from the newly built center. The director of the institute is Dr. J. B. Orr.

There is given in *Nature* some further information concerning the meeting of the Commission on Intellectual Cooperation of the

League of Nations which held its first session at Geneva from August 1 to 5. The commission had been given a free hand to define its own program with due regard to existing national activities and existing organs of international intellectual life. The following were among the topics selected for consideration: the desperate economic condition of the *intelligenzia* in some European countries—notably Austria and Poland; the protection of proprietary rights in scientific discoveries and ideas; the establishment of an international *entente* for the examination and publication of archeological monuments; inter-university relations; and an international organization of bibliography. All these questions have been referred to individual members of the commission or to sub-commissions for the preparation of reports with the view of taking further action. As for cooperation in scientific research, the commission, anxious not to interfere in the organization or work of the scientific societies, decided that this should be left to the initiative of the societies themselves. Another question on which the commission found itself unable to take any useful action was the publication by common consent of workers in all parts of the world of discoveries relative to toxic gases and the development of chemical warfare. It decided to reply to the reduction-of-armaments commission, which had referred the question, that it was unable to suggest methods whereby this result might be brought about.

UNIVERSITY AND EDUCATIONAL NOTES

Mr. James B. Duke has given $1,125,000 to Trinity College. The gifts include $1,000,000 to the college endowment fund, $25,000 to the new gymnasium, $50,000 towards a $100,000 law building and $50,000 toward a $100,000 building for the new school of religious training.

Dr. Worth Hale, assistant dean of the Harvard Medical School, has been appointed acting dean to serve during Dr. David L. Edsall's absence in Europe during the first half year; Dr. Roger I. Lee will serve as acting dean of the School of Public Health.

Dr. John M. T. Finney has been appointed temporary surgeon-in-chief of the Johns Hopkins Hospital and professor of surgery in the medical school, in place of the late Dr. William S. Halsted. The faculty will appoint a committee to make a permanent selection.

Dr. L. A. Pechstein, director of the department of psychology and education of the University of Rochester, has been appointed dean of the College for Teachers of the University of Cincinnati, to succeed Dr. W. P. Burris.

The psychology department of the Ohio State University announces the following additions to its staff: Herbert H. Goddard, full professor; Robert D. Williams, assistant professor; Marjorie Bates, instructor. The following promotions have also been made: Harold E. Burtt to full professor; A. Sophie Rogers to assistant professor.

Richard C. Lord, Ph.D. (Washington and Lee), for some time engaged in industrial chemistry, has been appointed assistant professor of chemistry and physics in Kenyon College.

Dr. F. I. Wertheimer, recently connected with Professor Kraepelin's clinic at Munich, has become a member of the staff of the Henry Phipps Psychiatric Clinic at the Johns Hopkins Hospital.

The Council of University College of North Wales has appointed Professor David Thoday, of the South African University, Cape Town, to the chair of botany, in succession to Dr. Phillips, who retires after thirty-eight years' service.

Dr. George Haswell Wilson, lecturer in bacteriology at the University of Glasgow, has been appointed to the chair of pathology in the University of Birmingham, rendered vacant by the election of Professor J. Shaw Dunn to the corresponding post in the University of Manchester.

DISCUSSION AND CORRESPONDENCE

THE DEATH RATE FROM TUBERCULOSIS

To the Editor of Science: About a year ago, I had occasion to request of the chief executive of one of our important health departments, information upon the incidence of tuberculosis in his state for the past decade. In his reply he stated, among other things, that recently there had been a very marked and quite inexplainable decline in the tuberculosis death rate. The statement struck me as singular, for it is difficult to conceive of a sudden, conspicuous decline in the death rate of a disease of the nature of tuberculosis, without a reasonable explanation for it. A very brief search for an explanation soon revealed the fact that the experience of the particular health officer to whom I had written was not peculiar to his state, but was demonstrable for practically all our registration states, as well as for the most of our larger centers of urban population.

If one will chart by years the mortality rates for tuberculosis for a period covering the past fifteen or twenty years, for almost any of our states or cities that keep correct records and that have been active in the suppression of tuberculosis, it will be seen that in the main there was a steady decline until 1917 and 1918. During 1918 and 1919 there was a sharp upward trend to the curve, followed in a year, or at most two years, by a marked downward direction of the curve—much steeper in its descent than that preceding 1917-1918. With a number of such charts before one, the reason for the recent decrease in the death rates from tuberculosis becomes obvious. The pandemic of influenza of 1918-19 carried off, in a brief period, a large number of tuberculosis subjects that would otherwise have lived on and their deaths been so distributed through later years as not materially to have disturbed the uniform downward direction of the tuberculosis curve that preceded the period of the great pandemic.

From the standpoint of results, advantageous to the race alone, and disregarding all humane considerations, this may be viewed as the beneficent influence of a great plague. The least resistant of the population succumbed, those more resistant and physically better fitted to survive, did so. The human material thus left is probably the most promising that has existed for generations, in so far as the permanent lessening of tuberculosis among it is concerned; and we can expect that the curve for tuberculosis death rates in the future will be for a time much more sharply downward than ever before, and that its average level for a number of coming years will be much lower than that preceding the epidemic of influenza, providing, of course, there is no abatement of those widespread activities that have been so instrumental in lessening the incidence of the disease in the past.

For the anti-tuberculosis worker, the present appears to offer a golden opportunity.

A. C. Abbott
School of Hygiene and Public Health,
University of Pennsylvania

OLD GLACIATION IN THE CORDILLERAN REGION

To the Editor of Science: The communication by Thomas Large on the above subject in the September 22 issue of Science prompts me to write that in 1916 I found till with striated boulders and pebbles in the brickyard near the normal school at Cheney, Washington, beyond the limits here reported by Large. I brought this matter to the notice of the Geological Society of America at the Albany meeting in December, 1916, and the following brief statement concerning it appears in the proceedings of that meeting (*Bull. Geol. Soc. America*, Vol. 28, p. 143):

> In northern Washington the occurrence of a very old drift, probably Kansas, was established by the discovery of till and striated stones on a high divide southwest of Spokane, in the vicinity of Cheney. Boulders had been observed in this region, and the possibility of glaciation had been suggested by M. R. Campbell in the Northern Pacific Guide Book.

Frank Leverett
Ann Arbor, Michigan,
September 25, 1922

SOME SIMILARITIES BETWEEN THE GEOLOGY OF CALIFORNIA AND PARTS OF THE DUTCH EAST INDIES

If we compare the Sierra Nevada with the Malay Peninsula, the Coast Range with the Barissan Mountains of West Sumatra and the great valley of California with the plains of East-Sumatra, it is obvious that the topographical similarities are attended with geological ones. In the Malay Peninsula as well as in the Sierra Nevada granitic rocks of about the same Mesozoic age have a great extension. The original cover of these rocks has disappeared during the succeeding periods by long erosion and the erosion products fill up the geosynclinal basins of East-Sumatra and the valley of California, which both are characterized by important oil deposits of Tertiary age. And to the west young mountain ranges, in which strong earth movements still continue, have separated the geosynclinal basins from the ocean.

In the Dutch East Indies important transversal and diagonal fractures occur near the bending points of the horizontal projection of the geanticlinal axes. In the western mountains of North America striking examples of the same kind are found. Several depressions of the geanticlinal axes along which transcontinental railroads cross the mountain ranges, can be compared with straits near the bending points of the East Indian rows of islands. For instance, the traveler, who approaches the Sierra Nevada from the desert region on the Santa Fé route, can reach the Pacific coast along transversal and diagonal fractures, which exist near the bending points between the Sierra Nevada and the San Bernardino range.

H. A. Brouwer

Delft, Holland,
September, 1922

RELIEF FOR RUSSIAN SCIENTIFIC MEN

The "Friends of Russian Scientists," an organization sponsored by a hundred professors and social workers in and around Boston, for the purpose of raising contributions to be known as the Gorki Fund for the Relief of Russian Scientists, has just received the following letter from Maxim Gorki:

In reply to your letter let me make the following statement: "The House of Scientists" in Petrograd is a charitable organization for mutual benefit, founded by Petrograd professors. I have the honor to be its chairman. The full name of the organization is "Committee for the Betterment of the Condition of Scientists" (Kommissia Ulutschenia Bita Utschenich — abbreviated: KUBU). Address: C. Oldenburg, Member of the Academy, House of Scientists, 27 Millionaia, Petrograd.

The "House of Scientists" brings together all the scientific workers of Petrograd—there are about 3,000 of them, and together with their families they comprise about 12,000 souls. They are undergoing great privation, and are in particular need of sugar, flour and fats.

Most of the scientists are men of middle or advanced age, enfeebled by years of undernourishment and the numerous worries of present day life in Russia.

A ten dollar "A. R. A." parcel is a great help. The work of the American Relief Administration with Hoover at the head is one of the most brilliant pages in the history of the United States.

It seems to me that there is no need to describe in great detail the extent of misery among the scientists.

Do make every possible effort to sustain at least ten of these precious lives—precious in the broad sense of serving all mankind, the work of science being truly international and universal.

I wish you success in your good work!

M. Gorki

Steringsford, Sept. 1, 1922.

A large section of the American public, which has perhaps grown callous to the continued appeals for relief funds, has cherished the notion that the emergency in Russia is over. Gorki's letter shows that this is not true. Moreover, in a recent communication to the treasurer of the Gorki Fund, Mr. Herbert Hoover says:

There is no question of the need of the Russian intellectuals—they as a class have suffered more than any other class in the Russian debacle. Any funds raised for the relief of these people will contribute to a most worthy undertaking.

If the scientists and educators . . . will contribute to the support of their colleagues in Russia, we know of no more worthy cause to which they can lend their support.

Contributions are being received by Professor H. W. L. Dana, treasurer of the Gorki Fund, 105 Brattle Street, Cambridge, Mass. They are being transmitted to the Petrograd "House of Scientists," the non-partisan body of which H. G. Wells and others have written with enthusiasm, and are in turn distributed to the Russian scientific workers most in need. It may be added that the sums received here for this purpose are forwarded in full to Russia, since the incidental expenses of printing and postage are being met independently.

Isidore Levitt,
Cambridge, Mass. *Secretary*

QUOTATIONS

THE BRITISH ASSOCIATION

The meeting of the British Association at Hull ended yesterday. It will be remembered chiefly by Sir Charles Sherrington's presidential address, on which discussion did not cease during the week, nor is it more likely to die down when science and philosophy have had time to study the full text. So far as it was a positive statement it was definitely on the materialistic as opposed to the vitalistic interpretation of Nature. It explained the increasing number of mechanisms in the body of men and animals which are now understood, and definitely referred these to the order of chemistry and physics instead of to vague non-material principles. So far, its assault was limited to fashionable doctrines within the sphere of science, and should disturb only those who trace purpose and consciousness back to animalculæ, or attribute a *psyche* to the cells of the liver. With regard to the mind itself no positive statement of a materialistic interpretation was made; on the contrary, Sir Charles Sherrington, with a deliberateness perhaps in itself suggestive, reiterated our complete failure to interpret mind in terms of matter. But the president traced the relations between the evolution of the nervous system and the rise of mind in the animal kingdom with meticulous care, and insisted so coldly but so minutely on the correspondences between what he stated to be mechanism and what all regard as mind that it is at least open to read intention into his argument. No one can doubt but that the British Association, through its president, has fulfilled one of its highest functions this year. It has set men thinking and talking on one of the more fundamental problems that excite the human intelligence.

Otherwise the meeting at Hull was useful rather than distinguished. There were many solid papers, some valuable discussions, and no more than the customary number of attempts to reach the public ear by the methods of exaggeration, or of insistence on the dramatic side of a communication. The debate on nitrogen was a sound and instructive contribution to one of the branches of applied science most vital to the safety and the prosperity of nations. The coming together of zoologists, government officials, fishery experts and members of the fishing industry did much to enlighten both science and industry. We admit with pleasure that since we and others called attention to the diffuse and overloaded nature of the program of meetings of the association, the organization has been notably improved, especially with regard to the arrangement of joint discussions, in which two or more sections take part. Our special correspondents, however, inform us that there were still at the Hull meeting many cases of several papers or discussions of wide interest set down for the same day and hour. Unfortunately, moreover, not a few of the speakers and readers of papers had rudimentary ideas on public speaking, and attempted to cover far too much ground in the time allotted to them, or overloaded their contributions with unnecessary introductory matter. Science should not disdain the art of presentation.—The London *Times*.

SCIENTIFIC BOOKS

Respiration. By J. S. Haldane, M. D., LL. D., F. R. S., Fellow of New College, Oxford; Hon. Professor, Birmingham University. Yale University Press, 1922. 427 pp., 104 figures, and an appendix of analytical methods.

This volume contains the Silliman Memorial lectures at Yale University for 1915, revised so as to bring the presentation of the material up to the date of publication. It is a monograph covering the field of respiration: a field which, largely as the result of the work of Haldane and his collaborators, has assumed outstanding importance in recent years, and promises further important developments in the near future in theoretical knowledge and in practical applications to clinical medicine and industrial hygiene.

In brief, this book is the carefully revised and coordinated presentation, while the author is at the acme of his productive powers, of the life work of one of the master investigators of our time. It is a fit companion to the volumes from the pens of previous Silliman lecturers, including such names as J. J. Thomson, Sherrington, Rutherford, Nernst, Bateson, and Arrhenius.

It begins with a brief but illuminating account of the historical development of the knowledge of respiration; its relation to chemistry and physics on the one hand, and to the theory of physiological regulation on the other. The chapters following deal with carbon dioxide and the chemical regulation of breathing; the nervous mechanism and control and some of the nervous disturbances of respiration, as in "soldier's heart," neurasthenia and fatigue; the blood as a carrier of oxygen with a discussion of the properties of hæmoglobin and the variations of its dissociation curve; the blood as a carrier of carbon dioxide and the relations of carbon dioxide to neutrality regulation in the blood and other fluid media of the body; the causes and effects of anoxhemia, and the importance and frequency of oxygen deficiency as a factor in functional disturbances; the mutually regulative relations of blood reaction and breathing; the much disputed question of gas secretion in the lungs; the influence of vitiation of the atmosphere upon health in relation to industrial hygiene; high atmospheric pressures and caisson disease; low atmospheric pressures, mountain sickness, and the physiological conditions to which aviators are exposed; and an appendix giving the specialized methods which the author has developed for investigation in this field.

Two general aspects of Haldane's work deserve particular notice: Other master physiologists—formerly Voit, and in modern times, particularly Pawlow—have emphasized the importance of dealing with the normal and complete organism—for example, the conscious, healthy, happy, unanæsthetized, unrestrained dog. It is the failure of the general run of investigators to appreciate and apply this doctrine, and their attempt to infer truth directly from the essentially false conditions of most experimentation—for example, much of the current blood pressure experimentation, and the reduced circulation—which leaves so little value in most of the articles filling our journals. They deal merely (as Haldane incisively expresses it in his preface) "with fragments of frogs and other animals." Haldane, on the contrary, more than any other physiologist has found ways to use as his "versuchstier" not only the normal mammalian organism, with functions unpreverted by experimental conditions, but living, conscious, active man. The investigator himself and his collaborators have been the chief subjects of his experiments. Indeed Haldane's demonstration of the possibility and the efficiency of experimentation upon man will probably in the future be accounted his greatest contribution. By no other method apparently could the character and uniformity of the alveolar CO_2 regulation,—the central fact of the Haldanian conception of respiration—have been established.

The second aspect of Haldane's thought which gives it permanent philosophical value is his treatment of respiration and the blood as aspects and illustrations of physiological regulation: that extraordinary power of every living organism to maintain itself, so different from, or rather so much in addition to the equilibrium of an inorganic system. It is the capacity to "preserve constant the conditions of life in the internal environment," as Claude Bernard expresses it.

This conception of "organicism" as the central doctrine of biology differentiates Bernard, Haldane, and others who hold it, from the vitalists on the one hand, and from the mechanists on the other. It prompts the most thorough analysis of which our present day and incomplete chemistry and physics are capable into the physico-chemical conditions and properties of the humors and cells; but it looks on this analysis as merely a preliminary and sees as the essential topic of the physiologist those "living" reactions and processes by which the organism "preserves constant," or rather adjusts, controls, and regulates, within narrow limits of variation such "conditions of life" as osmotic pressure, hydrogen ion concentration, temperature, content of sugar, calcium, and potassium and a thousand other elements already known, suspected, or yet to be discovered "in the internal environment."

Yale University Yandell Henderson

SPECIAL ARTICLES

A CASE OF DUPLICATE GENES IN CREPIS CAPILLARIS (L.) WALLR.

The rosette leaves of *Crepis capillaris* (L.) Wallr. normally have a more or less pronounced pubescence on the lower surface of the midrib. Often the upper surface is also similarly pubescent, but not by any means in all cases, and the significance of this latter difference, if any exists, has not been learned.

In 1918 in a culture which had its origin from wild plants growing in Berkeley there was found a plant ($17.192P_2$) which did not show the pubescence on the lower surface of the midribs of the rosette leaves. When selfed this plant reproduced the type and a strain of "smooth" leaved plants was established. Although there is some variation in the amount of pubescence on the ribs of different plants of the hairy strain, there is no difficulty in distinguishing the two groups.

Crosses between these races at first gave discordant results. More recently with larger cultures and perfected technique data have been collected which indicate that hairiness of the midribs is due to duplicate dominant genes, which are not in the same chromosome group.

Two F_2 cultures in 1921 gave 556 hairy- to 40 smooth-leaved plants, a rato of 14.926 to 1.073 ± 0.106, which is a very good fit indeed. Among the F_2 plants there should be an equal number giving segregating populations and populations containing only one type of plant. Among those segregating in F_3 half should give 15 : 1 ratios and half 3 : 1 ratios.

Data from F_3 populations are not yet complete but cultures giving both 3 : 1 and 15 : 1 ratios have been obtained from another cross. These results show that the hairy plant used as pollen parent in this case was AABb which gave all hairy in F_1 and equal numbers of 3 : 1 and 15 : 1 populations in F_2. This supplies also the necessary data to satisfy theoretical requirements for the duplicate gene interpretation.

Complete data from crosses involving hairy and smooth characters are reserved for a future publication.

E. B. Babcock
J. L. Collins
Berkeley, California

INHERITANCE OF GLANDULAR PUBESCENCE IN CREPIS CAPILLARIS (L.) WALLR.

The usual wild type of this species has glandular pubescence on the involucral bracts and extending downward on the pedicel for some distance from the flower head.

In 1918 a single plant appeared which did not have these glandular hairs. Such plants have been designated as "bald." The culture in which this "bald" plant appeared grew from seed sent us from Copenhagen, Denmark. Since this first appearance, "bald" plants have been found in cultures derived from five other geographical locations as follows: England, Sweden, Chile, France and the Azores Islands.

The identity of the gene in all the cultures except that from France has been established by crossing, which in all cases produced only "bald" plants.

The bald character is produced by a single recessive gene. The F_1 plants obtained from crossing bald with glandular were completely glandular. In a culture of 77 back crossed plants 39 were glandular and 38 bald. A total of 210 F_2 plants gave a segregation of 174 glandular to 36 bald, the ratio being 3.314 : 0.685. The deviation in this case is 3.89 times the probable error. The major part of this deviation is due to one culture which produced 72 glandular to 2 bald plants. When this culture is excluded from the totals, there then remains 102 glandular to 34 bald, which is an exact 3 : 1 ratio. The F_2 bald plants which were tested bred true in F_3. Only two glandular F_2 plants have been tested, both segregating in F_3.

Detailed data for all bald cultures will be given in a future publication.

E. B. Babcock
J. L. Collins
Berkeley, California

THE AMERICAN CHEMICAL SOCIETY

The sixty-fourth gentral meeting of the American Chemical Society was held at the Carnegie Institute of Technology, Pittsburgh, Pa., on Tuesday morning, September 5, 1922. Short addresses were given by J. O. Handy, chairman of the Pittsburgh Section, John G. Bowman, chancellor of the University of Pittsburgh, and Thomas S. Baker, acting president of the Carnegie Institute of Technology. Dr. Edgar F. Smith responded on behalf of the society. The address of Edward E. Slosson on "The constructive chemist" was the feature of the morning and was heartily enjoyed by all those who had the privilege of hearing it. No business was transacted at the general meeting.

The following addresses were given at the afternoon session in the Carnegie Music Hall: "The chemical control of gaseous detonation with particular reference to the internal combustion engine," by Thos. Midgley, Jr., and T. A. Boyd; "The journal literature of chemistry," by E. J. Crane; "Structural colors in feathers," by Wilder D. Bancroft; "How research made a potash industry," by John E. Teeple.

On Tuesday evening a complimentary smoker was given the members as guests of the Pittsburgh Section at the Syria Mosque. There were 1,325 people present. A very interesting program, with songs, local vaudeville entertainment, moving pictures, etc., was enjoyed by all. On Wednesday at 2 P.M. a conference on "World Metric Standardization," with Eugene C. Bingham, chairman, was held in the theater of the Fine Arts Building with the following delegates present:

American Chemical Society: Eugene C. Bingham.

National Academy of Sciences: T. C. Mendenhall.

American Society of Zoologists: Dr. H. H. Collins.

American Psychological Association: Professor W. V. Bingham.

American Institute of Electrical Engineers: N. W. Storer.

American Metric Association: W. W. Stevenson.

Optical Society of America: Harry S. Hower.

United States Bureau of Standards: F. S. Holbrook.

New York Mineralogical Club: Dr. George F. Kunz (Absent).

American Statistical Association: Professor Roswell H. Johnson.

Geological Society of America: Professor Roswell H. Johnson.

Association of Seed Analysts: Dr. E. M. Gress.

American Electrochemical Society: R. E. Zimmerman.

American Pharmaceutical Association: Dean J. A. Koch.

National Society for the Study of Education: J. Freeman Guy (Absent).

American Astronomical Society: Professor Herman S. Davis.

Maryland Academy of Science: Dr. Claude H. Hall.

American Association of University Professors: Professor Alexander Silverman.

Ecological Society of America: A. E. Ortman (Absent).

American Institute of Architects: T. E. Billquist.

American Society of Biological Chemists: Howard B. Lewis (Absent).

American Society of Civil Engineers: R. A. Cummings.

American Mathematical Society: Professor F. L. Bishop.

American Medical Association: Dr. Paul N. Leech.

American Physiological Association: Dr. C. C. Guthrie.

American Public Health Association: Dr. Wadsworth.

Illuminating Engineering Society: E. J. Edwards.

Mathematical Association of America: Professor F. L. Bishop.

Sullivant Moss Society: Dr. O. E. Jennings.

The same evening a reception was held and President Edgar F. Smith gave the annual presidential address under the title "Our Science." On Thursday evening a garden party, followed by supper and an out-of-door dramatic entertainment, "The Wonder Hat," was the chief entertainment of the meeting. The party was held at "Oak Manor," which is the University of Pittsburgh faculty and Mellon Institute club house. The weather was ideal. Some 1,500 persons were present and a thoroughly delightful social evening, including also music and dancing, was enjoyed by all. On Friday, excursions were made to the Carnegie Steel Company's Clairton by-product coke plant, the steel works and to the American Window Glass Company's plant at Monongahela City. The ladies were entertained throughout the week with receptions, dinners and excursions. Further details will be found in the October issue of the *Journal of Industrial and Engineering Chemistry.*

The following divisions and sections met: Divisions of Agricultural and Food Chemistry, Biological Chemistry, Dye Chemistry, Fertilizer Chemistry, Industrial and Engineering Chemistry, Leather Chemistry, Chemistry of Medicinal Products, Organic Chemistry, Physical and Inorganic Chemistry, Rubber Chemistry, Sugar Chemistry, Water, Sewage and Sanitation Chemistry, and Sections of Cellulose Chemistry, Chemical Education, Gas and Fuel, History of Chemistry and Petroleum Chemistry. Full details of their meetings will be found in the October issue of the *Journal of Industrial and Engineering Chemistry.*

The divisions elected officers as follows:

Division of Agricultural and Food Chemistry: *Chairman,* H. A. Noyes; *vice-chairman,* R. H. Carr; *Secretary,* C. S. Brinton; *executive committee,* T. J. Bryan, Harper F. Zoller.

Division of Biological Chemistry: *Chairman,* J. S. Hughes; *secretary,* W. V. Bovie; *executive committee,* H. B. Lewis, *chairman,* A. W. Dox. D. B. Jones, A. R. Lamb, J. F. Lyman.

Division of Cellulose Chemistry: *Chairman,* G. J. Esselen, Jr.; *vice-chairman,* Louis E. Wise; *secretary-treasurer,* L. F. Hawley; *executive committee,* Harold Hibbert, J. F. Waite.

Division of Dye Chemistry: *Chairman,* W. J. Hale; *vice-chairman,* R. E. Rose; *secretary,* R. Norris Shreve; *executive committee,* L. A. Olney, L. F. Johnson.

Division of Fertilizer Chemistry: *Chairman,* F. B. Carpenter; *vice-chairman,* R. N. Brackett; *secretary,* H. C. Moore; *executive committee,* H. J. Wheeler, C. H. Jones, E. W. Magruder, A. J. Patten.

Division of Industrial and Engineering Chemistry: *Chairman,* D. R. Sperry; *vice-chairman,* W. A. Peters; *secretary,* E. M. Billings; *executive committee,* W. F. Hillebrand, Edward Mallinckrodt, Jr., F. M. DeBeers, A. Silverman, H. C. Moody, C. E. Coates.

Division of Leather Chemistry: *Chairman,* J. Arthur Wilson; *vice-chairman,* Charles S. Hollander; *secretary,* Arthur W. Thomas; *executive committee,* F. P. Veitch, C. R. McKee.

Division of Chemistry of Medicinal Products: *Chairman,* Edgar B. Carter; *secretary,* E. H. Volwiler; *executive committee,* Charles Caspari, Oliver Kamm.

Division of Organic Chemistry: *Chairman,* Frank C. Whitmore; *vice-chairman and secretary,* R. R. Renshaw.

Division of Petroleum Chemistry: *Chairman,* C. E. Delbridge; *vice-chairman,* R. R. Matthews; *secretary,* W. A. Gruse; *executive committee,* E. W. Dean, W. F. Faragher.

Division of Physical and Inorganic Chemistry: *Chairman,* Robert E. Wilson; *secretary,* Graham Edgar; *executive committee,* Farrington Daniels, J. H. Ellis, James Kendall, E. B. Millard, R. G. Van Name.

Division of Rubber Chemistry: *Chairman,* W. B. Wiegand; *vice-chairman,* E. B. Spear; *secretary,* Arnold H. Smith; *executive committee,* C. W. Bedford, D. F. Cranor, G. S. Whitby, H. L. Fisher, N. A. Shepard.

Division of Sugar Chemistry: *Chairman,* W. D. Horne; *vice-chairman,* F. W. Zerban; *secretary,* Frederick J. Bates; *executive committee,* W. B. Newkirk, C. E. Coates, C. A Browne, S. J. Osborn, H. S. Paine, H. E. Zitkowski.

Division of Water, Sewage and Sanitation Chemistry: *Chairman,* A. M. Buswell; *vice-chairman,* F. R. Georgia; *secretary,* W. W. Skinner; *executive committee,* W. R. Copeland, W. D. Collins.

DIVISION OF BIOLOGICAL CHEMISTRY

Howard B. Lewis, *chairman*
J. S. Hughes, *secretary*

The action of sodium soaps on trypsin. J. B. Brown. The sodium soaps of the higher fatty acids have been found to destroy trypsin very rapidly. The amount of destruction of enzyme depends on the concentration of the soap and the time of exposure of enzyme to soap. The presence of protein substrate protects the enzyme and lessens the destruction. The satured and unsatured soaps are about equally destructive. Sodium soaps destroy the autolytic enzymes of dog liver and the ptyalin of human saliva. The action of soaps on these enzymes is much greater than can be accounted for as a p_H effect.

Metabolic disturbances in cats on a milk diet. George W. Pucher and Karl F. Cori. A very interesting influence of milk on the alkalimetabolism of cats has been observed and studied quantitatively. The striking features are summarized as follows: (1) Cats fed on meat and water excrete a urine normal for carnivorous animals. The total carbon dioxide content of the urine is very small and constant in value. (2) Cats when fed on milk excrete within 24-48 hours a urine which shows the following qualities: (*a*) Alkaline to brilliant yellow and even to phenolphthalein. (*b*) Substances which easily reduce Benedict's solution (5 minutes). (*c*) Huge amounts of bicarbonates (calculated from total CO_2 evolved). (*d*) Increase of the ammonia and the ammonia total nitrogen ratio. (3) Within 48 hours after the withdrawal of the milk the animals returned to normal. (4) Milk sugar is not responsible for these changes.

The effect of various methods of pasteurization on the vitamin C content of milk. J. S. Hughes, N. E. Olson and J. C. Jenkins.

The relationship between the inhibition point of fungicides and their concentration and their molecular weight. Ernest Bateman. There is a definite relationship between the concentration of fungicides and the relative retardation in the growth of the fungus. This relationship can be expressed mathematically by the equation $\frac{R}{Cm^b} = K$ where Cm is the concentration in mols, b an exponent depending upon the structure of the compound, R the percentage retardation and K a constant. There is a definite relationship between the molecular weight of poisons in homologous series and their inhibition point. This relationship can be expressed by the equation $CM^d = K$ where C is the concentration at the killing point, M the molecular weight of the compound, d an exponent which is possibly governed by the organism and K a constant.

The proteins of wheat bran. D. Breese Jones and C. E. F. Gersdorff.

The nutritive value of the proteins of the palm kernel. A. J. Finks and D. Breese Jones.

Proteins from the cantaloupe seed (Cucumis melo); isolation of a crystalline globulin. D. Breese Jones *and* C. E. F. Gersdorff.

The physico-chemical properties of strong and weak flours. IV. The influence of the ash of flours upon the viscosity of flour-water suspensions. Rose Aiken Gortner and Paul F. Sharp. The viscosity of acidified flour-water suspensions is markedly influenced by the ash contained in the flour. The greater part of such ash may be removed by lixiviating the flour with water and using the leached residue for viscosity determinations. Such studies have led to the formula:

Log viscosity $= a + b$ (log concentration)
where a and b are constants, and the viscosity is the maximum viscosity obtainable with lactic acid. The numerical value of b is a measure of the colloidal properties of the gluten as influencing flour strength.

The physico-chemical properties of strong and weak flours. V. The identity of the gluten protein responsible for changes in hydration capacity as measured by viscosity. Paul F. Sharp with Ross A. Gortner. The maximum viscosity of acidulated (lactic acid) flour-water suspensions from which the ash has been leached is but little altered by repeated lixivation continued until all, or practically all, of the gliadin has been removed. Glutenin is the only protein present in such a preparation in any considerable quantity, and it is the physical state of the glutenin which is responsible for changes in hydration capacity of wheat flour gluten.

The physico-chemical properties of strong and weak flours. VI. The physical state of the gluten as affecting loaf volume. Paul F. Sharp with Ross Aiken Gortner. Experiments by other workers have shown that an inferior loaf results when gliadin is removed from a flour by extraction with alcohol and the gliadin-free flour is dried, remilled and baked. This has been interpreted as indicating that the absence of gliadin is the determining factor of the poor baking results. We have found that essentially the same results may be obtained when flour is doughed up with 85 per cent. alcohol and the whole mass dried, remilled and baked. Here nothing was added to or taken from the flour. Nevertheless the flour "strength" is destroyed. The alcohol treatment has destroyed the colloidal properties of the glutenin and any agent which influences the colloidal properties of the glutenin will affect loaf volume.

The quantitative production of furfural from pentose material. N. C. Pervier with Ross Aiken Gortner. Furfural in theoretical yield may be distilled from pentose material by boiling with 12 per cent. HCl and at the same time passing a rapid current of steam through the solution.

The quantitative estimation of furfural by electrometric titration. N. C. Pervier with Ross Aiken Gortner. Furfural can be quantitatively titrated with bromine. We have employed a standard solution of potassium bromate, titrating in the presence of KI and 5 per cent. HCl, using a galvanometer as an indicator. Two atoms of bromine are required for each molecule of furfural. Laevulnic acid and hexoses do not interfere in the estimation of pentose material by its conversion first into furfural and the subsequent titration.

Methods for the estimation of total solids and hydrophilic colloid content of expressed plant tissue fluids with certain phytochemical applications. Ross Aiken Gortner, Robert Newton and Walter F. Hoffman. The refractive index of a plant sap as measured by an Abbe refractometer may be used to measure quantitatively the total solids present in the sap. A measurement of "bound water" is used to estimate the hydrophilic colloid content. The depression of the freezing point of the original sap is obtained. Then a quantity of sucrose just sufficient to make a molar solution in the total water present is added and the depression of the freezing point is again obtained. The excess depression (over the theoretical 2,085 due to molar sucrose) is due to a part of the water being held by the hydrophilic colloids in such a manner as to be unavailable for the solution of sucrose.

The origin of the humin formed by the acid hydrolysis of proteins. VII. Hydrolysis in the presence of ketones. Ross Aiken Gortner and Earl R. Norris. Ketones do not appreciably alter the nitrogen distribution of a protein as measured by Van Slyke's method. No evidence was obtained that ketones could be involved in humin formation. We believe, therefore, that humin formation is caused by the interaction of tryphophane and an aldehyde.

The tyrosine content of diaminized casein. H. B. Lewis and Ralph C. Corley.

The influence of food on the excretion of endogenous uric acid in man. (By title.) H. B. Lewis and Ralph C. Corley.

The synthesis and rate of elimination of hippuric acid in the organism of the rabbit. H. B. Lewis and Wendell H. Griffith.

The analysis of the urine as a part of the physical examination of the college student. G. O. Higley. This work was begun in 1915 because of the death of a college student from diabetes. Tests are made for sugar and for albumin, and in special cases for other pathological substances. Each year a considerable number of cases of nephritis are discovered, of which about two thirds show a previous history of an acute attack of that disease. When any pathological substance is detected a second and often a third sample of urine is tested, and the student is advised to consult a competent physician and to report his findings to the college physical examiner.

Further observations on the influence of vitamin B on the development of organs in Single Comb White Leghorn cockerels. Arthur J. Souba and R. Adams Dutcher. Six hundred and nine chicks were hatched from eggs of pure line stock and placed on a normal chick ration. At the age of 76 days 150 normal cockerels were selected and divided in three groups, designated A, B and C. Group A received a normal ration with greens, Group B received an adequate synthetic diet and Group C received a synthetic diet, adequate in all particulars except vitamin B. After four weeks 25 birds in each group were killed and weights and measurements recorded on testes, heart, kidneys, spleen, pancreas, liver, thyroid and suprarenals. The remaining birds were allowed to continue until polyneuritis developed in Group C, at which time one bird from Groups A and B, including the polyneuritic bird, were killed. All data were treated biometrically. The absence of vitamin B produced significant losses in the weight of testes, heart, liver and kidneys. Differences in length of heart and spleen were also apparent.

Is nitrogen in gaseous form lost from germinating seed and young seedlings as an inherent function of their metabolic processes? Jehiel Davidson.

Influence of lysine upon the hydrolysis of starch by purified pancreatic amylase. H. C. Sherman and Mary L. Caldwell. This is an extension of the work with arginine, histidine and tryptophane which was reported by the same authors last year. Lysine resembles histidine and tryptophane in not increasing the amyloclastic activity of pancreatic amylase while both lysine and tryptophane do increase its saccharogenic activity. These results are best interpreted in terms of the theory that the favorable influence of amino acids is attributable to their effect in checking the hydrolytic destruction of the enzyme in the aqueous dispersions in which it acts. The theoretical part of the paper does not lend itself to further condensation.

Influence of some organic compounds upon the hydrolysis of starch by salivary and pancreatic amylases. H. C. Sherman and Nellie M. Naylor. In order to test the question whether the organic substances, which have been reported as favoring the activity of amylases, have a directly activating effect upon the enzyme by reason of their organic groupings, experiments have been made with aniline, methyl and ethyl amines, benzoic benzamide, anthranilic acid and hippuric acid. These substances collectively contain the amino and carboxyl groups both singly and in different combinations but none of them showed any favorable influence upon the activity of salivary or pancreatic amylase when tested under what are now regarded as standard conditions for the activity of these enzymes. The results fail to furnish any support for the view that certain organic groupings as such activate amylolytic action. They make it much more probable that the favorable influence of α-amino acids upon amylases is to be attributed primarily if not entirely to their effect in preserving the enzyme from hydrolytic destruction.

Effect of amino acids in retarding the hydrolytic decomposition of an enzyme (pancreatic amylase). H. C. Sherman and Florence Walker. The extent of the deterioration of this enzyme when allowed to stand in solution for different lengths of time and at different temperatures with and without the addition of amino acid has been determined. The higher the temperature, up to the point at which coagulation begins, or the longer the time of heating, the more marked was the favorable effect of the added amino acid, thus confirming the view that the enzyme in its chemical composition either is a protein or contains protein as an essential constituent, and that the added amino acid exerts its favorable influence by checking the hydrolytic destruction of the enzyme.

Catalytic action of phosphates on the separate and simultaneous oxidation of glucose and butyric acid with peroxide. Edgar J. Witzemann.

Energy expenditures by women during horizontal walking at different speeds. H. Monmouth Smith and Dortha B. Bailey. Using the Douglas-Haldane method of measuring the gaseous exchange the energy expenditure of nine women was determined when standing and walking at speeds of 30, 60 and 90 meters a minute. The average standing expenditure was 0.606 calorie per minute per square meter of body surface computed by Du Bois height-weight chart. The total increase for the walking over the standing values showed an average expenditure for the nine subjects of 0.527, 0.489 and 0.552 gram-calorie per horizontal kilogrammeter for the speeds of 30, 60 and 90 meters per minute respectively. Seven out of the nine subjects showed a greater energy expenditure per horizontal kilogrammeter at 30 meters per minute than at 60. The menstrual period was apparently without effect on either the standing or walking metabolism.

The substitutions of glass electrodes for the hydrogen electrodes in electrometric titration. Walter S. Hughes.

Oxidation-reduction potentials and the stability of vitamin C. Victor K. LaMer. The difference in acidity is insufficient to account alone for the much greater stability of vitamin C to heat in the case of tomato and citrus fruit juices compared to that of cabbage juice where almost complete destruction occurs on boiling for one hour in the absence of air. The oxidation-reduction potentials of these juices, freshly expressed, were determined electrometrically in the absence of atmospheric oxygen. The potentials, when corrected for p_H, indicate that the stability of the vitamin depends upon the natural oxidizing or reducing condition of the juice as well as upon the opportunities that are afforded for atmospheric oxidation.

Flour strength as influenced by the addition of diastatic ferments. F. A. Collatz. The optimum activity for the diastase in malt flour with raw wheat starch as a substrate was found at p_H 4.26 and at a temperature of 65 degrees C. This activity was apparently constant over the period of digestion. The reducing sugars increased proportionately to the amount of diastase added. The viscosity of the digestion mixture (plus lactic acid) decreased with increasing amounts of added diastase and also with the time of digestion. This decrease is apparently not due to the salt effect. The gas producing capacity of strong flours is not increased by diastase, but with weak flours the reverse is the case.

Changes in hydrogen-ion concentration of fermenting dough. (By title). F. A. Collatz.

The synthesis of vitamins by molds. V. E. Nelson, Ellis I. Fulmer, V. G. Heller and W. W. Duecker. Yeast grown on medium F is about 60 per cent. as potent in vitamin B as Fleischmann's yeast; the above synthetic yeast will cure polyneuritis in pigeons. Air drying destroys about 30 per cent. of the vitamin B potency of yeast. *Aspergillus niger* and *Penicillium expansum* synthesize vitamin B when grown on Raulin's medium but do not synthesize vitamin A. The potency in vitamin B is about the same as that of our synthetic yeast. *Sclerotinea cinerea* shows vegetative growth on medium F but does not sporulate. The mycelia, according to incomplete data, shows no vitamin B. The work is being continued.

The use of kelp in the preparation of a diet *amendment for use in the treatment and prevention of deficiency diseases, particularly goiter.* (By title). J. W. Turrentine.

SECTION OF CHEMICAL EDUCATION

Edgar F. Smith, *chairman*

Neil E. Gordon, *secretary*

Pandemic chemistry. Wilder D. Bancroft. There is a great need for a course in chemistry which shall be intended for the man who wishes to learn something about the subject as a part of a general education; but who has no intention of going on with the subject. Such a course should cover the whole field of chemistry in an interesting way without wasting time on technical details. Cornell University is considering seriously starting such a course when the new chemical laboratory is finished. A general outline of the proposed course is given.

What chemistry shall be taught in high school and how shall it be correlated with college chemistry? Louis W. Mattern. Stress is placed on the adaptability of chemistry in high schools to the development of certain habits and mental traits not only essential to the successful study of chemistry and other scientific subjects in colleges, but, as well, to the average citizen, at a time when such habits and mental traits are better obtained than in college. A discussion is made of the problems in the articulation between high school chemistry and college chemistry. A brief statement of content to cover less ground and to emphasize unity in high school chemistry is made with a view of the high school taking to college a greater thoroughness in fundamental principles, their relationships and the ability to apply them.

What chemistry shall be taught in the first year of college and how shall this be correlated with high school chemistry. Harry N. Holmes. High school chemistry is valuable as a training in scientific thinking but it should not be forced to prepare the student for second year college chemistry. First year college chemistry must consolidate what was learned before in an interpretive spirit and must introduce much new material. It should give much more attention to physical chemistry, organic chemistry, qualitative analysis—and be more quantitative in general. The research attitude of mind may be stimulated even in the first year. In dividing a large class into groups—the more elementary and the more advanced—the judgment of the teacher should be influenced by the records of the high schools from which students came and by a more or less formal quiz on high school chemistry.

What chemistry shall be taught in our professional schools? L. B. Broughton. The chemical requirements for pre-medical students are cited as specified by the American Medical Association. The question is raised as to how the colleges of liberal arts and science should deal with this type of chemical training, with suggestions that some adaptations could be made.

Chemical education in dental schools. Wortley F. Rudd. The following points were covered in this paper: (1) Needs of freshmen students in chemistry in those dental schools requiring only high school graduation for matriculation. (2) Needs in those schools requiring one year of college work for matriculation. (3) The proper correlation of dental metallurgy and dental chemistry.

Chemical education in pharmacy schools. John C. Krantz, Jr. The purpose of the paper was to point out the objections to the teaching of strictly applied pharmaceutical chemistry in pharmacy schools, and also to show that the substitution of general college chemistry does not supply the needs of pharmacy students. The paper also describes an efficient and comprehensive method of correlating general and pharmaceutical chemistry in order to meet the demands of the pharmacy student.

What chemistry should be taught an agricultural student. C. W. Stoddart. General inorganic and agricultural chemistry should be given to all agricultural students. Qualitative analysis should be a part of general chemistry. Organic chemistry and possibly quantitative analysis should be a part of agricultural chemistry, although the latter is not necessarily a part of the laboratory work of agricultural chemistry. For specialists in agricultural chemistry a separate course in organic chemistry is essential, and it ought to be "well rubbed in." They need also a course in quantitative analysis but combining theory with agricultural practice, not too distinct courses. Agricultural chemists must be well grounded in chemistry. But after all the teacher is the principal item in what chemistry should be taught to an agricultural student.

Qualitative analysis for engineering students. Charles W. Cuno. A short synopsis of the paper follows: (1) A discussion of the present methods of teaching qualitative analysis as a preliminary to other courses in chemistry. (2) A questioning of the wisdom of such a course for civil, mechanical and electrical engineers. (3) Suggestions: (*a*) For the modification of the course. (*b*) For a new course.

An experience with the general intelligence test in teaching freshmen chemistry. Edward Bartow and Jacob Cornog. A comparison of intelligence ratings as determined by a general intelligence test given at the beginning of the year with the final grades received by 948 students in freshmen chemistry gives a coefficient of correlation of .44 where complete causation would be represented by unity and no causation by zero. This indicates that intelligence as determined by this test is a partial but not predominant factor in determining final grades. The general intelligence test may be used in evaluating teaching performance of large numbers of teachers giving instruction in the same subject; for effecting economy in administration by early elimination of students of hopelessly low capacity; and for comparison of the mental potentialities of different groups of students. The general intelligence test does not afford a dependable basis for accurately forecasting a student's final grade in individual cases, except for students of extremely low intelligence.

The teaching of chemistry in negro private schools. B. T. Harvey, Jr. This paper presented some facts and conclusions derived from an investigation of the teaching of chemistry in negro private schools by means of personal observation, answers to a questionnaire and study of the catalogs of these institutions. After a preliminary survey of the scope of negro education and its effects, a statement of the aims of the courses in chemistry was made. Practice and results in these schools were checked by aims, finally suggestions were made for help in meeting difficulties involved in the teaching of chemistry in negro private schools.

Quantitative experiments in general chemistry. H. W. Moseley. In this paper the question was raised as to whether quantitative experiments usually assigned to students in general chemistry laboratory served their purpose; and as a result of this study a plan was suggested for the assignment of quantitative work to such students in a way to get results. Data were included.

The student's laboratory bench and his supplies. W. L. Estabrooke. The purpose of this paper was to trace the development of the student's laboratory bench during the past twenty-five years and the corresponding improvement in the method of handling his supplies. Two new student's desks were shown, one of which was a radical departure from that usually seen in chemical laboratories. The handling of student's chemicals was described by the writer in Science of May 30, 1919, under the heading "The Freas System" in honor of Thomas B. Freas of Columbia University, who has done more than most men in America to meet this problem. The exhibit consists of: (1) The chemicals used in one year of inorganic chemistry at the College of the City of New York. (2) The chemicals used in one year of qualitative analysis at the College of the City of New York. (3) The Fales' student's bench in inorganic chemistry, borrowed from Professors Freas and Fales of Columbia University, with a full equipment of apparatus and chemicals.

A system of individual reagents for courses in qualitative analysis. Louis J. Curtman. The author has designed two small wooden kits provided with shelves and capable of holding all the reagents, solids and solutions needed in qualitative analysis. These kits are of such dimensions that they can easily be locked up in the student's locker or cupboard. The shelves are specially constructed to permit the labels on the bottles to be plainly seen and to allow the bottles to be easily removed and replaced. Bottles of six different sizes are used depending upon the quantity of material needed. A set of solid salts and compounds, contained in a pasteboard box, is also provided. From this small supply of chemicals the student weighs out the quantities needed for making his solutions. In the Freas system, which is in use at Columbia University, the student is provided with all the solutions he needs. In the author's method, the student is required to prepare all his solutions. The advantages of this system are: (1) The student becomes acquainted with the physical properties of the solid substances he used. (2) He is required to calculate, in each case, the quantity of salt needed to prepare a specified volume of a solution of definite normality. (3) By actually making up the solutions, he becomes familiar with the characteristic properties of such substances which require special treatment. This information he can obtain by no other method. The system outlined above has been successfully used at the College of the City of New York for the past five years. A paper describing this system in detail will shortly be published.

The teaching value of the electrochemical series of metals. R. A. Baker. It is recommended that at the beginning of the course in general chemistry, each student be required to learn the names and symbols of the common metals, arranged in the order of the electrochemical series, together with the physical properties of the metals as a group. For the remainder of the course the conventional order is preserved. As each non-metal is studied, its chemistry is projected on to this series of metals, with the result that no special consideration of the metals is required at the close. This arrangement causes any student who had studied chemistry before to adopt such a different point of view that he is fully occupied in applying the knowledge he already possesses. The exact order of the electrochemical series is an aid to the student in interpreting, correlating and directing his own experimentation. Use may be made of it in connection with the heats of formation of the metal oxides, hydroxides, nitrates, etc.; the replacements of metals by each other; the strength of bases, etc.

The schoolmaster and the teacher. E. G. Mahin. The problems of the teacher of chemistry are briefly discussed and stress is laid upon correct personality of the teacher as an absolute prerequisite to successful teaching of science. Lack of interest on the part of the student frequently springs from lack of respect for the sincerity of the teacher. Science is the truth of nature and as such it must be respected. Before it sham and imposture must eventually give way. This conviction must be made a part of the student's training or he will never possess correct ideals of his life work.

The possibility of improvement in the contributions colleges make to industries. Edward Ellery.

Proper methods of conducting undergraduate research. William A. Noyes. Two purposes should be constantly in the mind of the teacher who directs research work of undergraduates. First, the student should be trained in the use of chemical literature. He should learn how to find for himself the results of previous work on the problem he is studying. Second, he should be taught to develop personal initiative in attacking a problem. He should never be considered merely an agent to carry out an experiment which the teacher wishes to be performed.

The best college course for the chemist. Robert E. Rose. What the industries most desire is a well balanced education in those who enter their research laboratories. Chemistry, as it is taught at present, is sub-divided much too rigidly, and the several parts are not treated in the proper perspective. A course is outlined which would give a general survey of the whole field of chemistry during the first year. This would be valuable to those specializing in chemistry as well as to students desiring the course for its cultural value. The essentials in science and in the correlated subjects for the four year course are discussed, and the content of the courses outlined. The suggestions call for a totally different treatment of all our science classes.

The education of the chemist. J. B. Garner. The subject is one regarding which there is a diversity of opinion varying from that of the dreamy academician to that of the true practicalist. Both the unreasonable expectation of the classical pedant to justify his idea of culture and the behest of the industrialist to meet immediate technical demands sacrifice the ultimate welfare of the chemist in training. Experience has shown that personality, mentality and professional training are the essential elements in the make-up of a chemist. Personality is one of the most valuable assets of the chemist. Personal qualities protrude more in concerted research than in any other human endeavor. Personality is made up of the qualities of resourcefulness, creativeness, initiative, pertinacity, cheerfulness, loyalty, honesty and courtesy. Mentality is the mental power, or the right kind of brains for successful issue in matters chemical. Mentality comprehends consciousness, thought, opinion, memory, reason, decision, purpose, common sense and tact. The real character of the chemist is in his purpose and the strength of his character is in the decision and firmness of this purpose. Personality and mentality energize and give direction to professional training. The test of the adequacy of professional training is the use of this training. It must be sufficient when combined with personality and mentality to supply that which is needed as one's life program. Men must be trained by colleges, technical schools and universities to adapt themselves with certainty to the new economic conditions. Therefore, courses of study must be rearranged as to their content, and curricula must be formulated. The subject matter of all courses must be such that contact with real life, actual conditions, and needs, is made. Education is for life and for service. The general scope of training must be as extensive, and the time required for its completion as great, as that for the profession of medicine. Chemists must be industry builders and developers of national natural resources. A proposed outline of courses for the professional training of the chemist will be offered. As far as professional training is concerned, the shortcomings of the chemist are largely English, chemical literature, German, French, quantitative analyses and general engineering.

Charles L. Parsons,
Secretary

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CONTENTS

THE THEORY OF NUMBERS[1]

THERE is probably less difference between the methods of a physicist and a mathematician than is generally supposed. The most striking among them seems to me to be this, that the mathematician is in much more direct contact with reality. This may perhaps seem to you a paradox, since it is the physicist who deals with the subject-matter to which the epithet "real" is commonly applied. But a very little reflection will show that the "reality" of the physicist, whatever it may be (and it is extraordinarily difficult to say), has few or none of the attributes which common-sense instinctively marks as real. A chair may be a collection of whirling atoms, or an idea in the mind of God. It is not my business to suggest that one account of it is obviously more plausible than the other. Whatever the merits of either of them may be, neither draws its inspiration from the suggestions of common-sense.

Neither the philosophers, nor the physicists themselves, have ever put forward any very convincing account of what physical reality is, or of how the physicist passes, from the confused mass of fact or sensation with which he starts, to the construction of the objects which he classifies as real. We can not be said, therefore, to know what the subject-matter of physics is; but this need not prevent us from understanding the task which a physicist is trying to perform. That, clearly, is to correlate the incoherent body of facts confronting him with some definite and orderly scheme of abstract relations, the kind of scheme, in short, which he can borrow only from mathematics.

A mathematician, on the other hand, fortunately for him, is not concerned with this

[1] From the address of the president of the Section of Mathematics and Physics, given at the Hull meeting of the British Association for the Advancement of Science.

physical reality at all. It is impossible to prove, by mathematical reasoning, any proposition whatsoever concerning the physical world, and only a mathematical crank would be likely now to imagine it his function to do so. There is plainly one way only of ascertaining the facts of experience, and that is by observation. It is not the business of a mathematician to suggest one view of the universe or another, but merely to supply the physicists with a collection of abstract schemes, which it is for them to select from, and to adopt or discard at their pleasure.

The most obvious example is to be found in the science of geometry. Mathematicians have constructed a very large number of different systems of geometry, Euclidean or non-Euclidean, of one, two, three, or any number of dimensions. All these systems are of complete and equal validity. They embody the results of mathematicians' observations of *their* reality, a reality far more intense and far more rigid than the dubious and elusive reality of physics. The old-fashioned geometry of Euclid, the entertaining seven-point geometry of Veblen, the space-times of Minkowski and Einstein, are all absolutely and equally real. When a mathematician has constructed, or, to be more accurate, when he has observed them, his professional interest in the matter ends. It may be the seven-point geometry that fits the facts the best, for anything that mathematicians have to say. There may be three dimensions in this room and five next door. As a professional mathematician, I have no idea; I can only ask some competent physicist to instruct me in the facts.

The function of a mathematician, then, is simply to observe the facts about his own intricate system of reality, that astonishingly beautiful complex of logical relations which forms the subject-matter of his science, as if he were an explorer looking at a distant range of mountains, and to record the results of his observations in a series of maps, each of which is a branch of pure mathematics. Many of these maps have been completed, while in others, and these, naturally, are the most interesting, there are vast uncharted regions. Some, it seems, have some relevance to the structure of the physical world, while others have no such tangible application. Among them there is perhaps none quite so fascinating, with quite the same astonishing contrasts of sharp outline and mysterious shade, as that which constitutes the theory of numbers.

The number system of arithmetic is, as we know too well, not without its applications to the sensible world. The currency systems of Europe, for example, conform to it approximately; west of the Vistula, two and two make something approaching four. The practical applications of arithmetic, however, are tedious beyond words. One must probe a little deeper into the subject if one wishes to interest the ordinary man, whose taste in such matters is astonishingly correct, and who turns with joy from the routine of common life to anything strange and odd, like the fourth dimension, or imaginary time, or the theory of the representation of integers by sums of squares or cubes.

It is impossible for me to give you, in the time at my command, any general account of the problems of the theory of numbers, or of the progress that has been made towards their solution even during the last twenty years. I must adopt a much simpler method. I will merely state to you, with a few words of comment, three or four isolated questions, selected in a haphazard way. They are seemingly simple questions, and it is not necessary to be anything of a mathematician to understand them; and I have chosen them for no better reason than that I happen to be interested in them myself. There is no one of them to which I know the answer, nor, so far as I know, does any mathematician in the world; and there is no one of them, with one exception which I have included deliberately, the answer to which any one of us would not make almost any sacrifice to know.

1. *When is a number the sum of two cubes, and what is the number of its representations?* This is my first question, and first of all I will elucidate it by some examples. The numbers $2 = 1^3 + 1^3$ and $9 = 2^3 + 1^3$ are sums of two cubes, while 3 and 4 are not: it is exceptional for a number to be of this particular form. The number of cubes up to 1,000,000 is 100, and the number of numbers, up to this limit

and of the form required, can not exceed 10,000, one hundredth of the whole. The density of the distribution of such numbers tends to zero as the numbers tend to infinity. Is there, I am asking, any simple criterion by which such numbers can be distinguished?

Again, 2 and 9 are sums of two cubes, and can be expressed in this form in one way only. There are numbers so expressible in a variety of different ways. The least such number is 1729, which is $12^3 + 1^3$ and also $10^3 + 9^3$. It is more difficult to find a number with *three* representations; the least such number is $175{,}959{,}000 = 560^3 + 70^3 = 552^3 + 198^3 = 525^3 + 315^3$. One number at any rate is known with *four* representations, namely, 19×363510^3 (a number of 18 digits), but I am not prepared to assert that it is the least. No number has been calculated, so far as I know, with more than four, but theory, running ahead of computation, shows that numbers exist with five representations, or six, or any number.

A distinguished physicist has argued that the possible number of isotopes of an element is probably limited because, among the ninety or so elements at present under observation, there is none which has more isotopes than six. I dare not criticise a physicist in his own field; but the figures I have quoted may suggest to you that an arithmetical generalization, based on a corresponding volume of evidence, would be more than a little rash.

There are similar questions, of course, for squares, but the answers to these were found long ago by Euler and by Gauss, and belong to the classical mathematics. Suppose, for simplicity of statement, that the number in question is *prime*. Then, if it is of the form $4m + 1$, it is a sum of squares, and in one way only, while if it is of the form $4m + 3$ it is not so expressible; and this simple rule may readily be generalized so as to apply to numbers of any form. But there is no similar solution for our actual problem, nor, I need scarcely say, for the analogous problems for fourth, fifth or higher powers. The smallest number known to be expressible in two ways by two biquadrates is $635318657 = 158^4 + 59^4 = 134^4 + 133^4$; and I do not believe that any number is known expressible in three. Nor, to my knowledge, has the bare existence of such a number yet been proved. When we come to fifth powers, nothing is known at all. The field for future research is unlimited and practically untrodden.

2. I pass to another question, again about cubes, but of a somewhat different kind. *Is every large number* (every number, that is to say, from a definite point onwards) *the sum of five cubes?* This is another exceptionally difficult problem. It is known that every number, without exception, is the sum of nine cubes; two numbers, 23 (which is $2.2^3 + 7.1^3$) and 239, actually require so many. It seems that there are just fifteen numbers, the largest being 454, which need eight, and 121 numbers, the largest being 8042, which need seven; and the evidence suggests forcibly that the six-cube numbers also ultimately disappear. In a lecture which I delivered on this subject at Oxford I stated, on the authority of Dr. Ruckle, that there were two numbers, in the immediate neighborhood of 1,000,000, which could not be resolved into fewer cubes than six; but Dr. A. E. Western has refuted this assertion by resolving each of them into five, and is of opinion, I believe, that the six-cube numbers have disappeared entirely considerably before this point. It is conceivable that the five-cube numbers also disappear, but this, if it be so, is probably in depths where computation is helpless. The four-cube numbers must certainly persist for ever, for it is impossible that a number $9n + 4$ or $9n + 5$ should be the sum of three.

I need scarcely add that there is a similar problem for every higher power. For fourth powers the critical number is 16. There is no case, except the simple case of squares, in which the solution is in any sense complete. About the squares there is no mystery; every number is the sum of four squares, and there are infinitely many numbers which can not be expressed by fewer.

3. I will next raise the question *whether the number* $2^{137} - 1$ *is prime.* I said that I would include one question which does not interest me particularly; and I should like to explain to you the kind of reasons which damp down

my interest in this one. I do not know the answer, and I do not care greatly what it is.

The problem belongs to the theory of the so-called "perfect" numbers, which has exercised mathematicians since the times of the Greeks. A number is perfect if, like 6 or 28, it is the sum of all its divisors, unity included. Euclid proved that the number $2^m(2^{m+1} - 1)$ is perfect if the second factor is prime; and Euler, 2,000 years later, that all *even* perfect numbers are of Euclid's form. It is still unknown whether a perfect number can be odd.

It would obviously be most interesting to know generally in what circumstances a number $2^n - 1$ is prime. It is plain that this can be so only if n itself is prime, as otherwise the number has obvious factors; and the 137 of my question happens to be the least value of n for which the answer is still in doubt. You may perhaps be surprised that a question apparently so fascinating should fail to arouse me more.

It was asserted by Mersenne in 1644 that the only values of n, up to 257, for which $2^n - 1$ is prime are 2, 3, 5, 7, 13, 17, 19, 31, 67, 127, 257; and an enormous amount of labor has been expended on attempts to verify this assertion. There are no simple general tests by which the primality of a number chosen at random can be determined, and the amount of computation required in any particular case may be appalling. It has, however, been imagined that Mersenne perhaps knew something which later mathematicians have failed to rediscover. The idea is a little fantastic, but there is no doubt that, so long as the possibility remained, arithmeticians were justified in their determination to ascertain the facts at all costs. "The riddle as to how Mersenne's numbers were discovered remains unsolved," wrote Mr. Rouse Ball in 1891. Mersenne, he observes, was a good mathematician, but not an Euler or a Gauss, and he inclines to attribute the discovery to the exceptional genius of Fermat, the only mathematician of the age whom any one could suspect of being hundreds of years ahead of his time.

These speculations appear extremely fanciful now, for the bubble has at last been pricked. It seems now that Mersenne's assertion, so far from hiding unplumbed depths of mathematical profundity, was a conjecture based on inadequate empirical evidence, and a somewhat unhappy one at that. It is now known that there are at least four numbers about which Mersenne is definitely wrong; he should have included at any rate 61, 89 and 107, and he should have left out 67. The mistake as regards 61 and 67 was discovered so long ago as 1886, but could be explained with some plausibility, so long as it stood alone, as a merely clerical error. But when Mr. R. E. Powers, in 1911 and 1914, proved that Mersenne was also wrong about 89 and 107, this line of defence collapsed, and it ceased to be possible to take Mersenne's assertion seriously.

The fact may be summed up as follows. Mersenne makes fifty-five assertions, for the fifty-five primes from 2 to 257. Of these assertions forty are true, four false, and eleven still doubtful. Not a bad result, you may think; but there is more to be said. Of the forty correct assertions many, half at least, are trivial, either because the numbers in question are comparatively small, or because they possess quite small and easily detected divisors. The test cases are those in which the numbers are prime, or Mersenne asserts that they are so; there are only four of these cases which are difficult and in which the truth is known; and in these Mersenne is wrong in every case but one.

It seems to me, then, that we must regard Mersenne's assertion as exploded; and for my part it interests me no longer. If he is wrong about 89 and 107, I do not care greatly whether he is wrong about 137 as well, and I should regard the computations necessary to decide as very largely wasted. There are so many much more profitable calculations which a computer could undertake.

I hope that you will not infer that I regard the problem of perfect numbers as uninteresting in itself; that would be very far from the truth. There are at least two intensely interesting problems. The first is the old problem, which so many mathematicians have failed to solve, whether a perfect number can be odd. The second is whether the number of perfect numbers is infinite or not. If we assume that all perfect numbers are even, we can state this problem in a still more arresting form. *Are there infinitely many primes of the form* $2^n - 1$? I find it difficult to imagine a problem more fascinatiing or more intricate than that. It is plain, though, that this is a question which computation can never decide, and it is very unlikely that it can ever give us any data of serious value. . . . .

There is a great deal of mathematics the purport of which is quite impossible for any amateur to grasp, and which, however beautiful and important it may be, must always remain the possession of a narrow circle of experts. It is the peculiarity of the theory of numbers that much of it could be published broadcast, and would win new readers for the *Daily Mail.* The positive integers do not lie, like the logical foundations of mathematics, in the scarcely visible distance, nor in the uncomfortably tangled foreground, like the immediate data of the physical world, but at a decent middle distance, where the outlines are clear and yet some element of mystery remains. There is no one so blind that he does not see them, and no one so sharp-sighted that his vision does not fail; they stand there a continual and inevitable challenge to the curiosity of every healthy mind. I have merely directed your attention for a moment to a few of the less immediately conspicuous features of the landscape, in the hope that I may sharpen your curiosity a little, and that some may feel tempted to walk a little nearer and take a closer view.

G. H. Hardy

WHITHER?[1]

I

Whether one enters a group of socially minded thinkers or a group of doctors in private conference or in public assembly, one soon becomes conscious of a restlessness regarding the profession of medicine. What does one think of membership in the American "Royal" College of Surgeons or Physicians, of medicine practiced under the ægis of a "group," of higher education for nurses, of chiropractors, of Christian Sciencers, of medical societies going to the public with their wares? Is the patient still the doctor's, or does he belong to a hospital? Should "industrial" medicine be developed? Should hospitals be standardized? Should the medical educational requirements of six years be lengthened to seven or eight or nine? Where ought one to stand on "state" medicine; should medicine have a portfolio in the cabinet; should clinical teachers be forbidden private practice? Should hospitals be open only to staffs or to all licentiates in medicine?

[1] Remarks made at the banquet of the Ohio State Medical Association meeting, May 3, 1922.

Are the answers to these problems really hard to find?

The medical profession has been caught in the swirl of the times. In the press of the moment it has forgotten its origins. Lost sight of are the circumstances, the principles and the ideas which in all times have made medicine what it is. Cause and effect are being mixed up. The present day shows too much of the form and too little of the spirit of that which has given the doctor his place and power.

II

It is no new discovery that the tyranny of a crowd is no better than the tyranny of an individual and that both lead to death. In spite of our cry that we are democratic we are almost exactly the reverse. We certainly dress alike; it has been said that we look alike; the corollary is that we think alike. Tersely put, we work in crowds and think in gangs and when applied to medicine we forget why anything smacking of such forms has prospered.

A case in point is offered by the diagnostic and operating "groups" in medicine which today infest us. Blinded by the success of one or two prototypes, medical men have concluded that their form accounts for their popularity. The fact is that none such has prospered—save as any business which is not bankrupt may be said to be prospering—except as the old substance of medical practice has been kept alive in the group by one or two dominating personalities. Without such vital souls there is left only a paper organization—all, it is safe to predict, that will survive when the present day medical or surgical leaders of these groups are gone.

A second case is offered by the specialists. Men formerly were driven into specialisms through professional or popular demand. A doctor peculiarly skillful of hand or mind had his day filled for him by those insistent that he do continuously the thing in which he excelled. The present day specialist is a self-anointed soul. He knows that to have a large view in medicine means hard work and broken hours; he sees an "opening" for a specialist, spends six weeks learning the necessary tricks and succumbs to the easiest way. It will be answered that specialists are needed to do the complicated things of blood analysis, bacteriological study and X-ray investigation. The truth is that these newer things have not become additions, as they should be, to the older and established methods of diagnosis and treatment but lazy-man substitutes for them—and poor ones. In the main, these "scientific" methods have not decreased error in diagnosis or broadened treatment. Chemical methods of blood analysis have not enlarged our knowledge of kidney disease; failures to obtain positive bacteriological findings have permitted patients to go without a diagnosis where an older generation of doctors would have judged correctly the nature of the disease from its signs and symptoms; while the ease of looking through a patient with X-rays has dulled the touch, the sight, the hearing and the judgment which made great our predecessors.

It is the common thing for our patients to be sent to a laboratory man, an X-ray specialist, a nose and throat surgeon, a skin doctor and a half dozen different types of special surgeons. It has even been proposed that we need a specialist to determine what medicine shall be given. But those engaged in these types of practice are beginning to realize its dangers. The dangers are to be met with another specialist—one who is to gather together the findings of all the doctors and tell the patient what he came a-seeking. He is to be known as an integrator. I sent an article proposing this scheme to a friend of mine with the marginal note that our colleagues were beginning to look for doctors once more.

I know a place where one can serve himself to a diagnosis as one serves himself to a meal in a cafeteria. One starts with a numbered card and buys himself at different counters and from different men a general examination, an investigation of the throat, an X-ray plate of the gall bladder, a dental overhauling, a surgical operation and a plaster cast for the foot. Each item carries its price which is punched on the ticket. What the scheme takes no account of is that the patient does not care whether he has Hirschsprung's disease, erythema nodosum or pseudo-hypertrophic muscular atrophy. What he is after is a plain statement of what is the matter with him, and whether he can be "cured" or not; also there is wanted a little appreciation of his state of mind and some understanding of the economic hardships of his family in the interim of being ill. The food counters do not carry these dishes.

It is a sin against the Holy Ghost to say that the profession is overorganized, but such it is. Organization springs from the desire of minorities to live in spite of majorities. As such, organizations give life, shelter and fellowship to the threatened and despised of the world. Their purposes accomplished, they tend toward reaction so that rarely have they merit after birth, when their powers of leadership because of rightness of cause, are supplanted by the powers of organization to impress their will. What looks like strength is merely a cramp—medically expressed, the cramp of death. Once "successful," Chapman's charge is correct: "All association, business or social, literary or artistic, religious or scientific, is opposed to any disrupting idea." How much in medicine the individual cowers to-day in the shadows of this mass mediocrity is innocently portrayed in a recent volume on civilization in the United States. Of thirty men who write freely of our politics, art and religion the one who speaks for medicine must "for obvious reasons" remain anonymous.

This is just a reversed way of saying that the present day doctor has sacrified his individuality—the thing through which alone he has gained his public standing historically or in the present. Never before has he affected a community through mass action, and it is safe to predict that through such he never—lastingly—will. He enters the public's life through an individual's need of him; and in the crises of life—birth, fear, despair and death. Disease may be objective but its effects are all subjective. Through his understanding of the individual in these circumstances has come the reward of individual trust; and it is this confidence multiplied which constitutes the public esteem in which the doctor lives. To think that such can be built up through massed professional activity is idle.

When will we get a secretary of medicine in the cabinet? Never through a lobby but when someone politically powerful transposes the personal faith he feels in his body physician into political action. We may get him any day that an occupant of the White House trusts adequately the mind and heart of his doctor. This is the manner of men. Not so long ago another follower of the "regular" school asked me why one of our intelligent citizens threw his whole energies into the cause of homeopathy. I ventured the easy answer that his family doctor was homeopathist, and more —that as a man this doctor was no mean personality.

III

If the medical profession has problems it is because it has either voluntarily relinquished what it should have held or done badly what others have done better. Each of these headings has subheadings of a legitimate and an illegitimate type. The picture of my old doctor friend jogging along in his buggy in the hours after midnight, responsive to a charity call registered through a telephone which he had himself installed in the home of his patient is all too rare. I inquired why he had not sent his younger colleague. He answered that he could not ask an assistant to rise in the night and work without material recompense. The young doctors do not nowadays follow the sick poor of our hospitals to their homes. The social service workers do this and the human aspects of the problems of disease are to-day more commonly touched by the educated nurse than by medicine's new generation. But if these things be so, is it any wonder that the sum total of patients which constitutes our public is becoming increasingly deaf to suggestions which spring from the medical profession and increasingly responsive to those emanating from social uplifters or economic and political reformers?

I venture to add that we do not know enough. For more than a decade now the non-medical psychologists have been able to tell us more of the rank of our mental defectives than we ourselves knew; the graduates of domestic science schools have known more of food values than ninety-nine of a hundred doctors; and laboratory technicians in X-ray work and the simplest biochemical tests have become the interpreters to the profession of the things which it should know itself. If the medical man still feels that *he* is set apart to teach these things, he must be securer in his knowledge of the fundamentals.

From an illegitimate side, the doctor's calling has been placed in parallel with the caricatures and fragments of medical thought represented in Christian Science, osteopathy and chiropractice. There has been much scramble to keep these things in their proper places through the political seesawing of legislative groups inclined to listen at one time to the doctors and at another to the toredocs. The answer should be simple. Why does the doctor ever acknowledge these as competitors? Have they a better knowledge of the principles of medicine and surgery? Or need there be envy that chicane so often pays better than honesty? It will be argued that the public does not know enough and that it must be protected. This has been the cry of autocrats since the stork ruled the frogs. What is at stake is the question of our fundamental faith in democracy. In brutal terms, our average fourteen-year-old intelligence is asked to decide whether it will learn or die. For myself, I have little faith in the moral or mental merits of a people which in law buttress the one with the virtue of jails and the other by a superimposed intelligence. The superiority of a people is to be measured by its ability to withstand temptation and not by the number of its prohibitory laws which makes a going-wrong impossible; nor is its superiority proclaimed by an absence of quack solutions but by its clearness of intellect which permits it to distinguish these from better ones.

Why the forcing of more health laws upon an unwilling humanity? Those who do not believe in vaccination, antitoxins and the purification of water and food supplies might, for a change, be permitted to die. If our Christianity needs to be invoked let us consider St. Luke. As physician and teacher he preached that "Now is salvation come nigh unto you." But with the truth uttered he left his audiences to make the final choice.

The medical profession will increase or lose its public power only as the collective expression of the people's faith in the individual doctors who touch them. To breed such faith the doctor must get again his old courage and cease to be the pussyfooter of our present day. What is wanted is not a strutting vanity, common enough, but a consciousness in the doctor of where he came from and where he is going. To do this he needs to learn again that he is a judge and obligated as such to get at evidence first hand. The profession of medicine is an openhanded one whose discoveries, practice and points of view are free and obtainable for the asking. Let the medical man then choose well whom he will visit and learn from. Let him discover what men actually do and not what others tell him they do. This holds true also for the evidence which he gathers from the printed page. In the hustle of our modern life the medical man has here fallen into the group of the common. He does not read originals any more and hardly reviews. The thing has become so attenuated that in his journals and text-books he is literally consuming reviews of reviews of reviews. As well may a man think to understand the psychology of sheep because he feeds on lamb stew.

The fundamental situation will not be changed in the space of a night. New viewpoints and idealism grow best in young soil. Whence our interest in the education of the new doctor. But medical education like all so-called university education has fallen into bad ways. There have been carried into it the false ideals of the kindergarten and grammar school. Education is conceived of, too much, as something that may be bought for and added to a son. And the present day university course does cost only four years and four thousand dollars of anybody's money. This idea must change. If there is a fundamental law under which we live it is that of Lamarck. Not through environment but through the degree of reaction on our part to that environment do we develop or atrophy.

But what is there in modern university education which develops the senses to observation, the mind to logic and the soul to understanding? The medical student is to-day lectured into coma—but the skill we are seeking can be acquired only by doing. Whence will come the man and the institution to teach again by the apprentice system? When will we see again, working students emulating masters?

What is so badly started in the universities and medical schools continues in the subsequent professional life. There is an eternal clamor for positions on hospital staffs, on boards of control, on faculties of medicine. As in political parties, groups of doctors are insiders or outsiders. What does it all matter and when will it be learned again that only the man counts and not the circumstance? Staff jobs, faculty places and positions of power are the husks of corn. Men collect jobs like political badges, recognizing in all too few instances that they are nothing but opportunities for work—and who uses them?

A doctor friend told me recently that he felt cramped in a hospital which housed only eight hundred beds. But Boerhaave changed all European medicine with but twelve; Corrigan rewrote the chapter on heart disease with but six and Külz whose work fills one third of all the tomes on diabetes had just two patients. Could any practitioner have less?

IV

Our modern medicine is tending in two directions, the one leading toward the ideals of the five-and-ten-cent store and administrative madness. This group talks of "selling" its ideas to the public. The other is recognizing that the collective skill and power and position of the medical group is only a composite of the piled-together abilities of the individual doctor and the reaction evoked from the individual patient. Our time represents a call to return to the fathers. The world is seeking, as of old, doctors with a kindliness, a tolerance and large understanding, the skill of hand, the skill of mind and the resourcefulness of a past generation. Where are the successors of van Swieten, John Hunter and Benjamin Rush or, in more modern terms, of Neusser, Osler and Billings? The Greek world sank as it grew in democratic principle—not in the abstract principle of democracy but in the concrete expression of it which substituted for its earlier rulers, proficient in the arts and sciences, the ever increasing number of non-productive Athenian traders. Is the efficiency of modern medical practice riding to a similar fall? Let us be honest with ourselves. If medicine fails it can not be ascribed to our stars, for our time, as all ages before it, in the hour of sickness and death cries as did Jeremiah: "Is there no balm in Gilead; is there no physician there?"

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ALEXANDER SMITH

From Edinburgh, Scotland, his birthplace, comes the news of the death of Professor Alexander Smith, lately head of the chemistry department at Columbia University. While this termination of the long and insidious illness which clouded his latter days was not unexpected, his loss is a heavy one for chemistry.

His circle of influence was perhaps widest as a text-book writer. Someone has remarked that a pre-eminent elementary text-book in any science appears but once in a generation. In his generation, Alexander Smith's elementary text-books have been the pre-eminent ones in this country, and, in their various foreign translations, have become well known abroad. When Smith was president of the American Chemical Society in 1911, an after-dinner speaker referred in his remarks to Smith's clear and sparkling eye, which, as those who knew him will recollect, was a very conspicuous and characteristic feature of his. Now, the same two epithets, clear and sparkling, might very properly be applied to his text-books in part explanation of their unrivaled position in the text-book field.

Smith's teaching work in this country was begun at Wabash College, whence, in 1894, he went to Chicago, at which place his teaching methods were chiefly developed. He was intensely active here also in administrative work both within, and, as dean of the junior college of science, beyond his own department; but had still abundant energy in reserve to continue investigative work. The researches on sulfur and on vapor pressures, for which, in 1912, he was awarded the Keith Prize by the Royal Society of Edinburgh, will recur to the minds of most chemists. In 1911 he migrated to Columbia University as head of the department of chemistry, which he proceeded to reorganize very fundamentally, energizing progress with his overflowing vitality until forced by illness to desist.

Truly, his spark was a brilliant one, but all too short-lived.

Alan W. C. Menzies

SCIENTIFIC EVENTS

THE COST OF RESEARCH WORK

The report of the British Scientific and Industrial Research Department for the year which ended on July 31 last has been published. According to an abstract in the London *Times*, it is divided into two sections, the first, which is signed by Lord Balfour, being the report of the committee of the Privy Council for Scientific and Industrial Research, and the second, signed by the administrative chairman, Sir William S. McCormick, that of the Advisory Council.

The first section is largely concerned with financial detail. The total expenditure of the department during the financial year was £525,584, made up of £273,193 from the Exchequer, £65,358 interest on the capital fund of one million for the formation of research associations, £86,355 from the same fund, and £100,677 from fees for tests and special investigations carried out for outside bodies, from the contributions of the shipbuilding industry for research in the Froude tank, and from repayments by the fighting services for research undertaken directly for them. Deducting the last item and also the grants from the million capital fund, the actual net expenditure of the department from public fuuds amounted to £338,552, against £427,432 in the previous year.

For the current year this expenditure is estimated at £342,641—nearly £85,000 less than in 1920-21, though about £40,000 of the reduction is accounted for by the government decision that research work undertaken directly for the fighting services at the National Physical Laboratory shall be a charge on the votes of those departments and not on the research department's vote.

While the council deplore the necessity for this reduction of expenditure, with the consequent slowing down of the research program, they realize that the check is less injurious now than if it had come at a later stage, because a steady policy in the matter of research is more conducive to success than the provision of larger sums of money without the assurance of their continuance. They refer with special satisfaction to the report of the Geddes committee, which stated: "We are of opinion that the activities of this department have been minutely examined with a view to obtaining a reduction of expenditure, and we are unable to recommend any further reduction beyond what has been effected."

The second section of the report also deals with the question of expenditure, and its introduction contains short notes by the Advisory Council on each of the activities of the department, intended to show the necessity for their continuance. It goes on to discuss the present position and future prospects of the research associations connected with the department. Of these, twenty-four have now received licenses from the Board of Trade, and twenty-two are in active operation. In addition, three other industries have the possibility of forming such organizations under immediate consideration, and preliminary negotiations are taking place with several others. Several examples are given of the economies and improvements in practice that have resulted from the work of these associations.

The report proceeds to describe the work that has been done for national purposes, including the work of the coordinating research boards, the research undertaken in the various research institutions belonging to the department, and certain investigations undertaken for the department elsewhere. There is also a brief account of the development of research for other parts of the empire, reference being made to the Empire Cotton Growing Corporation, the Colonial Research Committee, and the West Indian Agricultural College, for the last of which temporary buildings and laboratories are being prepared in Trinidad.

Steady progress is reported in the direction of closer cooperation between the scientific work of the various government departments, represented on the coordination boards, and an increasing tendency is noted on the part of the service departments to enlist the cooperation of outside bodies and to arrange for the open publication of the results of their work, when these are of general scientific and industrial importance.

A general survey follows of the work of various institutions under the direct control of the department, including the National Physical Laboratory, the Geological Survey, the Fuel Research Board, the Deep and Hot Mines Research Committee, the Building Research Committee, the Food Investigation Board, and the Forest Products Research Board.

The last part of the report deals with certain independent institutions and specific researches which have been aided by the department, and with the grants made to individual research workers and students. As regards the latter, 544 applications for grants were considered, against 333 in the preceding year, and 280 awards were made, against 245. The bulk of the applications for the academic year 1922-23 have been received, and already it is clear that they will at least equal in number those received last year. The expenditure proposed under this head for 1922-23 is £50,000, against an estimate of £47,000 for the year ending on the thirtieth of September.

PEKING UNION MEDICAL COLLEGE

THE year 1921, the seventh of the work of the China Medical Board of the Rockefeller Foundation, was marked by the completion of the main buildings of the Peking Union Medical College, the only institution for which the China Medical Board has thus far assumed complete financial responsibility.

It is hoped, according to the report of Dr.

Roger S. Greene, the director, that it may serve as a model for other medical schools, not in the sense that it necessarily represents the ideal in all matters of organization and construction, nor that it is as yet complete in every respect as a few of the largest institutions in other countries may be said to be complete, but that it presents, in China, a demonstration more nearly adequate than any that has preceded it, of the essential elements of a modern medical school.

The college seeks to point the way by which the future system of Chinese medical education may be adapted as well as possible to the actual conditions in the country. If the hopes of its founders are realized, it will graduate a select group of leaders in medical education, in research, and in public health administration, and a larger number of useful practitioners of medicine and surgery.

The attempt to harmonize the exterior of the college buildings with the great architectural monuments of Peking may be regarded as typifying the hope that the Peking Union Medical College itself may in time become a true Chinese institution, and that through it Chinese scientists may succeed in adapting western medical science to the needs of their own country more effectively than foreigners can ever hope to do.

It is obvious that foreigners can play only a very limited part so far as giving actual medical service is concerned; while foreign-trained Chinese doctors and nurses, though they can be very useful in the initial stages, will always be few in number and at some disadvantage because the schools they have attended have not sought to equip them for meeting the special conditions, whether of climate or of social and economic organization, which prevail in China. Therefore the establishment of an institution to provide the requisite training on local soil was logically the first step in the program of the China Medical Board. The efforts of its officers during these first years have accordingly been largely devoted to the reorganization and equipment, on a satisfactory basis, of one such medical school, the Peking Union Medical College.

Since 1915 the college has been supported by annual contributions from the China Medical Board. The budget for the academic year 1921-1922 provides for a gross expenditure, on the school and hospital, of $1,418,989 Chinese silver currency. The local income from fees and hospital earnings is estimated at $219,383 Chinese currency. To cover the difference an appropriation of $600,000 United States currency has been provided.

Of a teaching staff of ninety at the end of 1921, forty-seven were Americans or Europeans and forty-three Chinese, the latter being for the most part men who had been students in the United States or Great Britain. In order to lessen the isolation of the staff from scientific progress in the west, provision has been made for visiting professorships under which, every year, one or two leading medical scientists of the United States or Europe are invited to spend from four months to a year in Peking.

In 1921 visiting professors included Dr. A. B. Macallum, of McGill University, in physiology, and Dr. Francis W. Peabody, of Harvard University, in medicine. In 1922 the visiting professors from the United States are: Dr. E. C. Dudley, professor of gynecology in Northwestern University, Chicago; Dr. Harry R. Slack, Jr., of Johns Hopkins Medical School, in charge of the department of otolaryngology; Dr. Donald D. Van Slyke, a member of the Rockefeller Institute for Medical Research, who is giving graduate instruction in the department of physiological chemistry, and Dr. Elliott G. Brackett, professor of orthopedic surgery, Harvard Medical School, and during the war director of military orthopedic surgery for the United States Army, who has conducted graduate courses and clinics.

LEGAL RESTRICTIONS ON TYPES OF BABCOCK GLASSWARE

A statement has been issued by the experiment station at Geneva setting forth the provisions of the amendment to the agricultural law enacted at the last session of the legislature relative to the kind of Babcock glassware that can be legally used for making butter fat tests of milk and cream where the test forms the basis of payment. Accurate glassware is essential for just payments, and milk dealers and farmers in New York have been protected by law in the past against inaccurate glassware which would influence the butter fat test. New York was one of the first states in the Union to compel all glassware jobbers and manufacturers to submit their glassware to be tested for accuracy previous to its sale. Since 1900, the experiment station has tested all the Babcock glassware used in New York before it was offered for sale. All glassware meeting the requirements is marked S. B., or state branded, to show that it has ben tested and found correct.

The purpose of the amendment of the old law is to reduce errors in testing milk and cream for butter fat by the Babcock method by reducing the number of kinds of glassware that can be legally used in making the test. During 1921 the experiment station tested more than 39,000 test bottles and pipettes representing more than 24 distinct types. Many of these types, although accurately made, were so constructed as to lead to errors. Such glassware is now illegal. Only five types of glassware are now permitted by law. These are the usual 8 per cent. milk bottle, the 9-gram short and long cream bottles, the 18-gram long cream bottle, and the plain 17.6 cc. pipette. The New York law, which is now in force, is in accordance with the provisions of the United States Bureau of Standards.

Babcock glassware takes its name from Dr. S. M. Babcock, of the University of Wisconsin, who perfected the method of testing milk and cream for butter fat. The method is now used universally as a basis for payment to the farmer for his milk and cream.

THE CONFERENCE ON HIGHWAYS

Increasing interest in the forthcoming conference on highway transport and highway engineering education, to be held by the Highway Education Board in Washington, from October 26 to 28, is reflected in replies to invitations from educators and men high in the councils of the automotive industry. It is estimated that at least three hundred regularly invited delegates will be present, with approximately half as many more in attendance who are concerned in the problems to be studied. The headquarters of the conference will be the New Willard Hotel.

Ten committees are now preparing reports for submission to the conference as a whole. They will function with an educational chairman directing the research of their respective committees. H. W. Leavitt, assistant professor of civil engineering, University of Maine, is educational chairman of the committee on "Required Elective Undergraduate Subjects in Highway Engineering." L. W. McIntyre, assistant professor of civil engineering, University of Pittsburgh, is educational chairman of the committee on "Required and Elective Undergraduate Subjects for Highway Transport Business and Engineering Positions." On the committee, "Subject Matter of Basic Required Undergraduate Course in Highway Engineering," L. E. Conrad, professor of civil engineering, Kansas State Agricultural College, will serve as educational chairman.

Other educational chairmen and their committees are: C. B. Breed, professor of civil engineering, Massachusetts Institute of Technology, "Subject Matter of Basic Undergraduate Course in Highway Transport"; C. C. Wiley, assistant professor of highway engineering, University of Illinois, "Subject Matter of Undergraduate Course in Highway Engineering Theory and Design"; C. A. Baughman, professor of civil engineering, Alabama Polytechnic Institute, "Subject Matter of Undergraduate Course in Highway Engineering Laboratory"; Charles S. Howe, president of the Case School of Applied Science, "Nature and Content of Supporting Non-Technical Courses in Economics and English"; H. C. Smith, assistant professor of highway engineering and highway transport, University of Michigan, "Graduate Work in Highway Engineering and Highway Transport"; C. C. Albright, professor of civil engineering, Purdue University, "Conferences or Short Courses on Highway Engineering and Highway Transport"; H. J. Hughes, dean Harvard Engineering School, "Teaching Highway Traffic Regulation and Safety."

Among the automotive officials who plan to attend are Alvan Macauley, president Packard

Motor Car Company; Robert H. Salmons, vice-president Selden Truck Corporation; E. M. Sternberg, Sterling Motor Truck Company; Roy D. Chapin, president Hudson Motor Car Company; A. J. Brosseau, president Mack Motor Car Company; H. S. Firestone, president Firestone Tire and Rubber Company; H. W. Alden, vice-president Timken-Detroit Axle Company; Clark A. Ward, president Ward Motor Vehicle Company.

THE AMERICAN PSYCHOLOGICAL ASSOCIATION

The Cambridge meeting of the American Psychological Association will be held on December 27, 28 and 29. The sessions will be in Emerson Hall, Harvard University, and the official headquarters at the Hotel Bellevue in Boston.

Because of the increased pressure for places on the program, the program committee is extending the sessions to include the afternoon of the third day of the meetings. So far as possible papers of general and theoretical import will be placed in the sessions on Wednesday, December 27. The business meeting will be on Wednesday evening. The sessions of Thursday, December 28, will include a symposium arranged by Section I of the American Association for the Advancement of Science and the address of Professor Bott, retiring vice-president of Section I. The annual dinner of the association followed by the presidential address and smoker will be Thursday evening. Friday, December 29, will be devoted to sessions of the Section of Clinical Psychology. In the afternoon the session will be at the Boston Psychopathic Hospital at the invitation of Dr. Campbell and Dr. Wells.

Apparatus may be exhibited in the Psychological Laboratory in Emerson Hall. Members are asked to supervise the setting up of their apparatus and the repacking of it. Consignments should be shipped to Dr. C. C. Pratt, Emerson Hall, Cambridge, Mass. The treasurer is authorized to pay transportation charges on apparatus, charts, demonstrational devices and text materials which the members display.

A cordial invitation has been extended to members by Professor M. W. Calkins to visit Wellesley College; by Dr. W. E. Fernald to visit the Massachusetts State School for Feeble-minded at Waverley; by Dr. Wm. Healy to visit the Judge Baker Foundation at 40 Court Street, Boston; and by Dr. O. H. Lundholm to visit McLean Hospital at Waverley. Arrangements for these visits will be made during the meeting. Dr. Campbell and Dr. Wells invite the members to examine the work at the Boston Psychopathic Hospital after the meeting at the hospital on December 29.

SCIENTIFIC NOTES AND NEWS

Dr. Robert A. Millikan, chairman of the board of the California Institute of Technology and director of the Norman Bridge Laboratory, has been appointed a member of the committee on intellectual cooperation of the League of Nations to succeed Dr. George E. Hale, who has resigned from the committee.

Dr. Ludwik Silberstein, mathematical physicist at the Eastman Kodak Company Research Laboratory, has been appointed a member of the Commission on Relativity of the International Astronomical Union.

Dr. Charles B. Davenport, director of the Station for Experimental Evolution and the Eugenics Record Office of the Carnegie Institution of Washington, left New York on the *Paris* for Europe on September 13. He planned to proceed to Brünn, Czechoslovakia, for the purpose of participating in the International Gregor Mendel Centenary on September 22, 1922, and from Brünn to go to Vienna to attend the meeting of the German Society of Geneticists from September 25 to 28. His next visit will be to Upsala, where he will confer with Dr. Herman B. Lundborg of the University of Sweden. From Sweden he will proceed to Norway for the purpose of paying a visit to Dr. Jon Alfred Mjoen, of the Winderen Laboratorium, Christiania, thence to Holland to visit Dr. Joh. Von Der Speck, Doldersche Weg. 60, Den Dolder. He will go to Belgium for the purpose of attending, as delegate of the Carnegie Institution of Washington and the Eugenics Research Association, the meetings of the International Commission of Eugenics.

These will be held from October 9 to 14. The next visit will be to Paris in the interests of the Third International Congress of Eugenics. In London, on October 24, he will lecture before the Eugenics Education Society on "Recent Work of the Eugenics Record Office." He will sail from England about October 25.

Dr. Hugh S. Cumming, surgeon general of the U. S. Public Health Service, sailed on October 5 for Europe to spend two weeks inspecting the government's sanitary stations abroad. While in France, General Cumming will also attend the convention at Paris which is to revise the international sanitary treaty of Rome, where he will present several amendments concerning international measures against typhus, the plague and cholera. He will attend, in addition, the meeting in Paris of the hygiene unit of the League of Nations.

Dr. David Starr Jordan has sailed for Japan. He expects to return to Stanford University in December.

Dr. H. Cilento, of the Australian Health Department, recently arrived in America to study the methods used by the late General Gorgas in effecting sanitation in the Canal Zone.

Drs. Leon Bleum, P. Bouin, Georges Weiss and L. M. Pautrier, of the University of Strasbourg, arrived in New York on October 2. They plan to make a study of American hospitals.

Neil M. Judd, curator of American archeology of the U. S. National Museum and director of the National Geographic Society's Pueblo Bonito Expedition, returned to Washington at the end of September after having completed the second season's exploration of the great ruin of Chaco Canyon, New Mexico.

Edward S. Handy, ethnologist of the Bishop Museum of Hawaii, will leave Honolulu in December or January to take charge of an expedition to Tahiti and Moore, for which the museum has completed arrangements. The work is planned to supplement the investigations by members of the Bayard Dominick Expedition, who have been at work in the Marquesas and the Austral Islands during the past two years.

Professor Albert W. Smith, formerly dean of Sibley College, Cornell University, and acting president of the university, has returned to Ithaca, where he is engaged in writing the biography of John Edson Sweet, first head of the mechanical engineering instruction at Cornell, and later president of the Straight Line Engine Company of Syracuse. Professor Smith retains his connection with the Kent Construction Company of Rutherford, New Jersey, as consulting engineer.

Dr. Warren D. Smith, who has been for the past two years on leave of absence from the University of Oregon, in charge of the Division of Mines, Bureau of Science, Manila, P. I., has returned to the university to resume his work in geology and geography.

The Norman Lockyer Observatory, Sidmouth, England, has elected Dr. Otto Klotz, chief astronomer and director of the Dominion Astronomical Observatory, Ottawa, an honorary overseas member.

Henry E. Summers has retired from active work as state entomologist of Iowa and professor of zoology in Iowa State College, positions to which he was appointed in 1898. He will live in Los Angeles, California.

Mayo Dyer Hersey, associate professor of the properties of matter in the department of physics of the Massachusetts Institute of Technology, has resigned to take a position as physicist in charge of the Physical Laboratory of the United States Bureau of Mines, Pittsburgh, Pa.

Mr. Barry J. Anson has recently resigned his assistantship in the U. S. Bureau of Fisheries Biological Station, at Fairport, Iowa, to accept a Rockefeller Foundation medical fellowship paying $2,000. He is working at Harvard University.

Mr. E. Leonard Gill, of the Hancock Museum at Newcastle-on-Tyne, has been appointed assistant in the natural history department of the Royal Scottish Museum, Edinburgh.

When the *Maud* was at Deering, Kotzebue Sound, Alaska, in order to land Captain Amundsen for his proposed airplane flight across the polar area, Dr. H. U. Sverdrup, in charge of the scientific work of the Amundsen expedition, mailed magnetic records to the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. The expedition was able to reoccupy magnetic stations of 1920 and 1921 at Kain-ge-sken, Siberia.

THE Italian government has decided to restore to the German psychiatrist, Professor E. Kraepelin, his villa in Italy, which was confiscated during the war as enemy property.

DR. E. D. BALL, director of scientific work in the U. S. Department of Agriculture, and national president of Gamma Sigma Delta, the agricultural honor society, installed a chapter at the Pennsylvania State College on October 10. A local association has also been formed by members of the Society of Sigma Xi who reside in State College or vicinity, with Dr. F. D. Kern as president and Professor C. Emory Myers secretary-treasurer.

DR. HENRY H. DALE, director of the National Institute for Medical Research, London, gave a Hanna lecture at the Medical Library Auditorium in Cleveland on October 6.

DR. HARLOW SHAPLEY, director of the Harvard College Observatory, lectured at Mount Holyoke College on October 6 on "Measuring the Milky Way." The lecture is the first of a series of science lectures provided for by the Polly Hollingsworth fund for lectures on art, science and music.

PROFESSOR L. BAIRSTOW delivered a lecture to the Royal Aeronautical Society on October 5, on "The Work of S. P. Langley."

THE twenty-fifth annual Traill-Taylor Memorial Lecture of the Royal Photographic Society was delivered by Dr. R. S. Clay on October 10, on "The development of the photographic lens from the historical point of view."

FOLLOWING services which were held at his home, the body of Dr. William S. Halsted, late professor of surgery in the Johns Hopkins University, who died on September 7 at Johns Hopkins Hospital, was cremated on September 9, in pursuance of his wish. Drs. William H. Welch, Howard A. Kelly, William H. Howell, John J. Abel, William G. MacCallum, Harvey Cushing, Ira Remsen, Winford H. Smith, John Whitridge Williams and Judge Harlan were the honorary pallbearers, and Drs. John M. T. Finney, Joseph C. Bloodgood, Hugh H. Young, George J. Heuer, Samuel J. Crowe, Walter E. Dandy and Mont R. Reid were the active pallbearers.

DR. JOSEPH E. WINTERS, professor emeritus of the diseases of children at Cornell University Medical College in New York, died in Boston on October 4.

DR. INIGUES, professor of astronomy at the University of Madrid and formerly director of the Madrid Observatory, has died.

DR. WILLIAM HALSE RIVERS RIVERS, of St. John's College, Cambridge, author of works on ethnology, psychology and anthropology, who died on June 4, aged fifty-eight, bequeathed to St. John's College the portrait of himself by Shields, to the library of the college such of his books as the council of that college may choose; the balance of his books and pamphlets to the University of Cambridge, for the departments of psychology and ethnology as the librarians may select; and to his friend, Professor Grafton Elliot Smith, professor of anatomy in the University of London, all his MSS. and unpublished works as his own property, but requesting him to publish such portion as he might consider ought to be published, and he left to him £500 for defraying the costs of preparing and publishing these documents.

THE John Elliott Memorial Pathological and Bacteriological Laboratory at the Chester Royal Infirmary was opened on September 16 by Sir Humphrey Rolleston, K.C.B., M.D., president of the Royal College of Physicians of London. The laboratory has been fitted and equipped by public subscription in memory of the late Dr. John Elliott, honorary physician to the infirmary from 1895 to 1921.

PRESIDENT-EMERITUS PATTERSON, of the University of Kentucky, died at his residence on the campus on August 15, 1922, in his eighty-ninth year. After making a number of personal bequests he left his residuary estate to be reinvested by the Security Trust Company, of Lexington, and the interest compounded until it shall become large enough to yield an income of $35,000 or $40,000 a year, when the income is to be used to maintain the William Andrew Patterson College of the University of Kentucky, the purpose of which shall be to train young men for diplomatic and consular service. President Patterson's library is to be given to the university on condition that it be kept intact and that the books be not allowed to go out of the room in which the library is kept. The will names as literary executors Dr. William B. Smith, of New Orleans, and Miss Mabel Pollitt, who are to examine correspondence and other writings and prepare and publish a biography.

A joint meeting of the Eastern and Western Divisions of the American Philosophical Association will be held in New York City on December 27, 28 and 29, at Union Theological Seminary. At this meeting Professor John Dewey will deliver the Paul Carus Lectures on the attempt to apply a theory of experience to certain metaphysical problems. The afternoon sessions will be largely devoted to the lectures by Professor Dewey, and the morning sessions to the reading and discussion of papers offered by members. Abstracts of papers should be in the hands of Professor G. A. Tawney, University of Cincinnati, Ohio, not later than November 10. On Wednesday and Thursday evenings, respectively, the smoker and annual dinner will be held, and at these times also addresses by the presidents will be delivered.

The writer of "From an Oxford Note-Book" in *The Observatory,* who is always very much alive, writes in the last number as follows: "Those interested in handy reference works will be grateful to the compilers of *Who's Who* for producing a supplementary volume *Who was Who,* covering the period 1897-1916. The volume was intended to appear in 1916, but owing to the war its publication was delayed. It has now been produced, and can be put upon the reference-shelves. Since it consists chiefly of extracts from the volumes of the main publication, with dates of death added, its information can generally be trusted; but I notice that it contains a statement of the death in 1909 of Professor Turner, of Oxford. Now I much doubt the accuracy of this information. I have certainly not seen the actual face of the learned gentleman for many years; but I have heard him lecture, and (unless wireless has entered upon a new phase) I do not think he was very far away. Further investigation is, however, proceeding."

UNIVERSITY AND EDUCATIONAL NOTES

The China Medical Board of the Rockefeller Foundation has given $125,000 each to Southeastern University at Nanking and Nankai College at Tientsin for science buildings and equipment. Southeastern University is a government institution, located at Nanking, the old southern capital of China. Nankai College, in the north, is a private institution receiving provincial aid.

The *Journal* of the American Medical Association reports that the new Darling Building in the Medical School of Adelaide University, South Australia, was opened recently by Sir George Murray. It is to be devoted to the departments of the fundamental sciences in the faculty of medicine, as there has been inadequate accommodation for the teaching of anatomy, physiology and pathology. The family of the late Mr. John Darling contributed £15,000 towards the erection of the building.

Dr. Charles Russ Richards, formerly dean and director of the College of Engineering of the University of Illinois, will be inaugurated as president of Lehigh University on October 14.

Dr. Howard B. Lewis, formerly associate professor of physiological chemistry at the University of Illinois, has accepted an appointment as professor and head of the department of physiological chemistry in the Medical School of the University of Michigan.

Dr. Leon A. Hausman, of Cornell University, has joined the staff of Rutgers College as instructor in zoology and research zoologist.

John L. Buys, instructor in entomology at Cornell University, has been appointed assistant professor of entomology at the University of Akron.

Dr. A. D. Howard, until recently assistant in the Bureau of Fisheries with assignment to certain fresh-water mussel studies at the biological laboratory at Fairport, Iowa, has resigned to become assistant professor of zoology at the University of Southern California.

PROFESSOR T. J. TALBERT, superintendent of farmer's institutes and extension schools and leader of subject matter specialists, Division of Extension, Kansas State Agricultural College, has been appointed professor of horticulture and chairman of the department of horticulture at the University of Missouri.

DISCUSSION AND CORRESPONDENCE

THE PALEOPATHOLOGY OF THE PARASUCHIANS

STUDENTS of vertebrate paleontology have long been aware of the presence of curious knob-like eminences on the snouts of the Triassic crocodile-like, elongate reptiles which Huxley regarded as the Parasuchia, but are now known as the Phytosauria with an organization quite remote from that of the Crocodilia. No adequate explanation of these eminences has ever been given although the writer referred to one of them as a callus following a fracture; an interpretation from which he was dissuaded by Huene. Recently Dr. Case has written me about a very curious example of these eminences and Professor O. Abel of Vienna has discussed[1] in a very interesting manner the nature of all the eminences, regarding them as lesions following injuries received in combat, and as occurring more frequently in the male. The ensuing complexities of a taxonomic nature are startling, and if correct pathological disturbances will reduce a lot of scientific names to the limbo of useless terms.

But I am not at all sure that Abel is correct. His argument is from analogy only. He has given not one positive anatomical or pathological evidence to prove that the eminences are "Bissverletzungen," or lesions of a traumatic nature with often huge necrotic sinuses, if they are at all pathological. The weakness of Abel's argument consists in the fact that the eminences are always in the median line and are always fairly symmetrical, at least in all the examples known to me. So before Abel's conclusions are accepted and the taxonomy of the Phytosauria revised we must have definite proof that these eminences really are pathological in nature and not something else. They *may* be pathological lesions, but we do not *know* they are, and there are methods of determining this point within reasonable limits of certainty, and that is by a histological comparison of the bone from one of the eminences, with normal bone elsewhere on the snout.

We have sufficient knowledge of the histology of fossil bone through the studies of Kölliker, Seitz and Schaffer, whose work is reviewed in my forthcoming volume on "Paleopathology," and to which I have made a number of additions. From the standpoint of histology the bone tissue of ancient forms, and of modern fishes, consists largely of an osteoid tissue which in normal fossil bone has few, widely-scattered lacunæ, scant lamellæ and little or no evidences of an Haversian arrangement. In fossil pathologic bone, however, the lacunæ become more numerous, the lamellæ more prominent, and numerous concentric arrangements, recalling Haversian systems, are apparent. I have found this to be true in callosites of the Permian reptiles, in the Comanchic dinosaurs, in the Pleistocene cats, in pre-Columbian man and in the modern bison, so we may say the phenomena are universal. Foote has recorded a similar fact for the modern bull-frog, in a case of a fracture of the femur.

Until positive evidence of this kind is forthcoming Abel's conclusions must await acceptance. The matter is far too important for hasty judgment. The numerous fossil pathological lesions I have studied are so different from the symmetrical, median eminences seen in the Phytosauria that I hesitate to accept them as callosities. We usually find a lack of symmetry in pathological lesions, especially in those of a traumatic character.

ROY L. MOODIE

COLLEGE OF MEDICINE,
UNIVERSITY OF ILLINOIS

[1] O. Abel: Die Schnauzenverletzungen der Parasuchier und ihre biologische Bedeutung (mit 10 Textfiguren). *Paleontologische Zeitschrift*, Bd. V, Heft 1, Juni 1922, pp. 26-57.

MEASUREMENTS OF HUMAN CRANIA

TO THE EDITOR OF SCIENCE: For many years students of physical anthropology have been handicapped by the lack of reliable cranial measurements from the American area. The National Museum in Washington and several other museums contain rich collections of crania, but no satisfactory measurements of these have been published.

After some discussion of the situation with Dr. Aleš Hrdlička, curator of physical anthropology at the National Museum, and correspondence with the secretary of the Smithsonian Institution, a plan has finally been adopted by which the large collections in Washington will soon be made available. Measurements of the entire series of human crania will be made under Dr. Hrdlička's direction and published in the form of a catalog which will be issued in parts in the Proceedings of the U. S. National Museum. It is expected that several parts will be printed each year, the first being already in press.

It is to be hoped that other museums will now follow the lead, and that in this way the large mass of materials which they contain for the study of the physical anthropology of the American Indian will, in similar fashion, be made available for students.

ROLAND B. DIXON

HARVARD UNIVERSITY,
SEPTEMBER 15, 1922

BIBLIOGRAPHY AND RESEARCH

TO THE EDITOR OF SCIENCE: A clearer portrait of the "book sciences" than that in Mr. W. W. Bishop's "The Record of Science," I have never seen in the ten years that I have been engaged in library work.

Many of the thoughts expressed in Mr. Bishop's address have been uppermost in the minds of many of the directors of the laboratories of book science, if I may be permitted to borrow Mr. Bishop's phrase. Many of us have seen this college and that college, this large concern and that large industry, endowed with munificent funds for research. In 1920-1921 there appeared in our leading index to technical periodicals over 100 titles relating to research work. The National Research Council has published a second edition of "Research Laboratories in Industrial Establishments in the United States," listing some 526 industrial houses operating laboratories devoted to research in one form or another. The same institution later published a list of the sums invested in research fellowships and endowments. The total endowments and fellowships amounted to 565, representing, in round numbers, over $22,000,000.

Now Mr. Bishop has pointed out that bibliography is the *foundation* of research. Yet I fail to find any specified sum set aside for a well equipped laboratory of book sciences. I doubt if 50 per cent. of these 526 industrial concerns supporting laboratories own and operate respectable laboratories for research in facts, or as I choose to call these libraries, laboratories for "research fact-oring." In fact, I know of one organization that spent over $400,000 for a research laboratory and yet in its laboratory for research fact-oring, it did not invest one tenth of that amount.

Now, then, why not promote sentiment for the establishment of endowments for research laboratories in "fact-oring" and fellowships in book sciences?

K. C. WALKER

AN UNUSUAL SOLITAIRE GAME

DEAL at random 25 cards from a pack of 52 playing cards and arrange them in five complete poker hands any one of which may be a flush (such as any five hearts), a straight (such as 3, 4, 5, 6, 7, or Ace, K, Q, J, 10, not necessarily of one suit), or a full-house (three of one kind and two of another).

Various persons have tried this solitaire several hundred times and worked it without finding a single case of failure, occasionally after many attempts. It was believed that it would always succeed. After some reflection, the writer invented the following impossible deal:

Diamonds:	2, 7, Q.
Hearts:	3, 4, 9, Q, K.
Clubs:	1, 3, 5, 6, 7, 8, 10, J.
Spades:	1, 2, 4, 6, 8, 9, 10, J, K.

with exactly two of each kind, excepting the single 5. Since there are not three of a kind, there can not be formed a full-house. But how are we to be certain that we can not make five flushes and straights with these 25 cards? We can not examine the more than 5,194 billions of ways of arranging the 25 cards into five sets of five each, not distinguishing the order of the cards in a set or the order of the sets. We shall resort to the following conclusive analysis:

Since there are only three diamonds, no one of them occurs in a flush, and they are too far apart for two of them to occur in a straight. Hence 2d, 7d, Qd occur in three separate straights.

First, let both 3h and 4h occur in a straight with 2d, and hence with 5c, the only 5. Since there is no 5 left to go in a straight with 3c or with 2s, there is a flush of clubs and a flush of spades. These with the three straights mentioned must exhaust the 25 cards. But Qh is too far from 2d or 7d to be in a straight with one of them, nor can it be in a straight with another queen, Qd, nor in a flush of clubs or spades.

Second, let either 3h or 4h be not in a straight with 2d, and hence not in another straight (since a new 5 is lacking). Thus either 3h or 4h lies in a flush, containing all our five hearts. Since 2s can not occur in a straight (5 lacking), there is a flush of spades. Hence we have these two flushes and the three straights containing 2d, 7d, Qd. But 7c can not occur in one of these five poker hands.

This completes the proof that the above 25 cards can not be arranged in five complete poker hands.

L. E. Dickson

SCIENCE IN FICTION

To the Editor of Science: I am getting up a little catalog of fiction on scientific themes and should like the help of Science readers. Such books belong mostly to four classes:

(1) Fantastic and futuristic fiction, such as Jules Verne's "Twenty Thousand Leagues Under the Sea" (submarine) or "A Voyage to the Moon" (astronomy) and Wells's "The Food of the Gods" (hormones) or "The Story of Davidson's Eyes" (fourth dimension). This seems to be the largest and most popular group.

(2) Novels based upon some scientific discovery or showing the influence of applied science upon society, such as Hergesheimer's "Three Black Pennys" (development of the iron industry).

(3) Stories in which some scientific fact or theory forms the theme, such as Arthur Reeve's detective stories and Rebecca West's "The Return of the Soldier" (Freudianism).

(4) Historical fiction where a distinguished man of science plays an important part, such as Merejkowski's "Romance of Leonardo da Vinci" and Guitry's play of Pasteur. This which would seem to be a fertile field for fiction has apparently been rather neglected.

I should be very much obliged if those who happen to know of good novels or worth while short stories of this sort would give me the titles and authors' names, also if convenient the publisher and the scientific motif.

Edwin E. Slosson

Science Service,
Washington

QUOTATIONS

THE WORK OF GENERAL GORGAS

One of the last acts of Congress before adjournment was to send to the President a bill to pay a monthly pension of $150 to the widow of General William C. Gorgas, who died in London on July 4, 1920. In 1918 General Gorgas was placed on the retired list, having reached the age of 64. In the two years of life remaining to him his services were in great demand as an expert in sanitation. The Rockefeller Foundation made him director of the yellow fever work of its International Health Board. He visited Guayaquil to see what could be done to clean up that pest-hole. The government of Peru engaged him to carry out a sanitary program in that country. General Gorgas did not live long enough to earn the reward to which he was entitled as a renowned specialist in sanitation. His army pay had increased slowly as he rose from grade to grade. It was not until 1916, two years before he left the army, that he became a major general. Upon his retired pay, which, of course, ceased with death, he could live comfortably with his family, but only by practicing economy. To gain a modest fortune it was necessary for him to live the strenuous life of scientific investigation in tropical countries, and the time at his disposal was too short. He carried on until he died worn out.

It was an irony of fate that the soldier who had saved an incalculable number of lives by his campaigns against yellow fever and malaria in Havana and in Panama should be struck down at sixty-five while risking his own health to provide for his family after his death. The republic is not ungratefnl to its Deweys and Pershings, who are rewarded with special rank and high pay for life for fighting its battles, but may not the charge of failing to recognize the merits of a great soldier-sanitarian like William C. Gorgas be preferred against it? There might be extenuation if the world had not acclaimed him the most efficient plague-fighter of his day. Great Britain sent for him when its own medical men were baffled by the virulence of influenza in the Rand gold mines in 1913, the War Department lending Colonel Gorgas to find means of checking the epidemic, in which he was successful. If he had been an Englishman, Great Britain would have known how to reward as well as to honor him for his invaluable services. Great Britain could only give to him a decoration coveted by its own scientists. France made him a commander of the Legion of Honor. It can not be pleaded for Congress that it has not the power in such a case to reward conspicuous merit and service. If a precedent had been made when General Gorgas retired from the army, there would not now be the spectacle of a belated effort to do something in a small way for the relief of his widow.—New York *Times*.

SCIENTIFIC BOOKS

Plane and Solid Analytic Geometry. By William F. Osgood, Ph.D., LL.D., and William C. Graustein, Ph.D. New York, The Macmillan Company, 1921. Pp. xvii + 614.

This book is somewhat larger than the usual American text-book designed for an elementary college course in analytic geometry. The material is so arranged that it is easy to select therefrom suitable subjects for comparatively short courses, and hence the book will be welcomed by those teachers who believe that it is desirable to place in the students' hands books which will enable the most gifted to go beyond what is discussed in class. Emphasis is laid on presenting the subject in the simplest and most concrete form, and on pointing out its relation to physics whenever possible. It may be recalled that Descartes, who is commonly regarded as the founder of analytic geometry, once said in a letter to Mersenne that all his physics was nothing else than geometry.

In view of the fact that the various mathematical theories are so interdependent good text-books for courses in elementary mathematics must cover the same fundamental ideas. There is, however, considerable latitude as regards the mode of presentation, especially as regards illustrative examples and the choice of the problems which the students are expected to solve for the purpose of developing their ability to use the subject. Students can usually prove a large number of theorems which they do not understand until they have applied them in the solutions of different types of problems. The present volume contains a large number of problems selected by men who are well qualified to determine what is most essential for the later progress of the students in pure and applied mathematics.

About 200 pages of the book are devoted to solid analytic geometry. Most of our courses for engineering students are too weak along this line. Many of the standard texts on applied mathematics presuppose a thorough knowledge of the rudiments of solid analytic geometry, and even the ordinary courses in integral calculus and mechanics frequently make greater demands on space conceptions than the student has acquired in the brief course which he followed. The developments found in these last 200 pages are especially to be recommended to students who seek a clear presentation of very useful facts lying just beyond the ordinary elementary course in analytic geometry.

The text-book under review will doubtless remain a standard for many years. It may be too extensive to meet the wants of most institutions for a first course but it will probably be consulted by many teachers who prefer to place briefer treatments in the hands of their students. The high mathematical attainments of its authors are naturally reflected in many details of treatment, and inspire deserved confidence in the accuracy of the statements relating to matters of fundamental importance. The modern tendency towards the insertion of numerous historical notes in elementary text-books on mathematics is not followed here.

It may be added that the authors state in a foot-note on page 177 that a tangent can not be defined as a line meeting the conic in a single point. The opposite view was recently expressed by Professor Cajori in an article published in *School Science and Mathematics,* volume 22, page 463, where the author tries to support an inaccurate statement found on page 163 of the second edition of his "History of Mathematics," 1919. It is here stated that Roberval "broke off from the ancient definition of a tangent as a straight line having only one point in common with a curve." It may also be noted here that some readers might question whether it should be said that a mathematical argument can be convincing without being conclusive, as is implied by the authors in a foot-note appearing on page 180. In view of the extensive literature on Greek algebra the second paragraph of the Introduction is misleading.

G. A. Miller

University of Illinois

SPECIAL ARTICLES

WATER CULTURE EXPERIMENTATION

As a one-salt solution is the simplest possible salt solution, so the simplest growth media that can be devised for plants, provided they need but two elements at a time, should be the proper combination of one-salt solutions. Because green plants require at least seven salt elements, available to and absorbed through the roots, complete nutrient solutions having these elements present together are employed as the media in which the plants are grown. The use of at least three simple salts plus a trace of iron (added as a salt) is required to supply the growth media with the necessary elements.

The writer has recently grown wheat for a period of three months, which included the heading out stage of the plants, in a combination of single salt solutions of KNO_3, $CaSO_4$ and $MgHPO_4$ (each of .01 mol. concentration). The plants grown in these solutions were equal or comparable in their various features of growth, including that of total dry weight, to those of plants grown contemporaneously in complete well-balanced nutrient solutions prepared either with the above named salts or with other salts supplying the same elements.

The salts named appear to be the only three salts that can be used as a combination of three single salt solutions that permit of normal and undiminished growth of wheat. This is the conclusion arrived at from an investigation of culture tests using those salts singly as combinations of one-salt solutions that were outlined as combinations of three-salt solutions (complete nutrient solutions) in the Plan of Cooperative Research on the Salt Requirements of some Agricultural Plants.[1]

Because the mono-basic phosphates given in the plan were found to be too acid for these tests with single salt solution, the diabasic phosphates of calcium and magnesium were substituted for those of the respective mono-basic phosphates. It appears, therefore, that by using the proper salts, wheat plants grow as well with only two nutriment elements present in the media at one time (exclusive of a trace of iron supplied at weekly intervals to all cultures) as they do in complete nutrient solutions.

The set of plants that made best growth, of those sets tested, as combinations of one-salt solutions named, were apportioned among the solutions as follows: four days continuously in KNO_3, one day in $CaSO_4$ and one day in

[1] See Plan of Cooperative Research on the Salt Requirements of Representative Agricultural Plants, prepared for a Special Committee of the Division of Biology and Agriculture of the National Research Council. B. E. Livingston, editor. Baltimore, 1919.

$MgHPO_4$. On the seventh day the plants were transferred back to KNO_3 and the above sequence continued. The plants were rinsed in distilled water with every change of culture from one solution to another. Whether this apportionment of exposure of culture to the several solutions would continue to be the best for the growth of wheat can not be stated until the plants have matured. It appears the best apportionment of exposure of the plants to the different solutions may vary, being not inconsiderably influenced by the aerial growth environment and by the nutrient requirements of the plant at different stages of growth.

Because of its simplicity, the method appears well adapted for investigation of these points as well as for instruction in the principles of plant nutrition. It should aid materially in throwing more light on the causative interrelations of the growth of plants and the composition of the growth media.

W. F. Gericke

University of California

A NOTE ON THE SPERMS OF VALLISNERIA

After trying for many years to secure favorable fixation of ovules of *Vallisneria spiralis* the writer recently succeeded in getting more fortunate material. Perhaps a few words, by way of preliminary publication, on the method and results may be of interest to workers in this field.

The ovules are borne numerously in the epigynous ovary surrounded by a mucilaginous substance which greatly retards the action of reagents and is but slowly dissolved by water. Cutting the ovary across permits one to squeeze out the contents which in their mass movement break off the ovules and carry them out. Several hours of washing in water are then necessary to free these ovules from their gelatinous matrix. In repeated earlier attempts it was found that all ovules having received pollen tubes completed their fertilization and double fertilization before killing agents penetrated to them. If pistils were killed *in toto* the pollen tubes running down their inner walls in the edge of the gelatin would be well fixed, but the interior ovules were invariably found in poor shape due to the influence of this slime.

Last year the writer modified the method by lowering the temperature of the water used in dissolving the mucilage from the expressed ovary content. The water was cooled by adding small pieces of ice, and the container was set in a larger vessel of iced water. It was hoped in this way to slow down or stop both growth and cyclosis and to hold all parts *in status quo* until killing was possible.

The results were very satisfactory. Sperms were found not only in the tip of pollen tube within the synergid but in all subsequent situations through to the completion of fertilization. Many points regarding the male cells of Vallisneria, previously left obscure through poor fixation, were cleared up by use of this material. A brief statement of findings is given below.

The sperms of *Vallisneria spiralis* maintain their integrity as male cells until the egg is reached. During the journey through the pollen tube they remain joined end to end and pass out of the tip of the tube together. The sperm that later fuses with the egg emerges from the tube as a cell and immediately flattens against the egg membrane. Many preparations showed the male nucleus with its definite mass of cytoplasm and bordering membrane pressed, as a complete cell, against the egg cyst. One would hardly expect to find, in fixed material, stages showing events at the moment the two cells break together, for the union would probably be completed quickly. But the two masses of cytoplasm must intermingle in some degree in fertilization and probably the male cytoplasm partly or wholly enters that of the egg. The male nucleus soon moves to the center and unites with the egg nucleus. There can be no doubt of the morphology of the sperm up to the time of its union with the egg,—they come together as complete cells.

The second sperm loses its cytoplasm soon after it emerges from the pollen tube. Its nucleus is often observed as a spherical body within a strand of protoplasm extending from the egg-apparatus to the polars. Its successive positions suggest that it is carried to the polars by movement of cytoplasm within the embryo-sac. The male nuclei of Vallisneria are never vermiform in the slightest degree nor is there any suggestion of motility on their part.

ROBERT B. WYLIE
UNIVERSITY OF IOWA

THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-ninth summer meeting of the American Mathematical Society was held at the University of Rochester, Thursday and Friday, September 7-8, 1922, in conjunction with the meeting of the Mathematical Association of America. Special features of the session included visits to the research laboratories of the Eastman Kodak Company and to the buildings of the Bausch and Lomb Optical Company, a chamber concert at the Eastman School of Music, and an automobile drive through the environs of Rochester, arranged by the alumni of the university. A resolution was passed expressing the thanks of the society for the generous hospitality extended.

The attendance included seventy members of the society. The secretary announced the election of ten persons to membership in the society; twenty-one applications for membership were received.

At the meeting of the council, committees were appointed as follows: Professors C. N. Haskins, T. S. Fiske and H. S. White on award of the Bôcher Memorial Prize; Professors D. R. Curtiss, Dunham Jackson and H. H. Mitchell on nomination of officers for 1923.

The medal presented to the society by the Royal Academy of Belgium on the occasion of its one hundred and fiftieth anniversary was exhibited.

A reciprocity agreement was ratified with the London Mathematical Society which grants to members of one society membership in the other at half-rates.

The session of Friday morning was especially marked by a paper read by Professor C. A. Fischer, at the request of the program committee, on "Functions of lines."

The following papers were read at this meeting:

Condition that a tensor be the curl of a vector: L. P. EISENHART.

A new class of topological invariants for two-sided manifolds: S. LEFSCHETZ.

The (1, 2) quaternary correspondence associated with certain space involutions: F. R. SHARPE and V. SNYDER.

On the summability of the double Fourier series: C. N. MOORE.

The theory of sets and the foundation of arithmetic: N. J. LENNES.

Kirkman parades: F. N. COLE.

On the definition of a simple closed surface: R. L. MOORE and J. R. KLINE.

The theory of functions of one Boolean variable: K. SCHMIDT.

Representation of rectilinear motion by the geodesics of a surface: A. MYLLER.

Note on steady fluid motion: S. D. ZELDIN.

Real representatives of analytic complex curves: W. C. GRAUSTEIN.

Extension of Bernstein's theorem to Sturm-Liouville sums: ELIZABETH CARLSON.

A Bohr-Langmuir contact transformation: G. C. EVANS.

An elementary theory of competition: G. C. EVANS.

Groups in which the number of operators in a set of conjugates is equal to the order of the commutator subgroup: G. A. MILLER.

Expansions in terms of solutions of partial differential equations. First paper: Multiple Fourier expansions: C. C. CAMP.

On the minimum of the sum of a definite integral and a function of a point: E. H. CLARKE.

A simple proof of a fundamental lemma concerning the limit of a sum: H. J. ETTLINGER.

Application of Duhamel's theorem to the convergence proof for approximate solutions of differential equations: A. H. COWLING.

Two theorems on multiple integrals: P. FRANKLIN.

An extension of the theorem of Bayes, by the use of a certain limit: E. L. DODD.

Fundamental systems of protomorphic formal modular seminvariants of binary forms: W. L. G. WILLIAMS.

An example in potential theory: O. D. KELLOGG.

On certain systems of differential equations containing a parameter: F. H. MURRAY.

Periodic solutions in the problem of three bodies: F. H. MURRAY.

Functions of lines: C. A. FISCHER.

The expansion of a certain function: I. J. SCHWATT.

The summation of a family of deranged series: I. J. SCHWATT.

The sum of the harmonic series: I. J. SCHWATT.

R. G. D. RICHARDSON,
Secretary

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF INDUSTRIAL AND ENGINEERING CHEMISTRY

W. K. Lewis, *chairman*
E. M. Billings, *secretary*

The control of industrial heating processes: J. A. Doyle. The paper will be based upon consideration of factors affecting the quality and cost of products subjected to the action of heat in the process of manufacture. Reference will be made to the influence of time as well as temperature in the conduct of such operations and the variable factors that affect the time and rate of heating and cooling. Further reference will be made to factors affecting the selection and use of various forms of fuel or electricity with suitable equipment, and of the necessity of considering the mechanical features incident to heating, cooling and handling, as well as the strictly thermal features incident to the thermodynamics of the problem.

Automatic volumetric analysis—carbon monoxide recorder: Guy B. Taylor and Hugh S. Taylor. An instrument for automatically making chemical analysis and recording the results is described. The instrument can be adapted to any case where two or more fluids can be mixed in regulated volumes, and the result of the obtained reaction of the fluids recorded by electrical conductivity, temperature rise, etc. Specifically the application of the apparatus to the analysis of flue gas for carbon monoxide is described.

Control devices employed in the high pressure testing of NH_3 catalysts: A. T. Larson. Flowsheet of one hundred atmospheres experimental synthesis NH_3 plant shown (slide). Need for close regulation of pressure and rate of flow discussed. Various forms of an electromagnetically operated valve are shown. Consists essentially of a valve seat cut in metal block; a valve stem moving in a guide; an adjusting spring for holding stem against seat; and an electromagnet for lifting valve stem off seat. Use of accessories such as gauges, manometers, relays, shown by slides. Flowmeter for gases under high pressure shown. Also compensating device for density balance employed in controlling composition of gas.

The absorption process for the recovery of gasoline from natural gas: J. B. Garner. The paper consists of (*a*) General description of the absorption process; (*b*) application of process to recovery of gasoline from dry natural gas; (*c*) conditions of operation of a large gasoline plant; (*d*) economies effected in plant operation; and (*e*) physical properties of natural gas gasoline.

The plastometer as an instrument for process control: Eugene C. Bingham, H. D. Bruce and H. D. Wolbach. Recent work proves that the *viscosity* of colloidal solutions is not a physical constant as ordinarily measured, but varies with the shearing stress used, so that a certain paint showed a change in viscosity of 10 per cent. when the shearing stress was trebled. It appears that this difficulty is not limited to any one class of colloids, nor are high concentrations of the disperse phase necessary. The difficulty can be overcome by the use of the plastometer. We have, then, two apparently well-defined properties, *viz., yield value* and *mobility.* Colloidal solutions at different concentrations fall into two types—*plastic* and *pseudo-plastic*—between which there seems to be a sharp distinction, dependent upon the character of the structure of the material. Moreover, some colloidal solutions, such as glue and nitro-cellulose, show a definite temperature from plastic solid to true liquid, which is the analogue of the melting point of crystalline substances. Finally the concentration of disperse phase at which the property of plasticity finally disappears appears to be well-defined and measurable and definitely related to the pore space and the volume of the dispersion medium.

A glass pressure gauge: S. Karrer. It is often desirable to measure the pressure of a gas or vapor which will react chemically with the materials out of which ordinary pressure gauges are constructed. An all glass gauge has been developed for this purpose and has been used successfully for several years. The gauge consists essentially of a thin glass diaphragm whose motion due to changes in pressures on it is detected by means of a suitable electrical contact. The unknown gas pressure on one side of the diaphragm is balanced by a known or measurable air pressure on the other side. Equality of these two gas pressures is indicated by the making or breaking of the electrical contact. Gauges having a range of several atmospheres' pressure and a sensitivity of $1/10$ mm. of mercury have been used.

The construction and selection of temperature and pressure instruments for automatic process control: S. S. Andinsky. There are three classifications of instruments used in automatic process control: first, indication; second, recording, and third, controlling. Indicating types of instruments are used in determining experimentally and in actual production the exact temperature and pressure specifications to follow to obtain higher quality and maximum production at a minimum cost. Recording types of instruments are used to maintain continuous and permanent records of these readings, which records may then be filed for future reference. Controlling instruments are used to control these temperatures and pressures automatically. In this way there is the assurance of duplicating results. In many cases only by automatic control can certain temperature or pressure specifications be followed exactly.

Some phases of automatic process control: Herbert A. Clark. Process control during the initial stages of the development of the process is usually a matter of close observation on the part of the operator and careful hand adjustment to meet conditions as they arise. When the steps become known, the process is standardized and the control is made automatic as far as practicable. If the desired control is merely to keep the temperature constant, some type of thermostat is employed. Where the temperature must be varied in a predetermined way over a certain length of time, an instrument has been devised which automatically varies the temperature of the container at any desired rate, either constant or variable; holds the temperature at any point between certain limits for any desired time; removes the condensation in case of steam-heated apparatus; cools the container at any desired rate at the end of the process; stops the process at any desired point, and signals this fact to the operator.

Hydrogen ion methods as applied to process control: Earl A. Keller. The increasing use of hydrogen ion measurements in the laboratory has opened a field for such methods in automatic process control. A brief description of an installation is given. Other automatic control methods utilizing electrical measuring apparatus have already been applied successfully, such as the temperature controller in oil-refining processes and in the making of illuminating gas. Electrolytic conductivity equipment has also proven very useful. The value of process control by signal indicating apparatus with manual operation is compared to control that is entirely automatic. A brief description is given of the conductivity equipment used for salinity measurements on battleships. A new method for measuring and controlling turbidity is described, based on the characteristics of a photo-electric cell.

Cost accounting as a factor in the control of chemical processes: Charles Wadsworth, 3d. Once accurate costs are obtained, they must be deftly used. There are many pitfalls for the executive who places blind allegiance in cost figures. Close contact with manufacturing plants is essential, and an understanding of manufacturing problems and manufacturing psychology is *sine qua non.* An intelligent limit can be placed on purchasing, prices and wages. The efficiency of each step in complicated manufacturing processes can be isolated, controlled and made more efficient. The knowledge of whether a product is making money or not enables the executive to control production and sales, especially as to quantities, and to direct emphasis to the most profitable enterprise. As the most accurate indicator of business health, technical men must become acquainted with cost procedure, unless they are willing to remain in positions subordinate to men with business training who understand cost procedure.

The removal of small amounts of CO from gases by passage through heated granular soda lime: Robert E. Wilson, C. A. Hasslacher and E. Masterson. The problem of the complete removal of CO from gas streams is of importance in a number of industrial applications, particularly in the purification of hydrogen and nitrogen for the synthesis of ammonia. Several references and patents have mentioned the use of soda lime at high temperatures for the purpose, but practically no quantitative data is offered with regard to the removal of small amounts or the effect of the composition of the soda lime. This paper describes a series of experiments on gas containing 2 per cent. CO in N_2 at temperatures varying from 250° to 550° and using soda limes of varying composition. The results show that soda lime with high caustic soda contents are better than those too low, or than lime alone. The former give substantially complete removal of CO at around 400° C. Small amounts of moisture are helpful in increasing the efficiency but do not appear to be essential. Experiments in the presence of hydrogen are inconclusive because the hydrogen reacted slightly with the I_2O_5 used to determine CO. The fundamental reaction involved is apparently $CO + 2NaOH = Na_2CO_3 + H_2$.

The calculation and comparison of specific rates of corrosion in natural waters: Robert E. Wilson. The writer makes use of the fact that corrosion in practically all natural waters at temperatures below 200° F. is substantially independent of the hydrogen ion concentration and is directly proportional to the oxygen concentration. *Specific* rates of corrosion are then calculated in terms of the weight of iron corroded per unit area, per unit time, per unit concentration of oxygen. Units are suggested for the specific rates of corrosion, and formulæ given for calculating these rates from data on (*a*) loss in weight of test pieces and (*b*) drop in oxygen content of water. By thus correcting for the effect of oxygen concentration, etc., it is possible to compare rates of corrosion under different conditions and determine the precise effect of velocity, temperature, etc. It appears that the specific rates of corrosion depend more on velocity than on any other single factor and that the composition of the metal and the hydrogen ion concentration are generally unimportant in under-water corrosion.

A new method of measuring corrosion under water. Investigation of effect of velocity: F. N. SPELLER and V. V. KENDALL. Subaqueous corrosion is nearly proportionate to the concentration of oxygen dissolved in water, which fact is used for measuring the amount of corrosion in the experiments described. Water is passed through a certain length of ¼-inch, ½-inch and ¾-inch commercial steel pipe, uncoated, and the corrosion is measured by the difference in concentration of dissolved oxygen. Time of contact was held constant by varying the length of pipe. Velocities from $\frac{1}{10}$ foot per second to 8 feet per second were obtained. Corrosion-velocity curves are given for each size pipe, for temperatures ranging from 60° to 170° F. Corrosion is found to increase with velocity in all cases, but at a decreasing rate. Rate of corrosion accelerates rapidly with rise in temperature over 90°, velocity and all other conditions being constant. This method of measuring corrosion is applicable to the investigation of the influence of other factors on subaqueous corrosion, such as composition of the metal, character of the water, etc.

The action of sodium silicate when used in soaps: A. S. RICHARDSON. The possible advantages of sodium silicate in soap have been studied under the following headings: Water softening action; detergent action without admixture of soap; and effect on emulsification power of soap. The soap-sparing effect of sodium silicate varies with the conditions of its use, being most pronounced at high temperature and in hard water high in magnesium salts, under which conditions the amount of soap conserved may be more than the chemical equivalent of the sodium silicate used. Sodium silicate has probably no detergent action when used without soap, except in so far as free fatty acid is present in the wash. However, sodium silicate increases the emulsifying power of soap solutions, as shown by a decrease of the surface tension of the soap solution toward a mineral oil.

Counter-current digestion of wood by the soda process: R. T. HASLAM and W. P. RYAN. From a consideration of the law of mass action, the digestion of wood by the soda process seems to offer a field for the application of the counter-current principle. Ungerer, an Austrian chemist, patented the equivalent of such a process in 1872, but no record is found of its commercial application. Recent work has shown that by passing the soda solution in counter-current direction to the wood chips the time required for digestion can be decreased by one third to one half that of the usual batch process, that the yields on small scale equipments are from 2 to 10 per cent. lower, that a better bleaching pulp is obtained and that the alpha (resistant) cellulose content of the pulp is materially increased.

Factors influencing the efficiency of alkali-chlorine cells: W. P. RYAN, C. T. HARDING and R. P. RUSSELL. A study of the effect of effluent flow *vs.* current efficiency at four current densities shows that the efficiency increases rapidly with increased flow, approaching 100 per cent. asymphotically. A plot of current density *vs.* effluent flow at the guaranteed (92 per cent.) efficiency is of especial interest to plants forced to run at varying current densities because of the influence of seasonal changes on power supply. The performance of an Allen Moore cell was studied, and the results show that increasing the effluent flow increased the cathode current efficiency, the voltage and the energy efficiency, although the last decreases as high flows are reached. Increasing current density decreases the efficiency and increases the voltage at the rate of 0.01 volts per amp. per square root. For 92 per cent. current efficiency the salt conversion is very close to 50 per cent. For a given energy efficiency the flow is directly proportional to the current density. For a given current efficiency the flow is proportional to the current density above 75 amp. but falls off rapidly below that.

Physical properties of dental cements: PAUL POETSCHKE.

Filtration formulas: W. K. LEWIS. The formulas hitherto proposed for filtration in chamber and leaf presses completely fail to apply in the case of sludges which are highly compressible and those to which filter-aids have been added. Careful experimental study of the problem has been made and empirical formulæ developed which are believed to be satisfactory for the problems of engineering design.

Behavior of compressible sludges during filtration: M. P. Woodward and W. J. Edmonds. Careful study has been made of the resistance to flow of liquid through sludges of different types as a function or pressure, pressure gradient and time of filtration. On the basis of the experimental results fundamental differential equations have been derived. One method of solution of these equations has been suggested.

The solvent properties of acetone: R. F. Remler. The paper takes up the following industrial consideration regarding acetone as a solvent; uniformity of the present grade of acetone from calcium acetate, boiling point and volatility, freezing point, inflammability, dehydrating properties, miscibility with other solvents, use as a coupling or bending agent between immiscible solvents, relative cost per gallon, physiological effects and recovery of vapors. The solubility of acetylene, cellulose acetate and cellulose nitrate, rosin and mineral oils, gums, resins, shellacs, animal and vegetable oils, fats and greases, waxes, asphalts and bitumens are discussed. Mention is also made of acetone in the dry cleaning and leather industry as a constituent of paint, varnish and carbon removers.

Rosin determination in pine products: A. H. Vilbrandt and James R. Withrow. The determination of rosin in various mixtures, such as pine oils, wood creosotes and kerosene mixtures for materials used as fly chasers or in emulsions for disinfectant purposes is a matter of well-known importance. Results frequently reported by manufacturers and consumers are discordant. The writers have found, however, that the standard methods, with but slight modification for the prevention of emulsions, give results which are accurate easily within ¾ of 1 per cent. and sometimes much more accurate than this.

Some industrial uses of ozone: Erwin W. Felkel. The use of ozone in the industries has not been widespread due to two reasons, *viz.*, (1) A satisfactory source has not been obtainable, and (2) on account of the high cost of production. For the past several years ozonizers furnishing a large amount of ozone at a low concentration have been developed, and these machines have demonstrated their durability. The advent of the commercial ozonizer has opened two fields for the industrial application of this gas: (1) in places where a small amount of ozone will accomplish the desired result and (2) in the production of products that sell for a sufficiently high price to justify its use. In the first class we have the bleaching and oxidizing of vegetable drying oils and the drying of paints and varnishes. In the second class is the production of certain aromatic aldehydes and the production of potassium permanganate. Small amounts of ozone at low temperatures bleach an alkali refined linseed oil almost colorless, while if the temperature be raised the major effect is one of oxidation. The drying of varnishes is also an effect of oxidation. This oxidation is autocatalytic and can be greatly hastened by the presence of exceedingly small quantities of ozone in the atmosphere of the drying room. The production of vanillin is a straight chemical reaction in which the ozonide of isoeugenol is made and subsequently reduced. The production of potassium permanganate is accomplished by oxidizing potassium manganate in alkaline solution.

Methanol from methane: Ralph H. McKee and Stephen P. Burke. By passing methyl chloride mixed with steam over slaked lime at 375° C. there is obtained a 90 per cent. conversion into methanol (65 per cent.) and methyl ether (25 per cent.). By passing steam and methyl ether over aluminium oxide at 350° C., methyl ether is half converted to methyl alcohol. By reworking the residual methyl ether this conversion can be made complete. The presence of an inert gas, *e. g.*, methane, is not a hindrance to the process. All operations are carried through without pressure and can be arranged to work in a continuous operation. Accordingly we have now available to supplement our failing methanol supplies a process which incompletely chlorinates a high methane natural gas, hydrolyzes the methyl chloride content of same to methanol and methyl ether and reworks the methyl ether to give a final yield of methanol of 90 per cent. of the methyl chloride first made.

The examination of writing inks: F. F. Rupert. There is need of a system of examination of writing inks which shall proceed on scientific principles and at the same time be related to the needs of the average user of ink, and this paper attempts to provide such a basis. The four qualities of writing inks most desired are color, permanency, stability and non-corrosiveness, and these should be given consideration in approximately equal degree. The relation of composition of the ink to each of these properties has been studied experimentally, and briefly summarized results are given. The tests now in use by the Bureau of Standards and others are recommended, with modifications, with emphasis on the more practical tests. A system of rating giving equal weight to the four fundamental properties is suggested. Only iron tannate ink is considered in full, but the properties of other inks are discussed briefly.

Non-metallic inclusions: their influence upon ferrite segregation in steel: E. G. Mahin and H. W. Botts. In this paper is presented additional evidence to support the view that non-metallic inclusions in steel are centers of zones of segregation of soluble impurities, and that the segregation of these impurities is the primary cause of ferrite segregation. Giolitti's recent papers are discussed and his theory that only "oxidized" inclusions have any effect upon ferrite segregation is held to be untenable. Oxidation rings and sulfide halos have been studied and discussed in this connection, and photomicrographs are reproduced to illustrate the points at issue. H. M. Howe's conception regarding the mechanism of ferrite genesis is regarded as being correct for all steels except those cooling fairly rapidly from the liquid state.

The determination of various mono-hydric phenols by the phenol reagent of Folin and Denis: Carleton Henningsen. The phosphotungstic-phosphomolybdic acid reagent of Folin and Denis offers a means for the quantitative determination of a number of mono-hydric phenols in dilute aqueous solutions. The nature of the color produced with these phenols fulfills most of the requirements of a colorimetric method. The intensity of the color produced is dependent upon the concentration of the particular phenol in pure aqueous solutions free from reducing agents. B-naphthol and isoamyl phenol can be used as satisfactory standards for color comparison and offer an advantage over the much used carbolic acid in that they are solids at ordinary temperatures and can be weighed direct with ease.

The acid value of varnishes: Marks Neidle. The correct determination of the acid value of varnishes may be based upon two conditions: (1) The varnish must be of low viscosity so that on shaking with alcohol the distribution of the acid ingredient between the alcohol and the varnish solvent may quickly reach equilibrium; (2) If standard aqueous alkali is used for titrating, after having added alcohol, the final concentration of water in the alcohol layer should not be greater than 30 per cent. or low results will be obtained due to hydrolysis.

Propionic acid and ketones from whey: E. O. Whittier and J. M. Sherman. The factors affecting the propionic fermentation of lactose have been investigated and conditions determined whereby approximately 2.4 pounds of propionic acid and one pound of acetic acid may be obtained from five pounds of lactose in twelve days' incubation. A mixed culture of *Bact. Acidi Propionici* (d) and *Lactobacillus Casei* incubated at 30° C. for three days is used for the inoculation of the previously sterilized and buffered whey. The mixture of propionate and acetate obtained may be either converted into the free acids and refined or distilled to yield a mixture of acetone, methylethyl ketone and diethyl ketone.

Pittsburgh as an industrial center (historical): J. H. James. The greatest of Pittsburgh's resources is bituminous coal, upon which is built the whole metallurgical development of the district. The glass industry began developing somewhat before the iron, and has had an uninterrupted growth, until to-day its tonnage makes this one of the greatest glass districts of the world. In iron development the stages were pig iron principally for foundry iron at first, puddled iron, crucible steel, Bessemer steel, basic open hearth steel. The fuel first used was charcoal, then beehive coke, then natural gas for basic open hearth steel, and to-day the trend is towards by-product coke, utilization of the coke oven gas in steel manufacture supplemented by producer gas from bituminous coal, offsetting the decline in natural gas. Secondary to the above group are the iron and steel fabrication industries and chemical industries. Most of the chemical industries are merely tributary to the iron and steel.

Governing factors on which paint consistency depends—pigments flocculation one of the most important: Henry Green. The governing factors on which yield value and mobility depend are the viscosity of the vehicle, the pigment-vehicle ratio, the force of flocculation in the pigment-vehicle system and particle size of the pigment. As the force of flocculation in the pigment is the most important of the four factors, it is studied in detail. The paper contains much valuable information pertaining to paint manufacture.

Constants of rosin change after powdering: F. P. Veitch and W. F. Sterling. Samples of various grades of rosin were powdered and kept in stoppered bottles. Analyses at the start and after standing one week show a decided decrease in the acid and iodine numbers and a decided increase in the saponification number and melting point. The percentages of unsaponifiable matter remain constant. The results show that rosin should be kept in lump form and powdered immediately before the analysis is to be made in order to prevent changes in its constants.

The effects of treating materials and outdoor exposure upon the water resistance and tensile strength of cotton duck: T. D. Janell and H. P. Holman. Numerous samples of treated canvas were exposed to the weather for six months under conditions unfavorable to mildew and bacterial decay. Unexposed portions of the same samples after the same length of time showed little or no deterioration. With many of the treatments developed by the Bureau of Chemistry the treated canvas showed very high water-resistance after weathering. By adding certain bituminous materials or mineral pigments to treatments which, when used alone, gave the canvas low water-resistance after exposure, the water-resistance was considerably increased. With all of the treatments free from pigments the treated canvas gave after exposure tensile strengths lower than that of the untreated canvas after exposure. The addition of mineral pigments to certain waterproofing preparations which caused decided weakening of the canvas when exposed to the weather materially reduced such effect in every instance and in some cases the treated fabric after exposure was stronger than the untreated fabric after exposure. The results indicate that the addition of mineral pigments to waterproofing preparations is beneficial since they reduce the weakening effect of solar light and heat without reducing water-resistance.

A new form of precision hydrometer: C. W. Foulk. This hydrometer consists of a glass float moving freely in a glass tube carrying a suitable scale. Between the float and the lower end of the tube a light chain hangs in a catenary curve. The float is ballasted so as to be in approximately submerged floating equilibrium in the liquid to be tested. The final adjustment to exact equilibrium is automatically made by the action of the chain, and this position of the float is then read on the scale. With a properly calibrated instrument density determinations accurate to one unit in the fourth decimal place can be made in a couple of minutes.

Chemical corrosion of iron silicon alloys: A. K. Smalley. The desirability of using iron silicon alloys as universal resistant materials for chemical construction and wherever there is a possibility of chemical corrosion has been firmly established. Their manufacture demands the use of the best grades of material, the best foundry practice and careful metallurgical control. Silicon contents should be about 14.5 per cent. If it is lower the acid resistant qualities of the metal will be affected, and if it is higher the strength is lessened and many manufacturing difficulties are encountered. Other specifications are given in the paper.

Furfural resins: Carl S. Miner, John P. Trickey and Harold J. Brownlee.

Distillation of dilute ammonia solutions: G. Galingaert. In very dilute solutions ammonia does not follow Henry's law, the volatility being progressively less as dilution increases. In consequence the complete removal of ammonia from ammonia water mixtures is rendered difficult. Careful experimental determinations of the constant of Henry's Law demonstrate that the deviation is due to dissociation and indicate that in extreme dilutions there exists a constant boiling mixture.

Causticization of soda ash: J. Harrop. Experimental determination is reported of the influence of time, temperature and the amount and character of lime used in causticizing dilute soda ash solutions upon the degree of conversion and the rate of settling of the resultant sludge. The significance of the results in design and operation of causticizing plants is indicated.

Decomposition of nitrates: W. K. Lewis and G. J. Greenfield. The thermal decomposition of sodium nitrate into nitrate was studied in order to secure data on the temperature coefficient of the reaction rate constant of a completely homogeneous reaction at elevated temperatures. This data was obtained, and it was furthermore demonstrated that the conversion of nitrate to nitrite is reversible, the reaction equilibrium shifting to the nitrate side as temperature increases. In consequence the reaction rate, after the reaction has progressed to an appreciable extent, is decidedly retarded by the reverse reaction. The decomposition itself is monomolecular, but the character of the reverse reaction has not yet been determined.

Potash from kelp. VIII—Theoretical considerations pertaining to the preparation of potassium chloride from kelp brines: J. W. Turrentine and H. G. Tanner. Kelp brine contains, after rectification, potassium and sodium chlorides in the ratio of 20 : 7. These being the principal constituents, the problem of manufacturing potassium chloride therefrom is that of the separation of potassium and sodium chlorides. This is accomplished by alternately evaporating and cooling, the former precipitating the sodium salt, and the latter the potassium salt, advantage being taken of the wide difference in the temperature coefficients of solubility of the two. The cooling is accomplished by boiling in vacuum. The equilibria obtaining and their manipulation for the most convenient operation of the system and the manufacture of potassium chloride of desired purity have been studied from the phase rule point of view. Compositions at the various points of concentration have been determined, and methods of calculating these have been developed and applied to the practical operation of the evaporating and crystallizing processes.

The chemical control of the Mexican cotton boll weevil: LEHMAN JOHNSON. The U. S. D. A. method of dusting cotton plants with calcium arsenate is an effective means of control, but difficult, beyond the intelligence and skill of the average cotton farmer. None the less, in the absence of any easier or more successful method up to this time it deserves the endorsement of the American Chemical Society as an excellent piece of research work and the society's encouragement to simplify, standardize and make more general the application of the method, probably needing a special organization and a large body of trained inspectors and coaches in the method. Comparison is drawn with Mississippi River flood prevention.

DIVISION OF CELLULOSE CHEMISTRY

Harold Hibbert, *Chairman*
G. J. Esselen, Jr., *secretary*

Chemistry of Wood—VI: Results of analysis of heartwood and sapwood of some American species: G. J. RITTER and L. C. FLECK. The comparative chemical composition of heartwood and sapwood of ten American species is given in the paper. The results show that in general the cellulose and the lignin are higher in the sapwood of the conifers, but that these same constants are higher in the heartwood of the deciduous species. The higher yields of cellulose and lignin in the sapwood or in the heartwood of a given species are accompanied by lower yields in extractives.

The acetolysis reaction applied to cellulose isolated from a number of commercial woods: LOUIS E. WISE and WALTER C. RUSSELL. Cellulose was isolated from beech, birch, maple, aspen, oak, pine, balsam, cedar and hemlock by alternate chlorination and sodium sulfite treatments until free from lignin. The cellulose was then converted to "normal cellulose," which was subsequently subjected to acetolysis. In each case appreciable amounts of cellobiose octaacetate were isolated and identified.

Factors influencing the properties of wood cellulose as isolated by the chlorination method: MARK W. BRAY and T. M. ANDREWS. Certain series of pulps made by keeping all cooking conditions as constant as possible except time gave values for alpha, beta and gamma cellulose that did not lie in proper relation to each other. Unless the chlorination conditions are uniform in the preparation of cellulose from these pulps the character of the cellulose is affected. Therefore, a study was undertaken of the conditions which affect the character of the cellulose as expressed in the per cent. alpha, beta and gamma cellulose. It was found that increasing the temperature and time of chlorination (over-chlorination) increases the percentage of non-resistant cellulose in cellolose derived by the Cross and Bevan method. There is very little beta cellulose in pulps or wood before it is chlorinated for the preparation of cellulose, except in decayed material. The action of the organisms of decay in some cases is similar to that of chlorination on the character of cellulose. The copper number of cellulose is a measure of the resistance of cellulose toward 17.5 per cent. sodium hydroxide solution, and also of the amount of over-chlorination. The data indicate that beta and gamma cellulose have the same copper number.

$$\frac{\text{The ratio, copper number of the cellulose}}{\text{per. cent. beta plus gamma cellulose}} = \text{constant.}$$

From the relation of the copper reduction capacity of beta and gamma cellulose, the data indicate that within every three $C_6H_{10}O_5$ complexes there is one aldehyde group.

An improved method for the determination of alpha, beta and gamma cellulose: MARK W. BRAY and T. M. ANDREWS. A volumetric method for the determination of alpha, beta and gamma cellulose based upon the titration of the organic material in Cross and Bevan cellulose has been worked out. The separation of the resistant from the non-resistant cellulose is carried out by treatment with 17.5 per cent. NaOH, filtered by suction or centrifuged and washed. The alpha cellulose is dissolved in 72 per cent. H_2SO_4 made up to 100 cc. in a granulated flask, an aliquot of which is oxidized with standard $K_2Cr_2O_7$ solution; the excess $K_2Cr_2O_7$ is titrated with ferrous-ammonium sulphate solution. The alkaline filtrate is divided into two equal portions. One portion is acidified with dilute H_2SO_4, causing the beta cellulose to precipitate. An aliquot of the clear solution is oxidized as in the alpha cellulose determination for the estimation of gamma cellulose. The other portion of the alkaline filtrate is used for determining beta plus gamma cellulose. The value for beta cellulose is arrived at by subtracting the result of the gamma cellulose determination from that of the beta and gamma determination. The volumetric method gives a direct means for the estimation of these three constants in determining the character of the cellulose. Filtration and washing difficulties of the gravimetric determination are practically overcome. This method is more accurate and can be carried out much more rapidly than the gravimetric method of Cross and Bevan. Check determinations can be made without repeating the Cross and Bevan determination for preparing cellulose, which procedure is necessary in the gravimetric method.

The gelatinization of lignocelluloses: A. W. SCHORGER. It has been found that lignocelluloses when ground in dilute alkaline solutions attain a high degree of dispersion. The resulting gelatinous product when allowed to dry forms, without pressure, a dense, horny mass having a specific gravity of 1.4-1.5, which is three to five times greater than the apparent specific gravity of the original wood. The peptonizing action of alkali is particularly marked in the case of the hardwoods in comparison with the conifers, the difference being apparently due to the greater hemicellulose content of the former. The cereal straws gelatinize even more readily than woods by the above treatment.

A study of the methoxyl distribution in the products of the soda cook of jack pine (Pinus divaricata): S. S. AIYAR. This paper is a continuation of the work on the distribution of methoxyl in the products of wood distillation previously reported. As the period of cook is lengthened the methoxyl in the pulp gradually falls to a minimum after two hours' cook at maximum pressure. Thereafter the loss of methoxyl is not very appreciable. The liquor in its turn gains the methoxyl corresponding to the loss in the pulp so that all the methoxyl in the wood used is found in the products at the end. The volatile methoxyl derivatives in the liquor reach a maximum in half an hour after attaining maximum pressure, and then their quantity falls. There seems to be a reversal of the equilibrium as the strength of caustic falls and more woody matter is dissolved in the lye. The figures for the lignin and methoxyl contents of the pulp calculated to percentage on the lignin and methoxyl content of wood run parallel. This seems to be another confirmation for the theory that all the methoxyl is associated with the lignin.

Mannose from white spruce cellulose: E. C. SHERRARD. When white spruce wood is hydrolyzed with dilute acid at atmospheric pressure the quantity of cellulose removed corresponds to the quantity of sugar produced. Since no mannan can be isolated from the wood by the usual methods the mannose is probably present as a manno-cellulose and not in the adsorbed state. Otherwise, it is difficult to advance an explanation of the removal of a quantity of cellulose corresponding to the sugars produced. The paper directs attention to the presence of mannose as a product of the hydrolysis of white spruce cellulose and also to the fact that this sugar is distributed through the alpha, beta and gamma celluloses. While the mannose is quite easily removed by means of dilute acids a part of it withstands the action of alkali and is even found in cellulose re-precipitated from zinc chloride-hydrochloric or cuprammonium solutions. Mannose has been found in the solutions resulting from the hydrolysis of white spruce cellulose prepared by the Cross and Bevan method, and from soda, sulfate and sulfite processes.

Experimental work on the development of a theory of the protection of wood by preservatives: E. BATEMAN and C. HENNINGSEN. Practical methods of preserving wood against the attack of low forms of life require the injection of some material which either inhibits or kills the attacking organism. A working hypothesis on the protection of wood by preservatives is proposed. It states that wood preservative must possess sufficient solubility in water to produce a solution of lethal concentration. When injected into wood as an oil solution, the active ingredients are distributed in the ratio of their solubilities in water and oil. The paper, which includes new data on the solubilities, solubility coefficient and toxicity of mono-hydric phenols, offers experimental proof of the theory.

Notes on the rosin-sizing of paper. I. The reactions between aluminium sulfate and sodium resinate (rosin size) solutions: ALFRED TINGLE. The experimental results obtained may be summarized as follows: When solutions of these compounds are mixed in stoichiometrical proportions, precipitation of alumina and rosin is complete. When a considerable excess of aluminum sulfate is used the precipitate contains no resinate but consists of free rosin acids with less than their equivalent of free alumina. At certain concentrations all the alumina remains in solution, rosin acids only being precipitated. Rosin acids precipitated in this way ("Rosin B") are not in the same physical condition as when precipitated by mineral acids. Addition of mineral acids to this modification of rosin changes it to the more common form ("Rosin A"). "Rosin B" is probably spongy rosin very thoroughly interpenetrated with water.

Notes on the rosin-sizing of paper. II. The process in the beating engine and at the wet end of the paper machine: Alfred Tingle. As commonly carried out the reaction in the beater results in the deposition of rosin in the form of "Rosin B" (see preceding paper) on the fibre with less than its equivalent of alumina. Most or all of the remaining free alumina is precipitated as the result of subsequent dilution. That alumina plays no essential part in the sizing is shown by the fact that paper can be successfully sized under such conditions that no alumina can be deposited. Rosin acids can be precipitated even by sulfuric acid in a condition closely resembling "Rosin B" if at the same time another precipitate is formed which will serve to keep the rosin finely divided. In such circumstances the rosin has sizing power. Investigation of the changes in size as paper dries are required.

New methods for measuring the effects of temperature and humidity on the dimensions of paper: Harold S. Davis. Where paper is used for printing purposes its expansion or contraction between imprints may cause blurring. It is, therefore, of great importance to have a knowledge of the magnitude of the changes in dimension and of the rates at which they take place. A new apparatus is described in which the humidity and temperature are susceptible to easy control and in which the changes in dimensions of different samples of paper may be accurately measured.

Copper numbers of cotton linters: W. F. Henderson. A brief description of the source and properties of the material used is given. Samples were treated with various kinds of acids of increasing concentrations, and after washing and drying the copper numbers of the linters were determined. In the cases of strong acids a rapid increase was noted in the copper values, but in the cases of weak acids very little change occurred. Alkalies were used in the same manner, and while the absorptive power of the linters increased, the reducing power remained practically constant. Curves are shown for each series of determination.

Change of viscosity in viscose: W. F. Henderson. Linters were treated with increasing concentrations of nitric acid under uniform conditions and afterwards the samples were washed and dried. These products were converted into viscose under exactly similar conditions, and the viscosities of the solutions were measured. A very sudden drop in viscosity was noted as is indicated by a curve which is to be shown.

The determination of the viscosity of cupro-ammonium solutions: W. O. Mitscherling.

The manufacture of standard cellulose: W. O. Mitscherling.

Report of committee on the preparation of standard cellulose.

Report of committee on analytical methods. I. Methods of analysis of cotton cellulose.

Report of viscosity committee.

Symposium on the nature of wood cellulose: Louis Wise, B. Johnson, J. D. Rue, E. C. Sherrard and others.

Adsorption of salts by cellulose: Wilder D. Bancroft. Though they merge one into another, we can consider four cases—miscellaneous salts, bases and acids, mordants and substantive dyes. (1) We get a water-ring in filter paper with salts of copper, lead, mercury, etc. We get peptization of cotton by ammoniacal copper oxide, zinc chloride, barium iodide, etc. (2) Barium, strontium, calcium and lead hydroxides may be adsorbed so strongly by filter paper from dilute solutions as to introduce analytic errors. In mercerization caustic soda is adsorbed and changes the structure of the cotton; but no compound is formed. Mineral acids show no appreciable adsorption at moderate concentrations by titration method. (3) Cotton takes up alumina and chromic oxide only from colloidal solutions. In presence of tannin alum is decomposed. Tannin is adsorbed; but must be fixed by antimony, because it is peptized so readily by basic dyes. (4) Sodium and barium salts of substantive dyes are adsorbed as such. Being colloidal solutions the adsorption is increased by electrolytes which decrease the stability; and is decreased when these electrolytes coagulate the dye.

Charles L. Parsons,
Secretary

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CONTENTS

THE TEACHING OF SCIENCE[1]

The prime claim of science to a place in the school curriculum is based upon the intellectual value of the subject matter and its application to life. This conception of education through science as the best preparation for complete living was Herbert Spencer's contribution to educational theory; and to its influence the introduction of science into the school is largely due. Spencer's doctrine was in accord with the principles of Pestalozzi as to the sequence in which facts and ideas should be presented and be related to stages of development, in order to be effective in creating or fostering natural interests in the mind of the child. Scientific instruction implies, therefore, not alone knowledge that is best for use in life, but knowledge adapted to the normal course of mental development. Both substance and method should be judged by the criterion of what is of greatest immediate worth or nearest to the pupil's interest at the moment. When this standard of psychological suitability is applied to the school science courses now usually followed, it must be confessed that they rarely reach it, many topics and much material being remote from the pupil's natural interests and needs.

The truth is that in the design of science courses for schools "trial-and-error" methods have been followed. In the absence of accurate knowledge these are the only possible methods of construction, but sufficient is now known of child psychology to produce a scheme of scientific instruction which represents not merely the views of advocates of particular subjects, but is biologically sound because it is in accord with the principles of mental growth, and, therefore, with those of

[1] From the address of the president of the section of Educational Science, British Association for the Advancement of Science, Hull, September, 1922.

educational science. When instruction in science was first introduced into schools its character was determined by insight and conviction rather than by mental needs or interests; so later, when practical work came to be regarded as an essential part of such instruction, its nature and scope represented what certain authorities believed pupils should do, instead of what they were capable of doing with intelligence and purpose. Practical chemistry became drill in the test-tubing operations of qualitative analysis, and the result was so unsatisfactory from the points of view of both science and education that when Professor Armstrong put forward a scheme of instruction devised by him, in which intelligent experimentation took the place of routine exercises, acknowledgment of its superior educational value could not be withheld, and for thirty years its principles have influenced the greater part of the science teaching in our schools.

In its aims the "heuristic" methods of studying science energetically advocated by Professor Armstrong were much the same as those associated with the names of other educational reformers. Education in every age tends to a condition of scholasticism, and practical science teaching is no exception to this general rule, its trend being towards ritual, after which a revolt follows in the natural order of events. Comenius, with his insistence upon sense perception as the foundation of early training—"Leave nothing," he said, "until it has been impressed by means of the ear, the eye, the tongue, the hand." John Dury among the Commonwealth writers who urged that pupils should be guided to observe all things and reflect upon them; Locke, with his use of sciences not to bring about "a variety and stock of knowledge, but a variety and freedom of thinking"; and Rousseau who would "measure, reason, weigh, compare," not in order to teach particular sciences, but to develop methods of learning them—all these were in different degrees apostles of the same gospel of education according to Nature, and the development of a scientific habit of mind as the intention of instruction. What Rousseau persistently urged in this direction was clearly formulated by Spencer in the words, "Children should be led to make their own investigations, and to draw their own inferences. They should be *told* as little as possible, and induced to *discover* as much as possible"—principles which cover all that is implied in what has since been termed "heuristic" teaching.

Professor Armstrong's particular contribution to educational science consisted in the production of detailed schemes of work in which these principles were put into practice. Ideas are relatively cheap, and it needs a master mind to make a coherent story or useful structure from them. This was done in the courses in chemistry outlined in reports presented to the British Association in 1889 and 1890, and the effect was a complete change in the methods of teaching that subject. "The great mistake," said Professor Armstrong, "that has been made hitherto is that of attempting to teach the elements of this or that special branch of science; what we should seek to do is to impart the elements of scientific method and inculcate wisdom, so choosing the material studied as to develop an intelligent appreciation of what is going on in the world." One feature of heuristic instruction emphasized by its modern advocate, but often neglected, is that which it presents to the teaching of English. Accounts of experiments had to be written out in literary form describing the purpose of the inquiry and the bearing of the results upon the questions raised, and wide reading of original works was encouraged. A few years ago English composition was regarded as a thing apart from written work in science, but this should not be so, and most teachers would now agree with the view expressed by Sir J. J. Thomson's committee on the position of natural science in the educational system of Great Britain that "All through the science course the greatest care should be taken to insist on the accurate use of the English language, and the longer the time given to science the greater becomes the responsibility of the teacher in this matter. . . . The conventional jargon of laboratories, which is far too common in much that is written on pure and applied science, is quite out of place in schools."

When heuristic methods are followed in the spirit in which they were conceived, namely, that of arousing interest in common occurrences, and leading pupils to follow clues as to their cause, as a detective unravels a mystery, there is no doubt as to their success. No one supposes that pupils must find out everything for themselves by practical inquiry, but they can be trained to bring intelligent thought upon simple facts and phenomena, and to devise experiments to test their own explanations of what they themselves have observed. It is impossible, however, to be true to heuristic methods in the teaching of science and at the same time pay addresses to a syllabus. A single question raised by a pupil may take a term or a year to arrive at a reasonable answer, and the time may be well spent in forming habits of independent thinking about evidence obtained at first-hand, but the work can not also embrace a prescribed range of scientific topics. Yet under existing conditions, in which examinations are used to test attainments, this double duty has to be attempted by even the most enlightened and progressive teachers of school science. There can, indeed, be no profitable training in research methods in school laboratories under the shadow of examination syllabuses. Where there is freedom from such restraint, and individual pupils can be permitted to proceed at their own speeds in inquiries initiated on their own motives, success is assured, but in few schools are such conditions practicable; so that, in the main, strict adherence to the heuristic method is a policy of perfection which may be aimed at but is rarely reached.

A necessary condition of the research method of teaching science is that the pupils themselves must consider the problems presented to them as worth solving, and not merely laboratory exercises. Moreover, the inquiries undertaken must be such as can lead to clear conclusions when the experimental work is accurately performed. It may be doubted whether the rusting of iron or the study of germination of beans and the growth of seedlings fulfils the first of these conditions, and the common adoption of these subjects of inquiry is due to custom and convenience rather than to recognition of what most pupils consider to be worth their efforts. It needed a Priestley and a Lavoisier to proceed from the rusting of iron to the composition of air and water, and even such an acute investigator as Galileo, though well aware that air has weight, did not understand how this fact explained the working of the common suction pump. If research methods are to be followed faithfully, and what pupils want to discover about natural facts and phenomena is to determine what they do, then teachers must be prepared to guide them in scores of inquiries both in and out of the laboratory. Under the exigencies of school work it is impracticable to contemplate such procedure, and all that can be usefully attempted is to lead pupils to read the book of Nature and to understand how difficult it is to obtain a precise answer to what may seem the simplest question.

The mission of school science should not, indeed, be only to provide training in scientific method—valuable as this is to every one. Such training does cultivate painstaking and observant habits, and encourages independent and intelligent reasoning, but it can not be held in these days that any one subject may be used for the general nourishment of faculties which are thereby rendered more capable of assimilating other subjects. Modern psychology, as well as everyday experience, has disposed of this belief. If the doctrine of transfer of power were psychologically sound, then as good a case could be made out for the classical languages as for science, because they also may be taught so as to develop the power of solving problems and of acquiring knowledge at the same time. When, therefore, advocates of particular courses of instruction state that they do not pretend to teach science, but are concerned solely with method, they show unwise indifference to what is known about educational values. Locke's disciplinary theory—that the process of learning trains faculties for use in any fields, and that the nature of the subject is of little consequence—can no longer be entertained. It has now to be acknowledged that information obtained in the years of school life is as important as the process of obtaining it; that, in other words, subject matter as well as the doctrine of formal discipline must be taken into consideration in designing courses of scientific instruction which will conform to the best educational principles.

So long ago as 1867 the distinction between subject and method was clearly stated by a Committee of the British Association, which included among its members Professor Huxley, Professor Tyndall and Canon Wilson. It was pointed out that general literary acquaintance with scientific things in actual life and knowledge relating to common facts and phenomena of nature were as desirable as the habits of mind aimed at in scientific training through "experimental physics, elementary chemistry and botany." The subjects which the committee recommended for scientific information, as distinguished from training, comprehended "a general description of the solar system; of the form and physical geography of the earth, and such natural phenomena as tides, currents, winds and the causes that influence climate; of the broad facts of geology; of elementary natural history with especial reference to the useful plants and animals; and of the rudiments of physiology." If we add to this outline a few suitable topics illustrating applications of science to everyday life, we have a course of instruction much more suitable for all pupils as a part of their general education than what is now commonly followed in secondary schools. It will be a course which will excite wonder and stimulate the imagination, will promote active interest in the beauty and order of nature, and the extension of the kingdom of man, and provide guidance in the laws of healthy life.

The purpose of this kind of instruction is, of course, altogether different from that of practical experiment in the laboratory. One of the functions is to provide pupils with a knowledge of the nature of everyday phenomena and applications of science, and of the meaning of scientific words in common use. Instead of aiming at creating appreciation of scientific method by an intensive study of a narrow field, a wide range of subjects should be presented in order to give extensive views which can not possibly be obtained through experimental work alone. The object is indeed almost as much literary as scientific, and the early lessons necessary for its attainment ought to be within the capacity of every qualified teacher of English. Without acquaintance with the common vocabulary of natural science a large and increasing body of current literature is unintelligible, and there are classical scientific works which are just as worthy of study in both style and substance as many of the English texts prescribed for use in schools. We all now accept the view that science students should be taught to express themselves in good English, but little is heard of the equal necessity for students of the English language to possess even an elementary knowledge of the ideas and terminology of everyday science, which are vital elements in the modern world, and which it is the business of literature to present and interpret.

So much has been, and can be, said in favor of broad courses of general informative science in addition to laboratory instruction and lessons which follow closely upon it, that the rarity of such courses in our secondary schools is a little surprising at first sight. Their absence seems to be due to several reasons. In the first place, the teachers themselves are specialists in physics, chemistry, biology or some other department of science, and they occupy their own territory in school as definitely as Mr. Eliot Howard has shown to be the behavior-routine of birds in woods and fields. You may, therefore, have a teacher of physics who has taken an honors degree and yet knows less of plant or animal life than a child in an elementary school where nature study is wisely taught; and, on the other hand, there are teachers of natural history altogether unacquainted with the influence of physical and chemical conditions upon the observations they describe or the conclusions they reach. Natural science as a single subject no longer exists either in school or university, and with its division and sub-division has come a corresponding limitation of interest. No man can now be considered as having received a liberal education if he knows nothing of the scientific thought around him, but it is equally true that no man of science is scientifically educated unless his range of intellectual vision embraces the outstanding facts and principles of all the main branches of natural knowledge. It cannot reasonably be suggested that this general knowledge of science should be acquired by all if teachers of science themselves do not possess it. During the past thirty years or so there has been far too much boundary-marking of science teaching in school on account of the specialized qualifications of the teachers. What is wanted is less attention to the conventional division of science into separate compartments designed by examining bodies, and more to the whole field of nature and the scientific activities by which man has transformed the world; and no teacher of school science should be unwilling or unqualified to impart such instruction to his pupils.

Where such teachers do exist, however, they are compelled by the exigencies of examinations to conform to syllabuses of which the boundary lines are no more natural than those which mark political divisions of countries on a map of the world. All that can be said in favor of the delimination of territory is that it is convenient; the examiner knows what the scope of his questions may be, and teachers the limits of the field they are expected to survey with their pupils. While, therefore, it may be believed that a general course of science is best suited to the needs of pupils up to the age of about sixteen years, examining authorities recognize no course of this character, and very few schools include it in the curriculum. Expressed in other words, the proximate or ultimate end of the instruction is not education but examination, not the revealing of wide prospects because of the stimulus and interest to be derived from them, but the study of an arbitrary group of topics prescribed because knowledge of them can be readily tested. It may be urged that this is the only practicable plan to adopt if a science course is to have a defined shape, and not, like much that passes for nature study, merely odds and ends about nature, without articulation or purpose. Acceptance of this view, however, carries with it the acknowledgment that expediency rather than principle has to determine the scope and character of school science, which is equivalent to saying that science has no secure place in educational theory. I prefer to believe that a school course of general science can be constructed which is largely informative and at the same time truly educational, but it must provide what is best adapted to enlarge the outlook and develop the capacity of the minds which receive it, and not be determined by the facilities it offers for examinational tests.

A third reason for the relative absence of general scientific education in schools is the demands which the teaching might make upon apparatus and equipment. Simple quantitative work in physics, chemistry or botany can be done in the laboratory with little apparatus, and a single experiment may occupy a pupil for several teaching periods. To attempt to provide the means by which all pupils can observe for themselves a wide range of unrelated facts and phenomena belonging to the biological as well as to the physical sciences is obviously impracticable, and would be educationally ineffective. Experiments carried out in the laboratory should chiefly serve to train and test capacity of attacking problems and arriving at precise results just as definitely as do exercises in mathematical teaching. But knowledge by itself, whether of quantitative or qualitative character, is not sufficient, and it becomes power only when it is expressed or used. Every observation or experiment carries with it, therefore, the duty of recording it clearly and fully in words or computations, or both, and if this is faithfully done laboratory work of any kind may be made an aid to English composition as well as an incentive to independent inquiry and intelligent thought.

It is very difficult, however, to devise a laboratory course of general science which shall be both coherent and educative; shall be, in other words, both extensive in scope and intensive in method. I doubt, indeed, whether any practical course can perform this double function successfully. Probably the best working plan is to keep the descriptive lessons and the experimental problems separate, using demonstrations in the class-room as illustrations, and leaving the laboratory work to itself as a means of training in scientific method or of giving a practical acquaintance with a selected series of facts and principles. The main thing to avoid is the limitation of the science teaching to what can be done practically; for no general survey is possible under such conditions. Even if two thirds of the time available for scientific instruction be devoted to laboratory experiment and questions provoked by it, the remaining third should be used to reveal the wonder and the power and the poetry of scientific work and thought; to be an introduction to the rainbow-tinted world of nature as well as provide notes and a vocabulary which will make classical and contemporary scientific literature intelligible. If there must be a test of attention and understanding in connection with such descriptive lessons, because of the spirit of indifference inherent in many minds—young as well as old—let it be such as will show comprehension of the main facts and ideas presented and knowledge of the meaning of the words and terms used. In this way descriptive lessons may be used to provide material for work and active thought, and light dalliance with scientific subjects avoided.

It may be urged that no knowledge of this kind has any scientific reality unless it is derived from first-hand experience, and this is no doubt right in one sense; yet it is well to remember that science, like art, is long while school life is short, and that though practical familiarity with scientific things must be limited, much pleasure and profit can be derived from becoming acquainted with what others have seen or thought. It is true that we learn from personal experience, but a wise man learns also from the experience of others, and one purpose of a descriptive science course should be to cultivate this capacity of understanding what others have described. As in art, or in music, or in literature, the intention of school teaching should be mainly to promote appreciation of what is best in them rather than to train artists, musicians or men of letters, so in science the most appropriate instruction for a class as an entity must be that which expands the vision and creates a spirit of reverence for nature and the power of man, and not that which aims solely at training scientific investigators. It should conform with Kant's view that the ultimate ideal of education is nothing less than the perfection of human nature, and not merely a goal to be obtained by the select few.

The sum and substance of this address is a plea for the expansion of scientific instruction in this humanizing spirit, for widening the gateway into the land of promise where the destinies of the human race are shaped. It is the privilege of a president to be to some extent pontifical—to express opinions which in other circumstances would demand qualification—and to leave others to determine how far the doctrines pronounced can be put into practice in daily life. I do not, therefore, attempt to suggest the outlines of courses of science teaching for pupils of different ages, or for schools of different types; this has been done already in a number of books and reports, among the latter being the report of Sir J. J. Thomson's committee on the position of natural science, the report of the British Association committee on science teaching in secondary schools, Mr. O. H. Latter's report to the Board of Education on science teaching in public schools, the "science for all" report and syllabus issued by the Science Masters' Association, a Board of Education report on "Some Experiments in the Teaching of Science and Handwork in Certain Elementary Schools in London," and one prepared for the board by Mr. J. Dover Wilson on "Humanism in the Continuation School." What has been said in this address as to the need for extending the outlook of customary scientific instruction beyond the narrow range of manual exercises, manipulative dexterity, experimental ritual or incipient research, can be both amplified and justified from these reports. I want science not only to be a means of stimulating real and careful thinking through doing things, but also a means of creating interest and enlarging the working vocabulary of the pupils and thus truly increasing their range of intelligence. So may scientific instruction be made a power and an inspiration by giving, in the words of the Book of Wisdom (vii: 16-20):

> an unerring knowledge of the things that are,
> To know the constitution of the world and the operation of the elements;
> The beginning and end and middle of times,
> The alternations of the solstices and the changes of seasons,
> The circuits of years and the positions of stars;
> The nature of living creatures and the raging of wild beasts,
> The violences of wind and the thoughts of men,
> The diversities of plants and the virtues of roots.

When school science has this outlook it will lie closer to the human heart than it does at present, and a common bond of sympathy will be formed between all who are guiding the growth of young minds for both beauty and strength. So will the community of educational aims be established and the place of science in modern life be understood by a generation which will be entrusted with the task of making a new heaven and a new earth. If these trustees for the future learn to know science in spirit as well as in truth we may look forward with happy confidence to the social structure they will build, in which knowledge will be the bedrock of springs of action and wisdom will make man the worthy monarch of the world.

Richard Gregory

FROG AND TOAD TADPOLES AS SOURCES OF INTESTINAL PROTOZOA FOR TEACHING PURPOSES

Many teachers of protozoology and invertebrate zoology use frogs for the purpose of obtaining intestinal protozoa for class use, but it does not seem to be generally known that the tadpoles of frogs and toads are even more valuable than the adults as sources of material. Unfortunately tadpoles are most abundant late in the spring and in early summer when classes are usually not in session, but two species of frogs that are more or less common throughout the United States pass two or more seasons in the tadpole stage and hence are available in the autumn and, in the southern part of the country, at any time of the year; these are the green frog, *Rana clamitans,* and the bullfrog, *R. catesbiana.* The former is common throughout eastern North America, inhabiting swamps and large and small ponds; the latter has a similar distribution but is limited to swamps and the larger and deeper ponds. Tadpoles should be looked for in these habitats. The identification of these, so far as their use as material for intestinal protozoa is concerned, is of little importance, but it may be stated here that the tadpoles of the two species are very similar and difficult to distinguish from each other. Full descriptions of them are given by Wright (1914). A breeding place once found will serve as a source of supply year after year. Sample tadpoles should be collected some time before the class meets so as to determine the incidence of infection and numbers present of the various species of protozoa, since this varies from year to year. The specimens for class use may be collected several days before they are needed but should not be kept in the laboratory for more than a week or two since they tend to lose their infections under laboratory conditions. The writer has found dishes about ten inches in diameter and three inches deep containing a quart of tap water to be suitable for about twenty tadpoles each. The dishes should not be covered with glass plates, but the water should be changed every day or two. Tadpoles may be killed very quickly, as adult frogs usually are, by destroying the brain and spinal cord with a heavy needle. The ventral body wall can then be opened from the anterior to the posterior end. The intestine is coiled within the body cavity, being several hundred millimeters in length. The rectum, or posterior portion of the alimentary tract, is tightly coiled and is separated from the intestine by a constriction. The different species of intestinal protozoa are rather definitely distributed within the intestine and rectum. The anterior portion of the intestine is inhabited by a flagellate, *Giardia agilis;* in various parts of the intestine and rectum *Endamœba ranarum* may be found; the rectum is the principal habitat of two genera of ciliates, *Opalina* and *Nyctotherus,* of two genera of flagellates, *Trichomonas* and *Hexamitus,* and of several green flagellates resembling members of the genera *Euglena* and *Phacus.* To study any of these species in the living condition, the part of the digestive tract containing them should be teased out in a drop of 0.7 per cent. salt solution and covered with a cover glass. Any of the species mentioned can be found with low magnification, such as obtained with a 16 mm. objective and a number 5 ocular. To study the details of most of these protozoa, however, the Schaudinn iron-hæmotoxylin method is necessary. This in brief is as follows: Spread the intestinal or rectal contents in a thin layer over about one half the area of a 3x1 glass slide. Before this has a chance to dry drop it face downward into a dish containing Schaudinn's fixing solution. This is made up of a saturated solution of mercuric chloride in distilled water, 200 c.c.; 95 per cent. alcohol, 100 c.c.; and glacial acetic acid, 15 c.c. Leave in this solution for about ten minutes. The slide should then be treated by the well-known iron-hæmotoxylin method (70 per cent. alcohol plus iodin, 30 minutes to 24 hours; water, a few minutes; four per cent. aqueous solution of iron alum, 1 to 4 hours; rinse in water; 0.5 per cent. aqueous solution of hæmotoxylin, 4 to 24 hours; rinse in water; differentiate in two per cent. iron alum; wash thoroughly; dehydrate; mount).

Giardia agilis inhabits the anterior portion of the intestine. First observed by Kunstler in 1882, it has recently been studied in detail (Hegner, 1922). When alive it looks like a minute, slender tadpole and undergoes extremely rapid wriggling movements which no doubt suggested its specific name. When fixed and stained as suggested above it exhibits bilateral symmetry, with two nuclei, four pairs of flagella with intracytoplasmic portions, a pair of axostyles, and one or several parabasal bodies. Another species of this genus, *Giardia lamblia,* occurs in about 12 per cent. of human beings (Hegner and Payne, 1921). This species, which has been carefully studied and described by Simon (1921, 1922), is considered by some to be responsible for serious intestinal disturbances, but may be present in apparently healthy persons.

Trichomonas augusta is confined principally to the rectum, although it occurs occasionally in the intestine of the tadpole. This flagellate may be recognized by its jerky movement. When the living animal is examined with high magnification its active undulating membrane, along the outer edge of which is fastened a flagellum, can be seen; waves of motion start at the anterior end and pass posteriorly to the end of the body. Such an undulating membrane is characteristic of certain parasitic protozoa. The pointed extension of the rod-like axostyle may also be seen protruding from the posterior end. When fixed and stained a single nucleus, three anterior flagella, the undulating membrane, axostyle and mouth are clearly revealed. A species of *Trichomonas, T. hominis,* that occurs in man is similar in appearance to that in the tadpole but does not stain well and hence its structure is difficult to determine. Trichomonads that have been recorded from man are *T. hominis,* in the intestine; *T. vaginalis,* in the vagina; and *T. buccalis,* in the mouth. The intestinal form has been found in about three per cent. of the human beings examined.

Hexamitus intestinalis is a very minute species with two nuclei, and four anterior and two posterior flagella. It is an active swimmer and moves rapidly across the microscopic field. It differs from *Trichomonas* in the absence of a mouth and probably takes in its food through the surface of the body. No species of this genus are known from man.

Nyctotherus cordiformis is a very large ciliate that is often found in the rectum of tadpoles. It appears to be a scavenger and resembles *Paramecium* in structure and in its primary life processes. A species of this genus, *N. faba,* has been recorded from man.

Opalina ranarum is also a large ciliate that is a frequent inhabitant of the rectum of tadpoles. This and other species of *Opalina* that also may be encountered in this habitat are especially interesting because of their polynuclear condition and absence of an oral aperture, food being absorbed through the body wall. The variations in nuclear number and structure in various members of the Opalinidæ are of particular interest (Metcalf, 1914). The value of these protozoa with respect to problems of geographical distribution has been emphasized by Metcalf (in press).

Balantidium entozoon is an inhabitant of the rectum of certain frogs. It has not been found by the writer in tadpoles, but probably occurs in them in certain localities. Its mouth is situated near the anterior end instead of forming a large conspicuous crescent near the center of the body as in *Nyctotherus.* A human species of *Balantidium, B. coli,* although not very common, is sometimes very pathogenic, causing intestinal ulcers and frequently bringing about the death of the host.

Endamœba ranarum is a species that is often abundant in tadpoles. It is of particular interest because of its close resemblance to *E. histolytica,* which causes dysentery in man, and has been found in about nine per cent. of all human beings examined.

Recently the writer has discovered Euglena-like flagellates in the rectum and intestine of tadpoles. One species has many of the characteristics of free living Euglenæ including green chromatophores, a reservoir and a red stigma. This species possesses three flagella. Another species resembles *Euglena spirogyra* and a third species is similar to *Phacus pleuronectes.*

The following references contain detailed information concerning some of the organisms mentioned above:

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Intestinal protozoa of man. Hegner, R. W., and Cort, W. W., 1921. Pp. 1-72.

Giardia agilis. Hegner, R. W. *Amer. Journ. Hygiene,* 2: 435-441.

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Opalina ranarum. Metcalf, M. M., 1909. *Arch. f. Protist.,* 13: 195-375.

Opalina ranarum. Metcalf, M. M., 1914. *Zool. Anz.,* 44: 533-541.

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SCIENTIFIC EVENTS

ALEXANDER SMITH

The New York Section of the American Chemical Society having appointed a committee, consisting of Professors Thomas B. Freas, Ralph H. McKee and James Kendall, chairman, to draw up resolutions in memory of the late Professor Smith, the following resolutions were prepared and approved by the section on October 6:

Whereas, By the death of Alexander Smith at Edinburgh on September 8, 1922, the American Chemical Society has been deprived of a past president and the New York Section has lost one of its most highly esteemed members:

And whereas, Although the work of Alexander Smith as a teacher, as an administrator, and as an investigator in chemistry survives as an enduring monument to his name, yet it is none the less our privilege to put on record in the minutes of the section our sincere appreciation of his outstanding scientific genius and of his rare personal integrity and charm;

Be it therefore resolved, That the New York Section of the American Chemical Society express its profound regret at the passing of this distinguished leader in chemistry, who by his labors has added luster to science both in the land of his birth and in the land of his adoption;

And be it further resolved, That copies of this memorandum be forwarded to his widow and to his sister, with the respectful sympathy of the section.

THE TOTAL SOLAR ECLIPSE OF SEPTEMBER 21

Dr. A. C. D. Crommelin, writing in *Nature,* says that the failure of the Christmas Island eclipse expedition is a great astronomical disappointment. Messrs. Jones and Melotte have devoted ten months or more to it, and hoped to secure useful photometric results for connectng the northern and southern stellar magnitude scales in addition to the eclipse work. The climate, however, proved unexpectedly unfavorable, and practically nothing could be done.

On the other hand, the conditions appear to have been ideal right across Australia, and enthusiastic reports have come from Wollal (West Coast), Cordillo Downs (center) and Goondiwindi and Stanthorpe (Queensland). The Einstein problem was studied at Wollal by the Lick Observatory party under Professor Campbell, and that from Toronto under Professor Chant. Mr. Evershed also finally selected this station in preference to the Maldives, and is believed to have undertaken the same investigation, in addition, doubtless, to spectroscopic work. Professor Dodwell, the government astronomer at Adelaide, had the use at Cordillo Downs of a tower telescope lent by the Lick Observatory for the Einstein problem; the New South Wales astronomers were in Queensland and did some spectroscopic work; they intended also to make Einstein investigations, but the telegrams do not allude to these.

It is well to point out that the test of the Einstein theory does not depend wholly on the results of this eclipse. The plates secured in the 1919 eclipse at Principe and Sobral settled definitely that at least the half-shift was present, while the two cameras with the best definition gave values very close to the Einstein value. Further, the star-field in that eclipse was the best along the whole extent of the ecliptic, the stars in the present eclipse being much fainter. There are, however, two circumstances that should add weight to this eclipse: (1) that some of the observers were pointing directly on the stars, avoiding the use of a cœlostat or other mirror; (2) that the plan was being tried of photographing another star-field *during totality,* thus obtaining an independent scale-value for the plates, which gives a much larger coefficient to the Einstein displacement in the equations of condition.

Probably weeks or months must elapse before the Einstein results are to hand. The corona is said to have had four long streamers, one extending to three solar diameters, which is more than the average, though by no means a record. Professor Chant reports that the shadow bands were photographed. Professor Kerr Grant, of Adelaide University, made measures at Cordillo by the photo-electric cell of the relative brightness of the sun and the corona. The results, with this very sensitive instrument, should be more trustworthy than previous determinations.

The next two total eclipses (1923, September, and 1925, January) are visible in the United States; 1926, January, in Sumatra, etc., and 1921 in England and Norway.

THE FIJI-NEW ZEALAND EXPEDITION OF THE STATE UNIVERSITY OF IOWA

THE Fiji-New Zealand party from the University of Iowa arrived in San Francisco on September 4 by the Pacific steamer *Tahiti.* This expedition was organized by Professor C. C. Nutting, head of the department of zoology of the University of Iowa, and included the following additional members from the faculty of that institution: Professor Robert B. Wylie, botanist; Professor A. O. Thomas, geologist; Dr. Dayton Stoner, entomologist, and Mr. Waldo Glock, assistant in geology. Mrs. Dayton Stoner, wife of Professor Stoner, accompanied her husband and assisted in the work with insects. The party left Vancouver on the *Niagara* on May 19, and after spending five weeks in Fiji went on to New Zealand for a like period, working mainly in North Island.

The expedition was greatly aided by the officials of these islands, with whom Professor Nutting as director had made preliminary arrangements by correspondence. Considerable collections were secured by each member of the party in his own field, including both illustrative and research material. Several hundred negatives were secured which will be used as a basis of illustration in lectures and publications. The Dominion Museums, both at Auckland and Wellington, New Zealand, were especially helpful; they extended to the party use of their buildings as temporary laboratories, offered helpful cooperation at all times, and contributed many valuable specimens to the University of Iowa Museum. Their gifts included four living and two preserved Sphenodons.

THE NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE eighteenth annual New England Intercollegiate Geological Excursion was held in the vicinity of Springfield and Northampton, Massachusetts, on the sixth and seventh of October. Professor J. W. Goldthwait, of Dartmouth College, and Dr. Ernst Antevs, of the University of Stockholm, were the leaders. Dr. Antevs, who has continued the work of Baron de Geer since the latter's return to Sweden, demonstrated the field methods which have led him to important conclusions concerning the glacial history of New England. His chief conclusions are (1) that the Wisconsin ice-sheet retreated from Hartford, Connecticut, to the northern border of Vermont in a period of approximately 4,000 years; (2) that this time interval can not be correlated definitely with the period of 13,500 years which, according to de Geer, is the approximate number of years ago at which the last ice-sheet started to retreat across southern Sweden; (3) that an isostatic bulge made a freshwater lake of Long Island Sound during the last glacial period; and (4) that the axis of post-glacial tilting lies in the vicinity of Hartford, the dam holding back the lake in Long Island Sound between Fisher's Island and Long Island having been submerged approximately 200 feet in post-glacial time, or tilted southward from New Haven approximately eight feet to the mile.

Sixteen New England colleges and institutions, as well as the United States Geological Survey, were represented on the excursion. The list of institutions is Amherst (1), Brown (2), Clark (2), Colby (1), Dartmouth (1), Hartford High (2), Harvard (2), Massachusetts Agricultural (1), Mount Holyoke (3), Smith (6), Springfield Schools (1), Trinity (1), University of Stockholm (1), University of Vermont (1), United States Geological Survey (1), Wesleyan (2), Williams (5), Yale (7), unattached (1). The total attendance was, therefore, 41.

LECTURES OF THE LOWELL INSTITUTE

Among seven courses of Lowell lectures to be given during the present season are the following:

A course of eight lectures by Harlow Shapley, Ph.D., Paine professor of astronomy at Harvard Unversity and director of the Harvard College Observatory, on "The Content and Structure of the Sidereal Universe." 1. The Problems of Modern Astronomy. 2. Space, Time and Starlight. 3. Stars and Atoms. 4. Stellar Variation and Evolution. 5. Measuring the Milky Way. 6. Nebulæ and Island Universes. 7. Origin of the Earth. 8. Life and the Physical Universe. Tuesdays and Fridays at 8 o'clock in the evening, beginnng Tuesday, October 24.

A course of eight lectures by Edwin Grant Conklin, Ph.D., Sc.D., professor of biology in Princeton University, on "The Revolt against Darwinism." 1. Evolution, Historical and Experimental. 2. The Materials of Evolution. 3. The Rôle of Selection in Species Formation. 4. The Cellular Basis of Heredity. 5. The Cellular Basis of Development and Evolution. 6. Directions and Rates of Evolution. 7. The Mechanism of Adaptation. 8. Mechanism and Teleology. Wednesdays and Mondays at 8 o'clock in the evening, beginning on Wednesday, November 22, and omitting Wednesday, November 29.

A course of six lectures by A. Hamilton Rice, A.M., M.D., on "Journeys and Explorations in Tropical South America." 1. Physical Outlines of South America. Desiderata in Exploration. Some Notes on South American Hydrography. 2. Historical. Quito to the Amazons by the River Napo, the Route of Pizarro and Orellana. Caracas to Bogota by the Route of Bolivar and the Foreign Legion across the Venezuelan Lianos and the Colombian Andes. 3. Bogota and Exploration of the River Calaro-Uaupes, the Great West Affluent of the Rio Negro. 4. Further Explorations of the N. W. Amazons Valley, including the Sources of the Caqueta and the Rivers Inirida and Ieana. 5. The Great Rio Negro (Amazons). 6. The Casiquiare Canal and the Upper Orinoco. Fridays and Tuesdays at five o'clock in the afternoon, beginning on Friday, December 1.

A course of six lectures by W. J. V. Osterhout, Ph.D., professor of botany, Harvard University, on "The Nature of Life and Death." 1. Growth. 2. Reproduction and Motion. 3. Irritability. 4. Constructive Metabolism. 5. Destructive Metabolism. 6. Permeability. Thursdays and Mondays at 8 o'clock in the evening, beginning on Thursday, January 4.

INSTALLATION OF THE CHANCELLOR OF THE UNIVERSITY OF BUFFALO

Dr. Samuel Paul Capen, director of the American Council on Education since its organization in 1919, resigns this month to become chancellor of the University of Buffalo. This institution more than a year ago conducted an endowment fund campaign in which 26,000 citizens contributed more than $5,000,000. Dr.

Capen, as the new head of the institution, will have charge of developing the greater university. Its enrollment this fall totals 1,670 in the colleges of medicine, law, pharmacy, chemistry, arts and dentistry. The faculty numbers 262.

Dr. Capen will be installed as chancellor on Saturday, October 28. Between fifty and seventy-five of the best known leaders in education in the United States and Canada will attend as delegates from the colleges and universities with which they are connected. Speakers at the inaugural will include President Albott Lawrence Lowell, of Harvard; President Livingston Farrand of Cornell; President John A. Cousens, of Tufts; Sir Richard Falconer, of the University of Toronto; Dr. Frank P. Graves, New York state commissioner of education, and Governor Nathan L. Miller, of New York.

Following the installation of Dr. Capen and luncheons for men and women delegates at the University and Twentieth Century Clubs, respectively, there will be a flag-raising at Rotary Athletic Field just before the Buffalo-Clarkson foot-ball game. Rotary Field was made possible by contributions of Rotary Club members over and above what they otherwise contributed to the endowment fund. This field will be part of the campus. The inaugural dinner will be held in the evening.

On Friday afternoon, October 27, exercises will be held for dedication of Foster Hall, the new chemical laboratory of the University of Buffalo. Following an academic procession, the dedication will take place. Funds for erection of the building, which cost upwards of half a million dollars, were contributed during the endowment fund campaign by O. E. Foster, a Buffalo philanthropist.

The laboratory is the first of the buildings to be erected on the new 150-acre site to which, ultimately, all the university departments and activities will be transferred. It is located at the northern end of the city, amid beautiful surroundings, and is an ideal location for development of the greater University of Buffalo.

The expansion program of the University of Buffalo comes as an incident in its long record of usefulness, which started when Millard Fillmore, thirteenth president of the United States, was its first chancellor seventy-five years ago.

Dr. Capen, the son of a former president of Tufts College, commenced his career as instructor, assistant professor and then full professor in modern languages in Clark College, Worcester. Next he was professor of German and lecturer on educational administration in Clark University. He was a member of the Worcester school board from 1908 to 1914 and specialist in higher education in the U. S. Bureau of Education from 1914 to 1919, when he accepted directorship of the American Council on Education.

THE PRESIDENCY OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dr. Samuel Wesley Stratton, for twenty-one years director of the Bureau of Standards at Washington, was elected president of the Massachusetts Institute of Technology on October 11. He will assume the position on January 1.

The institute has been without an executive head since the death of Dr. Richard C. MacLaurin in January, 1920. Dr. Ernest Fox Nichols was elected president in 1921, but was forced by ill health to resign a few months later without having served in office. A committee of faculty and corporation members has carried on the administrative work.

Dr. Stratton was born in Litchfield, Ill., in 1861, and was graduated in 1884 from the University of Illinois, where he later became professor of physics and electrical engineering. From 1892 to 1901 he was professor of physics in the Unversity of Chicago.

As head of the Bureau of Standards he has built up from a small office of weights and measures employing three or four persons a bureau which occupies a dozen buildings and has a staff of more than 900 employees. The bureau is closely aligned with the industries of the country, aiding them in research work and development of methods of precision.

Dr. Stratton has received the honorary degree of doctor of engineering from the University of Illinois and that of doctor of science from the Western University of Pennsylvania, the University of Cambridge and from Yale

University. He was made a Chevalier of the Legion of Honor in 1909.

The New York *Times* reports that Secretary Hoover, commenting on the resignation of Dr. Stratton, said:

The loss of Dr. Stratton as head of the Bureau of Standards is a real national loss. He has built up that service from a bureau devoted to scientific determination of weights and measurements to a great physical laboratory cooperating with American industry and commerce in the solution of many problems of enormous value in industry which the commercial laboratories of the country, from lack of equipment and personnel, have been unable to undertake.

While the Massachusetts Institute of Technology is to be congratulated on securing Dr. Stratton, one can not overlook the fact that the desperately poor pay which our government gives to great experts makes it impossible for us to retain men capable of performing the great responsibilities which are placed upon them.

The Massachusetts Institute of Technology, an educational institution, finds no difficulty in paying a man of Dr. Stratton's calibre three times the salary the government is able to pay him.

Dr. Stratton has repeatedly refused large offers before, but the inability of the scientific men in the government to properly support themselves and their families under the living conditions in Washington, and to make any provision for old age, makes it impossible for any responsible department head to secure such men for public service at government salaries.

SCIENTIFIC NOTES AND NEWS

On October 5 the new biological building of McGill University, erected at a cost of over $500,000, was formally opened. The exercises were presided over by the principal, Sir Arthur Currie. Sir Charles Sherrington, P.R.S., Waynfleet professor of physiology at Oxford University, gave the opening address. He was followed by Dr. Harvey Cushing, of Harvard University. Lectures were also given by Dr. H. J. Hamburger, professor of physiology, University of Groningen, Netherlands, who spoke on "A new form of correlation between organs," and by Dr. John M. Coulter, professor of botany of the University of Chicago, whose subject was "The botanical perspective."

The Faraday Medal of the British Institution of Electrical Engineers, the first award of which was made by the council in the early part of the year to Mr. Oliver Heaviside, was personally presented to him by Mr. J. S. Highfield, president of the institution, at Torquay, on September 9.

The University of Leeds has conferred the honorary degree of doctor of science on Sir Charles Scott Sherrington, the Duc de Broglie, Paris; Dr. C. G. Joh. Petersen, director of the Danish Biological Station, Copenhagen, and Professor P. Weiss, director of the Physical Laboratory, University of Strasbourg.

Mr. Gano Dunn, president of the J. G. White Engineering Corporation of New York City, and second vice-chairman of the National Research Council, has been appointed a delegate from the Research Council to the Pan-Pacific Commercial Conference meeting in Honolulu from October 25 to November 7.

Dr. Martin H. Fischer, professor of physiology in the University of Cincinnati, has been elected a foreign member of the Leopoldinisch Carolinische Akademie of Halle, in the Division of Scientific Medicine.

Dr. Oliver Bowles, of the United States Bureau of Mines, has been admitted as an honorary member of the Institution of Quarry Managers of Great Britain.

At a recent meeting of the Committee on Science and the Arts of the Franklin Institute, an award of the Howard N. Potts Medal was granted to Dr. Charles Raymond Downs and Mr. John Morris Weiss of New York "in consideration of their notable achievement in the scientific and commercial development of the catalytic vapor-phase oxidation of benzene to maleic acid and their pioneer work in developing a commercial process for changing aromatic to aliphatic compounds."

Professor Hüppe, who was for many years director of the Hygienic Institute in Prague, celebrated, on Aug. 24, his seventieth birthday.

A Meyricke Scholarship at Jesus College, Oxford, open to graduates of the University of Wales and of St. Davids College, Lampeter, has been awarded to Leon Rubinstein, of University College, Aberystwyth, with a view to research in chemistry.

Dr. J. A. Detlefsen, who has leave of absence from the Unversity of Illinois, will spend the coming year at the Wistar Institute of Anatomy and Biology, Philadelphia.

Dr. Joseph Swain, former president of Swarthmore College and of Indiana University, previously professor of mathematics and a contributor to biological science, and Mrs. Swain, are spending a year in Japan and China.

Dr. Edmund Otis Hovey spent six weeks during the past summer in making a western tour partly in behalf of the American Museum of Natural History. His special object was to secure photographic and other data in the Pike's Peak region, the region of San Francisco Bay, and at Crater Lake, for use in the construction of relief models at the museum.

Dr. R. C. Farmer has accepted the position of deputy director of explosives research at the British War Office Research Department.

We learn from *Nature* that a committee has been appointed by the British secretary for mines to undertake research, under the general direction of the safety in mines research board, into the causes of, and the means of preventing, the ignition of firedamp and coal dust by the firing of explosives. The committee has been constituted as follows: Sir F. L. Nathan, Mr. W. Rintoul, Dr. G. Rotter, Mr. H. Walker, and Professor R. V. Wheeler. A grant has been made by the miners' welfare committee out of the miners' welfare fund to meet the cost of initiating the research.

The Harvard College Observatory is being opened from 7:30 P.M. to 9 P.M. on the following dates: October 13, October 28, November 13, November 28, December 12. A short illustrated talk will be preceded, when the weather permits, by telescopic observations of celestial objects. Exhibits showing the work of the observatory will be explained by members of the staff. A limited number of tickets of admission for any one of the open nights is supplied on application but must be obtained in advance. There is no charge for admission. The titles include: "Astronomical tests of the relativity theory," "The Harvard Observatory Station in Peru," "The large observatories of the west," "Scientific work for the amateur astronomer."

Dr. Walter B. Cannon, professor of physiology in the Harvard Medical School, gave an address before the Richmond Academy of Medicine and Surgery, September 26.

Dr. Rudolph Matas, head of the department of surgery at Tulane University, New Orleans, recently sailed for France where he attended the annual congress of French surgeons on October 2 and addressed the congress on "The surgery of blood vessels."

The New York Academy of Medicine has organized a celebration of the one hundredth anniversary of the birth of Louis Pasteur, which is to consist of a public exhibition, in the building of the academy, commencing on December 27, the anniversary date, and culminating at the end of a fortnight in an evening of public addresses by distinguished members of the medical profession. The exhibition will consist of a collection of Pasteur memorabilia, such as books, manuscripts, photographs, engravings, medals, etc., illustrating the life work of Pasteur.

F. T. Trouton, F.R.S., emeritus professor of physics in the University of London, died on September 21, at the age of fifty-eight years.

The death is announced of Mr. Louis Heathcote Walter, who had been editor of *Science Abstracts* since 1903.

Dr. J. K. A. Wertheim Salomonson, professor of neurology and radiology at Amsterdam University, died on September 16 at the age of fifty-eight years.

The spring meeting of the American Chemical Society will be held at New Haven, Conn., from April 3 to 7, 1923, inclusive.

The General Hospital Society of Connecticut is residuary legatee of the estate, believed to be considerably in excess of $1,000,000, of Mrs. Sarah L. Winchester, after certain bequests and life estates are taken from it. Mr. Winchester established a tuberculosis annex to a hospital at New Haven, where the Winchester

Arms Company's plant is located, and it was to continue that work that funds were bequeathed to the General Hospital Society.

The annual meeting of the American Society of Ichthyologists and Herpetologists will be held in the Field Museum, Chicago, on Friday, October 27, immediately following the meeting of the American Ornithologists' Union. All persons interested in any line of investigation relating to fishes, amphibians or reptiles are cordially invited to be present and take part in the meeting. Those desiring to present papers should communicate with the committee on arrangements, Karl P. Schmidt or Alfred C. Weed, Field Museum of Natural History, Chicago.

According to the September issue of the *Decimal Educator,* the official organ of the Decimal Association, as abstracted in *Nature,* the metric system has been or is soon to be adopted in Greece, Poland, Haiti and Japan, while the Russian government is rapidly introducing it into its administrative departments. The British Chamber of Commerce in the Argentine and the consul for Bolivia again warn British exporters of the futility of quoting in pounds, shillings and pence for amounts specified in imperial weights and measures. Mr. W. A. Appleton, secretary of the General Federation of Trade Unions, states that "these weights and measures of ours cheat the home buyer and arouse the suspicion of the foreigner," and asks how many buyers know the difference in weight of a peck of potatoes and a peck of peas. The Lancashire cotton market has ceased to quote cotton in sixty-fourths of a penny and now gives the price in hundredths, but we still appear likely to fulfil the prediction of Augustus de Morgan and "adopt the metric system when every other country has done so." Sir Richard Gregory, president of the association, recommends in an introductory article that the metric system should be made the sole legal system in all departments of state, and the nation thus prepared for its general introduction, which is bound to come in its time, as it is foolish to expect the world to adopt the imperial as an international system.

UNIVERSITY AND EDUCATIONAL NOTES

A trust agreement made by Mrs. Lydia C. Chamberlain, formerly of Des Moines, Iowa, who lived for many years in New York City, giving $419,000 to Columbia University for fellowships, has been upheld in the Supreme Court, but an attempt by Mrs. Chamberlain in her will to distribute the rest of her estate to Columbia also under the trust agreement, has been set aside. Mrs. Chamberlain directs that the income from the gift be used to establish "graduate" and "traveling" fellowships, to be restricted to men or women who were born in Iowa, graduated from Iowa institutions, and who return to live in Iowa. The amount payable yearly is limited to $850.

A campaign is being conducted to raise $10,000,000 for the University of Southern California, Los Angeles. Plans provide for a medical school and teaching hospital which will cost, on completion, approximately $3,500,000.

The Prudential Insurance Company of America has made a presentation of its entire sections on geological and geographical science to the library of Wellesley College. The collection includes over 3,000 volumes, publications and maps.

Dr. Elmer Pike has been appointed medical director of the University of Vermont, to succeed Dr. David Marvin.

Dr. Arthur Holmes, recently president of Drake University, has been elected professor of psychology in the University of Pennsylvania, where he will have charge of the welfare of men students.

Mr. Albert J. Walcott, a graduate of the University of Michigan, and for the last three years carrying on research work in optical glass with the Bausch & Lomb Optical Company, has been appointed lecturer in mineralogy at Northwestern University.

Raymond M. Deming, formerly instructor in mathematics at the Case School of Applied Science, has been appointed professor and head of the mathematics department at Upper Iowa University, Fayette.

Professor Robert Morris Ogden, of Cornell University, has been appointed lecturer on education at Harvard University for the second half of the academic year 1922-23.

Dr. Uhlenhuth, director of the Behring Institute for Experimental Therapy in Marburg, has received a call to the chair of hygiene in Bonn, as the successor of Professor Neumann, who has accepted the position left vacant in Hamburg by the death of Professor Dunbar.

DISCUSSION AND CORRESPONDENCE

THE PRODUCTION OF SPECIES

To the Editor of Science: It is often remarked by biologists who have never studied organisms in the field, that it is easy "to develop forms at will indistinguishable from actual species."

To my mind, this is one of the most deceptive of the anti-Darwinian heresies. A species is not merely a form or group of individuals distinguished from other groups by definable features. A complete definition involves longevity. A species is a kind of animal or plant which has run the gauntlet of the ages and *persisted.* Spreading across or around barriers, a species may break up into parallel or geminate species, each having run a special gauntlet of its own, its primitive qualities altering through selection, usually slowly, in the progress of the centuries. A new form inaugurated through change of surroundings, through persistent selection and segregation, or through hybridization, is not a "species" until it can hold its own with the rest. None of the created "new species" of plant or animal I know of would last five years in the open, nor is there the slightest evidence that any new species of field or forest or ocean ever originated from mutation, discontinuous variation or hybridization.

Garden or greenhouse products are immensely interesting and instructive, but they throw little light on the origin of species. To call them species is like calling dress-parade cadets "soldiers." I have heard this definition of a soldier—"one that has stood." It is easy to trick out a group of boys to look like soldiers, but you can not define them as such until they have "stood." A greenhouse variant is easily secured; with some plants excessive variability is itself a specific character. But temporary variations have no taxonomic value. A form is not a species until it has "stood."

The production of species from ancestral forms is a process which has striking analogies to the formation of words from older roots. It is easy to make a new word, as a variant or mutation from an older root, or even to create one without a root. But these creations are not words. They do not get into the dictionaries until they have "stood." They must have held their own in the gauntlet of speech which every word has to run. The new words may look as good as old ones. Riley's "gems that laugh hysteric lights, the glittering quespar, guenk and pleocynth," sound technical enough, but these are freaks of the poet, not real words. Being artificial and unreal they are not actual words, never having "stood" in the linguistic struggle for existence.

David Starr Jordan

THE TEACHING OF EVOLUTION

Readers of Professor Pickett's article on "The Teaching of Evolution"[1] will agree that "the teaching of science, particularly of biology or related subjects, in the high school is the chief area of stress." The teaching of introductory biology demands great tact, and, of course, not all teachers have tact. However, the responsibility for the conflict between religious teaching and scientific teaching can not be placed on those teachers.

Opposition to the doctrine of evolution by Mr. Bryan and those of similar views is not opposition to what Professor Pickett calls theories of evolution. It is opposition to the doctrine of evolution in any form whatever. The dispute between Neo-Darwinian and Neo-Lamarkian does not interest them except as cause for encouragement. To them Darwinism means evolution, nothing more. With an unbending mind they recognize disagreement between the plain literal biblical account of creation and the doctrine of evolution. They embrace the former and are unable to accept any of the compromises that have been offered.

[1] Science, September 15, 1922, LVI, 298.

The biologist is ready to receive new evidence but it is difficult to see how he can trim known facts to suit the opposition. However, science holds the key to the situation. The key is evolution itself, the evolutionary interpretation of history, especially the religious and literary history of the Hebrew people. This rather than biology would quickly become the storm center if it were taught in our high schools. It can not be done at present, but when historical science percolates more thoroughly into the Sunday schools the opposition to the teaching of evolution will dissolve. In the mean time the biologist bears the brunt of opposition because his pupils (or their parents) are not prepared for his message. He has to offer a new interpretation of life, a new basis of ethics, which is in opposition to tradition. He is usually better fitted to discuss and to appreciate the beliefs of the non-scientifically trained man than is the latter to discuss the scientific view, because the biologist has not always been a scientist. The scientist is a trained seeker for truth. His past beliefs, experiences and mental conflicts form a valuable intellectual background. The non-scientifically trained person can not claim a similar appreciation of the scientific view. The biologist must have something of the spirit of a missionary and if necessary that of a martyr.

J. HOWARD BROWN

PRINCETON

TINGITIDAE OR TINGIDAE

IN his discussion of this family name in a recent number of SCIENCE, Dr. W. J. Holland has provided us with an excellent review of the philological and nomenclatural facts in the matter, but he fails to mention certain items which have a bearing on the question.

Some years ago in a review of Van Duzee's "Check List of the Hemiptera" (*Psyche*, XXIII: 129, 1916), I stated very briefly my reason for adopting the form *Tingidæ* and it seems necessary to bring forward this argument again to the end that nothing pertinent be overlooked in reaching our decision. In connection with his original proposal of the generic name *Tingis*, Fabricius ("Systema Rhyngotorum," 1803, p. 124) *himself* uses the genitive *Tingis* in a foot-note, and accordingly we must adopt the family form *Tingidæ*, unless we can prove that the author was in error regarding the genitive form of his own generic name. When I first considered the question I took into account the facts which Dr. Holland adduces, and I came to the conclusion that we can not be sure that Fabricius did in fact adopt the Greek word Τίγγις, the name of a city; on the contrary, his use of the genitive *Tingis* shows us that he considered the word his own and indicates what its Latin declension should be.

Until this argument is disposed of I shall consider it necessary to use the form *Tingidæ*, as proposed by Westwood in 1840.

H. M. PARSHLEY

SMITH COLLEGE

THE VACUUM TUBE AMPLIFIER IN SCIENTIFIC WORK

THE amplification of sound by means of the triode vacuum tube has now passed on from its application to wired and wireless telephony to a means of aiding those of deficient hearing. Its effectiveness is so great that it promises to be to the partially deaf as great a boon as glasses to those optically defective. The use of the amplifier is sure to expand rapidly in this field, although it will be somewhat impeded by its expense.

The purpose of this note, however, is to call attention to the application or applicability of a sound magnifier in various fields of scientific work and industry:

1. For detecting distant underground operations as in mine rescue or military work.

2. Detecting the approach of a boat, train or automobile before it comes in sight.

3. Detecting the approach of a storm.

4. As a parallel instrument to the binocular prism glasses of the ornithologist, to detect bird songs too far to be heard distinctly or at all. It is particularly useful in detecting the higher notes that do not carry far and in observing nocturnal migration.

5. To aid the hunter in detecting sounds of distant game.

6. In conversation from vessel to vessel or station to station at shouting distance and a little further.

7. In directing men aboard or on shore.

8. To extend the possibilities of the dictograph in detecting evidence of crime.

9. To make possible addressing larger audiences and distant audiences.

10. To make it possible for some women with weak voices to nevertheless speak to large audiences.

11. In acoustical research for the study of subliminal sounds.

12. The detecting of subliminal sounds from animals not now known to make sounds.

13. To make more audible the whispers or weak sounds of the sick or injured.

14. To make communication by weak or injured less fatiguing.

That commercial equipment of good efficiency is now readily available may not be known to some of those who might make good use of the apparatus.

Roswell H. Johnson

Pittsburgh, Pa.,
September 22, 1922

CHEMICAL SPELLING

Hurrah for Professor Jacobson and his "chemical spelling match" at the West Virginia University, as described in Science for September 29! Twenty odd years' experience, when permanent secretary of the American Association for the Advancement of Science, in reading the proofs of the program of the chemical section, gave me some definite opinions of chemical terms. I was delighted, in reading the preface to a book recently published by the veteran naturalist, Auguste Forel, to note the expression *la vraie science est l'ennemie des grands mots.* Is it a plain inference from Forel's dictum that chemistry is not a true science?

L. O. Howard

QUOTATIONS

BIOLOGICAL STAINS

The stains employed by a worker in a series of investigations, and other workers repeating his methods, should involve identical materials. It is not necessary that the chemicals should be "pure"; indeed, the results from a particular method have sometimes been due to an unknown impurity, so recalling the famous salt in Stevenson's "Dr. Jekyll and Mr. Hyde." But they must be the same, if identifications are to be made by their use.

It was for these reasons and not from any superiority in German manufacture that authorities in microscopical technic so long ago advised the use of German stains and particularly those of Grübler of Leipzig. The advice was generally adopted, so that a practical monopoly of this small but important and profitable commerce in articles essential to medical practice and scientific research fell into German hands, to universal satisfaction. But the reason for the monopoly and the history of its institution were forgotten. When the war deprived allied countries and the United States of German imports of these chemicals, of which only very small stocks were held, manufacturers in other countries went into the trade. But their products were irregular in their action, did not always produce the familiar results and varied from maker to maker.

The supposed German scientific supremacy obtained another advertisement. It was demanded that importation of scientific stains should be allowed, or, alternatively, that by some great transformation, British, French and American skill should be brought up to the German level. Last autumn the National Research Council of America organized a practical inquiry into stains produced in America, obtaining the cooperation of workers in various branches of biological science. Their preliminary report has now been issued. Briefly, it dispels the idea of German superiority. American stains are often purer than the Grübler products; there is no difficulty in producing what is required. But the trouble is standardization; the stains of different manufacturers produce different effects.

It is suggested in the interests of science that the Research Council, after further inquiry, should determine a standard type for each stain, possibly recommending different manufacturers for different stains. But it is of importance that the standardization should extend beyond one country, so that the results of scientific investigation and the methods of bacteriological identification should be available for different countres. The whole business is small from the financial point of view, and it is to be hoped that standards will be adopted by international cooperation.—The London *Times.*

SCIENTIFIC BOOKS

Readings in Evolution, Genetics and Eugenics. By Horatio Hackett Newman. Chicago, 1921: The University of Chicago Press. Pp. XVIII plus 523.

Doubtless every college teacher who gives a general course in organic evolution has at times wished for the presentation in a single textbook of the materials he has found it necessary to have his students glean from numerous volumes. This need has been met by Professor Newman in the present book. The work is drawn up on much the lines of the "source books" in history which have become popular in recent years, and it will doubtless fulfill a similarly useful function for courses in evolution, genetics and eugenics. The wide range of matter necessary for such courses has been selected from the books and papers of many authors and reprinted in their own words, but the whole has been deftly knit together by means of occasional brief comments and passages written by the compiler himself.

One's preconception of such a presentation is that it must inevitably be a patchwork, but, as a matter of fact, Professor Newman, by judicious selection, has achieved a surprising unity. Another inherent difficulty in such a collection of articles and excerpts is the impossibility of touching out in otherwise excellent older accounts what, in the light of our more recent knowledge, are minor mistatements or contradictions; but here again, through careful choice, the defect has been reduced to a minimum.

The typographical errors observed by the reviewer are few. In line 6, page 294, *this is* should read *that is;* the numeral in line 16, page 365, should be 18 instead of 19; figures 87 and 88 on pages 434 and 435 have been exchanged.

The thirty-seven chapters (512 pages) are divided into five main parts: (1) Introductory and Historical (pp. 3 to 53); (2) Evidences of Organic Evolution (pp. 57 to 182); (3) The Causal Factors of Organic Evolution (pp. 185 to 283); (4) Genetics (pp. 287 to 456); and (5) Eugenics (pp. 459 to 512). Since the historical survey in Chapter II plunges one into the midst of genes, x-chromosomes, selection, orthogenesis, heterogenesis, Mendelism, biometry, etc., the general reader could find his way through this maze far more readily if a full glossary of scientific terms were appended. Such a glossary would also be very helpful in relation to other parts of the work.

In many colleges and universities the work in genetics and in organic evolution is given as separate courses. The reviewer, in fact, has used the volume under discussion in a practical way only as a text for a course in evolution. For such a purpose it would be advantageous to have the sections dealing with variation introduced before or along with the discussion of the causal factors of organic evolution. It is probable also that many teachers would, as does the reviewer, prefer to have the evidences from morphology presented before those from paleontology, but there is, of course, no reason why the user of the book may not take the various sections in this order if he so chooses. While to the initiated the chapters on Neo-Mendelian Heredity, Sex-linked and Other Kinds of Linked Inheritance, and Linkage and Crossing-Over are clear, succinct accounts, it is questionable if the beginner would get far with them without considerable additional elucidation on the part of the teacher.

In the opinion of the reviewer, Professor Newman has, in this series of readings, prepared for the general student the most complete and acceptable one-volume account of organic evolution and allied subjects in print.

M. F. Guyer

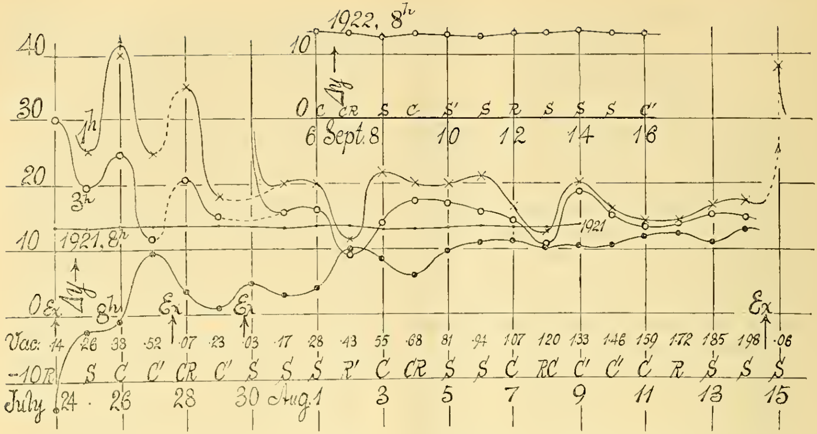
University of Wisconsin

SPECIAL ARTICLES

STATIC DEFLECTIONS OF THE VACUUM GRAVITATION NEEDLE, IN 1921 AND 1922

To obtain a comparison, it will be necessary to measure the distance apart, Δy (y being the telescopic scale reading, with the needle at rest), of the equilibrium curves corresponding to the two opposed positions of the attracting

[1] Advance note, from a Report to the Carnegie Institution of Washington, D. C.



weights, M, at the same hour, on successive days. As the graphs are often quite divergent, the interpolations will lose in accuracy; but the general relations of the results will nevertheless appear much more clearly. These static deflections, Δy, are given in the lapse of time in the figure. For 1922 the graphs are drawn for 1^h, 3^h, 8^h P.M. of the successive days,[2] and are distinguished by circles or crosses. For 1921 the night observations (at about 8 P.M. on the average) only are given, as the other lines would lie too close and confuse the diagram. In fact the variations in 1921 are of a smaller order and must be given on a scale ten times larger to be adequately shown.

The diagram brings out the striking difference of the results very well. For 1921 the observations lie practically on a straight line, $\Delta y = 13.42$, for which the normal period of the needle in vacuo would be 752 sec. In the results for 1922 the time of the successive exhaustions (Ex) is indicated approximately. It will be seen that the cooling or other influence of such an exhaustion (though carried from 1 mm. to .001 mm. only) is still effective in exaggerating the radiant forces, for at least six hours or more (*cf.* July 24, 30) after the exhaustion has been completed. Consequently the graphs for 1^h and 3^h should probably be joined by the dotted lines as indicated.

In all cases the extraneous radiant disturbance which is strong in July, 1922, gradually recedes more and more, as the observations enter the days in August. On July 24 at 8 P.M. the combined gravitation and radiant effect of the attracting mass M was repulsive (Δy negative), the radiant repulsion being about twice the gravitational pull. Positive values are not reached until after July 26. From July 28 on, the 8 P.M. increase is determined, though it has not quite reached the values of Δy even at the end of the diagram (August 14). In the afternoon observations (1922) the rain effect (or the absence of sun effect) is brought out very clearly by the marked depressions on August 2, 8, 11, 12. At night this effect may be reversed. When the day's radiation is scantily received, the needle fails to radiate at night.

In case of the observations of 1921, the small fluctuations of the Δy curves throughout a month showed instances of resemblance to the run of atmospheric temperature. But in the large variations recorded in 1922 (as a consequence perhaps) I was unable to detect such resemblances in the night observations, which are here alone of interest. The same is true of the change of temperature per day, etc. Nevertheless it is possible that relatively

[2] S denotes sunshine, C cloudy, C′ partly cloudy, R rain. Vac. shows the vacuum in mm. of mercury.

short atmospheric temperature changes from without, such as would not be otherwise recorded, may make an impression on the 8 P.M. graph. This, however, would not bear upon the 1922 graph as a whole, from July 24 to August 14. Supposing, moreover, that the closed region within is in some way modified thermally by the high exhaustions (carried to within .001 mm.), it seems hardly probable that the apparatus would take so long to return to the normal condition of 1921.

What has gone down during this series of measuremeents is the vacuum and one would therefore conclude that states of high exhaustion (a few hundredths or tenths of a mm.) are (like the plenum) more susceptible to the presence of radiant activity than the lower exhaustions of a few mm. Thus, night observations presupposed, the radiant forces pass through a minimum in a partial vacuum of several millimeters or more, and the best conditions for observation are then at hand. To test this further, I exhausted the apparatus on August 14. The morning observations August 15, twelve hours later (see figure) are again abnormally high.

It not infrequently happens that night values are low when day values are high and, in general, there is a tendency of the graphs to converge toward rainy or densely cloudy weather. All this conforms with the view that the needle is screened from radiation by the large attracting mass M and that the radiant forces act with gravitation, if the temperature-time coefficient $d\theta/dt$ is positive, and act against gravitation when $d\theta/dt$ is negative, as elsewhere explained. I have been tempted to envisage a coefficient $d\theta/dt$, which is not all temperature; for there may be some other radiation or agency behind the recent rains (for instance), as well as behind the difference in the character of the results of 1922 and 1921 as exhibited by the figure. It is difficult, in other words, to surmise what the nature of the radiant discrepancy may be, which clings to the apparatus so persistently in July and early August. If it were merely thermal, or dependent on a kinetic mechanism associated with $d\theta/dt$, its behavior would seem to be incompatible with the daily cycle, which is practically immediate. However, if the slopes of the curves giving the static elongations, y, of the needle in the lapse of time, are enhanced by the higher degrees of exhaustion, these curves would also ultimately intersect, so that even negative values of Δy, referable to causes within the apparatus would not be unexpected.

On my return to the laboratory in September, I resumed the work (upper curve). The vacuum had in the mean time decreased to about 3 mm. Under these conditions the night observations (8^h) are again normal and compare favorably with the corresponding graph of 1921, as was anticipated.

CARL BARUS
BROWN UNIVERSITY,
PROVIDENCE, R. I.

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF DYE CHEMISTRY

William J. Hale, *chairman*
R. Norris Shreve, *secretary*

SYMPOSIUM ON METHODS FOR STANDARDIZING AND TESTING DYES

R. E. Rose, *chairman*

Introductory remarks: ROBERT E. ROSE.

Chemical control of dyestuffs: WALTER M. SCOTT. This paper presents a general discussion of various methods for estimating the strength of dyestuffs as follows: (1) Colorimetric comparison of standard dyestuff solutions. (2) Titration of a solution of known strength of dyestuff with a standard solution of titanous chloride in an atmosphere of carbon dioxide. (3 Determination of the percentage of nitrogen by the Kjeldahl method. (4) Estimation of the inorganic salts which have been used in the standardization of the dyestuff. In connection with the materials used in dyeing there is such a great variety that it is only possible to discuss a few of the more common types. This paper gives an outline of the general methods of analysis used and also suggested specifications for the following: acetic acid, sulfuric acid, ammonia, black iron liquor, commercial ''nitrate'' of iron, di-sodium phosphate, Glauber's salt, common salt and soap made from olive or red oil.

The estimation of erythrosine: W. C. HOLMES. A method is outlined for the direct evaluation of dye in sample of erythrosine, based upon the gravimetric determination of the color acid, which is shown to have relatively excellent accuracy. The results obtained confirm the conclusion of Gomberg and Tabern that the dried dye contains a molecule of water of concentration. In the absence of interfering substances the consumption of acid involved in the precipitation of the color acid is determined by the dye and soda ash present and may be utilized as a convenient means of estimating the latter. A further investigation is being undertaken to determine the applicability of the methods to other dyes of the Eosine group and to afford evidence regarding their constitution.

The dangers of the titanium chloride method for determining the strength of dyes: EDWARD H. GAMBLE and ROBERT E. ROSE. The quantitative method, as described by Knecht for the estimation of the quantity of dyestuff in a sample by means of titanous chloride, is one which is very valuable; however, it must be used with great discretion and a full understanding of the material being tested. The method is sensitive to changes in chemical composition which are not accompanied by corresponding changes in tinctorial value and, therefore, may be extremely misleading.

Laundering of textiles: A. F. SHUPP. (1) Gross volume of business transacted; persons employed by; annual payroll. (2) Development of standard formulas for laundering cotton, linen, wool, silk and artificial silk fibers. (3) Effect of repeated laundering on cotton goods. (4) Discussion of the proper method for the use of low titer and high titer soaps. (5) Samples of textiles that have been improperly laundered. (6) Samples of textiles that have been poorly constructed. (7) American Institute of Laundering.

Dyeing as an art: J. MERRITT MATTHEWS. Dyestuffs and methods of dyeing have long been employed by many nations as a means of art expression, principally for the production of decorative effects on wearing apparel. The early eastern nations, such as the Indian, Chinese and Javanese, were especially prominent in this line of art work, although we also find a somewhat similar development of this form of art among the early Incas of Peru. The early nations, in contradistinction to our own of the present day, nearly always incorporated their art work in the actual utilities of their everyday life, and as their clothes were the nearest thing to them, they employed their art in the decoration of the fabrics used for their wearing apparel. We are more inclined to make our art work distinct in itself and with little or no connection with the things we use and wear. To us an art object is generally something that is set aside or put in a museum or cabinet, or hung on the wall, and must not be desecrated by using it or wearing it.

The tinting of white papers: W. C. HOLMES. For the tinting of newsprint stock and of white papers of the lower grades the basic dyes are exceptionally well adapted. The acid dyes are well qualified to serve the requirements of medium grade paper. In the tinting of white papers of the best quality it is necessary to resort to colors of the pigment type. The ultramarines, indanthrene dyes and the recently developed phosphotungstic lake products are employed, of which classes of colors each affords relative advantages in various essential respects. In the latter field none of the tinting materials available at present can be considered entirely satisfactory and it would appear probable that products of superior general excellence could be developed in other pigment types, of which the dyes derived from the anilids of beta-hydroxy-naphthoic acid are suggested as one of the more promising fields for investigation.

The relative stability of paper colors to bleach: W. C. HOLMES. Eighty representative paper colors are classified in respect to their relative susceptibility to calcium hypochlorite as determined by laboratory dyeing tests in which the essential conditions of beater operation were duplicated. In general the superior stability of pigment colors to photochemical attack finds an analogy in a corresponding stability to bleach, but little or no agreement is found between the relative susceptibility of the soluble dyes to the action of light and of bleach. From the point of view of coloring considerations it is preferable to eliminate residual bleach from the stock by washing rather than by the employment of anti-chlors.

Use of bichromates in wool dyeing (as mordants): WINTHROP C. DURFEE. Bichromates early used as mordants on wool when dyewoods benefited by oxidation were principal dyestuff. Oxidation is not usually beneficial to synthetic mordant dyes: is generally injurious. Synthetic mordant dyes as organic acids require suitable basic mordants. Bichromates furnish chromic acid peculiarly suited for absorption into wool fiber and conversion into basic chromes. Basic chrome should be combined in fiber with weak organic acid. Tartrates suitable for source of organic acid. Best results in mordanting require careful consideration of combining weights of reduced chrome. Amount of chrome used as mordant should have as near as practical a weight adjusted to combining weight of quantity of dye to be used.

Influence of tin weighting on the dyeing of silk: L. J. Matos.

Quercetin, constitution and uses: Geo. L. Terrasse. A brief synopsis of the constitution of flavone, flavonol and quercetin is given and attention is called to the brilliant synthetic work on these bodies performed by chemists of repute, these researches leaving no doubt about the correctness of the accepted formulas of the substances just mentioned and other bodies similarly constituted. In spite of the technical importance of quercetin and allied dyes the commercial synthetic non-production of them is emphasized. The color of quercetin in relation to its constitution is discussed and the reasons for the adjective dyeing qualities of this dye are considered. The influence of tautomerism, of the alpha hydroxyl and of the hydroxyls in other positions in the molecule are touched upon, as well as the influence of the quinoid formulation on its color. The application of quercetin to the various fibers with several different mordants is recorded and the characteristics of these dyeings are mentioned. The use of this dye on leather is also given and the analogy of the usual commercial forms of the dye to the tannins is indicated. The production of the various lakes of this color is likewise touched upon. It is pointed out that until the necessary original intermediates be produced much cheaper, or that entirely new and cheap syntheses be developed, quercetin must continue to be produced from natural sources.

An outline of the history and chemistry of the important natural dyestuffs: David Wallace and Emil Lesser, Ph.D. This paper covers the history of natural colors as used in ancient times and the impetus given to the industry by the discovery of America with its source of valuable natural dyestuffs, particularly logwood, fustic, hypernic and quercitron bark. Mention is made of the history of the development of the use of these colors. The chemistry of natural dyestuffs presents an interesting and complex study. It received years of study by such men as Chevroul, Erdmann, Graebe, Kostanacki, Herzig and Perkin. Most of their work was done on hæmotoxylin and brezilin, the coloring principles of logwood and hypernic. In this country, the work of Perkin has been thoroughly reviewed and extended in the search of a method for producing additional dyestuffs from natural sources. The sources, chemistry and application of the above mentioned dyestuffs are discussed. A brief mention is made of the present status of the industry.

Color and constitution: M. L. Crossley and P. V. Rosenvelt. A study was made of the effect of isomerism on the color of certain azo dyes. It is shown that there appears to be a definite relation between the reactivity of the naphthol sulfonic acids of beta-naphthol and the color of the dyes produced from them. The effect of the sulfonic acid group on the beta-naphthol ring appears to be greatest when it is in position 3. In this position it acts as a bathychromic group, while in position 7 it acts as a hypsochromic group. The influence of the nitro group on the benzene ring in an ortho position to the diazo group shifts the absorption of the dyes toward red. This effect is manifested to a maximum degree by the nitro group in the ortho position. When the nitro group is in the meta position it acts as a hypsochromic group, shifting the color of the nitrobenzene-azo-beta-naphthol-sulfonic acids in the entire series toward the yellow and beyond that of the corresponding benzene-azo-B-naphthol-sulfonic acid series. The methyl group substituted on the benzene ring has less influence on color than the nitro group. Chlorine appears to have very little influence on the color of the chlorobenzene-azo-B-naphthol-sulfonic acids. Bromine in the ortho position to the diazo group acts as a bathychromic group in dyes resulting from F acid and R salt but has no influence on the color of the dyes resulting from G salt and B-naphthol-3.6.8-trisulfonic acid. The sulfonic acid group introduced on the benzene ring shifts the color of the benzene-azo-B-naphthol-sulfonic acids towards yellow, the maximum effect being manifested by the meta position.

Constitution and chemical reactivity: M. L. Crossley and P. V. Rosenvelt. It is shown that there is some apparent relation between chemical constitution and reactivity in the B-naphthol-disulfonic acid products. The 2-naphthol-3.6-disulfonic acid, R salt, couples readily with azo compounds to give corresponding dyes, while the 2-naphthol-6.8-disulfonic acid and the 2-naphthol-3.6.8-trisulfonic acid, both of which contain a sulfonic acid group in the 8 position, do not react under ordinary conditions for coupling, with certain diazo compounds, particularly those containing a methyl group in an ortho position to the diazo group. Since the hydrogen atom in the adjacent position to the hydroxyl group is the only one of the several on the naphthol ring replaced by a diazo group, since the naphthol-sulfonic acids having a sulfonic acid group in position 8 do not form nitroso compounds, and since the substitution of an aryl radical for hydrogen of the hydroxyl group diminishes the reactivity of the adjacent hydrogen atom, as is evidenced by the fact that coupling no longer takes place on the naphthol ring, it is suggested that there is a dynamic relationship between the hydroxyl radical and the adjacent hydrogen atom, that this relationship is enhanced by a sulfonic acid group in position 3 and inhibited by a sulfonic acid group in position 8. It is further suggested that this condition of a "loose" hydrogen atom when position 8 is not occupied constitutes a condition of an "open field of reactivity," while the condition of the hydrogen atom when position 8 is occupied constitutes a condition of a "closed field of reactivity." An open field of reactivity is considered necessary for the formation of preliminary addition products, before any can result in the formation of stable reaction products.

Rhythmic bands of dyes on filter paper by evaporation. The refractivity, surface tension, conductivity, viscosity and Brownian movement of dye solutions: Earl C. H. Davies. (Lantern. Illustrated). Striking bands of dyes have been obtained, by a method of evaporation, in filter paper and with unglazed porcelain. There are no marked relations between the formation of these bands and the physical properties of the dye solutions, but it is probable that the viscosity of the very concentrated solutions is important. Oriented adsorption takes place in rhythmic band formation. A study was made of 62 dyes with 3 varieties of filter paper.

Adsorption phenomena in the application of dyes to plain and mordanted fabrics: L. W. Parsons and E. D. Lord. This paper deals with adsorption phenomena which occur in the dyeing of wool and mordanted cotton. The results are treated by the Freudlich adsorption equation, $\frac{x}{m} = kc\frac{1}{n}$, where $\frac{x}{m}$ is the grams of dye adsorbed per gram of adsorbent, c is the concentration of dye in the bath in equilibrium with the dyed fibres, and k and $\frac{1}{n}$ are constants for each individual dye. Characteristic samples of pure dyes containing various chromophore groupings were studied, the data applied to the adsorption equation and the factors affecting the exponent, $\frac{1}{n}$, are discussed. (1) In azo dyes the value of $\frac{1}{n}$ is in general high, and only slightly affected by the addition or removal of OH or So_3Na groups. (2) Thiazene dyes have particularly a low value. (3) Xanthene dyes containing the grouping COON or $COOCH_3$ have a low value for the exponent, the value being raised, however, if this group is absent. (4) The nitro group raised the value of $\frac{1}{n}$ provided that there is not a counteracting factor. (5) Triphenylmethane dyes have, in general, a low value. (6) In the case of mordanted cotton $\frac{1}{n}$ is particularly low, indicating that adsorption is a major factor. (7) This work is still in its infancy, but it is believed that a systematic study of such data and an application of it to the dyeing processes will lead to generalities of interest both to the practical dyer and to the physical chemist.

Dyes of the dinitro-malachite green series: T. B. Downey with Alexander Lowy. 2, 4-dinitrobenzaldehyde was condensed with dimethylaniline, benzyl-ethyl-aniline and diethyl-aniline (in the proportion of 1 mol. to 2 mols.), yielding 2, 4-dinitro-malachite-green dyestuffs which have the characteristic blue-green color typical of the malachite green series. The properties of the leucobases and dyes derived therefrom were studied. Samples of the dyes and dyeings will be shown.

Catalytic oxidation of anthracene to anthraquinone: C. E. Senseman and O. A. Nelson. The importance of anthraquinone as an intermediate in the manufacture of dyes is shown. Mention is made of the old methods of manufacture, chief among which is the chromic acid method. The catalytic method, patented by Gibbs and Conover, and worked out by the authors, is described in detail. The apparatus consists essentially of: (1) a carburetor, (2) reaction chamber and (3) sublimer for collecting the reaction products. All these parts are made of glass and heated by well-insulated electric heaters. The carburetor is built with two air inlets, one arranged so as to sweep over the molten anthracene and thus carry a definite amount of the hydrocarbon into the reaction chamber, the other arranged so as not to interfere with the work of the first but to vary the air-anthracene concentration as desired. Four methods of supporting the catalyst, vanadium pentoxide, are described. They are: (1) by boats, (2) by discs, (3) by pumice, (4) by fusing to a glass tube. The sublimer, as used during most of the runs, consists of a Kjeldahl flask with neck removed, and joined to the reaction chamber by a ground-glass joint. Tables were compiled showing the influence of different variables in the production of anthraquinone. The maximum yield obtained was 85.3 per cent. of the theoretical.

Equations for vapor pressures and latent heat of vaporization of naphthalene, anthracene, phanenthrene and anthraquinone: O. A. NELSON and C. E. SENSEMAN. This work deals only with the calculated vapor pressures and latent heats of vaporization of naphthalene, anthracene, phenanthrene and anthraquinone, and is an outgrowth of the work published by the authors on the observed vapor pressures of these compounds in *J. Ind. Eng. Chem.*, 14 (1922), 58. The calculations were made by applying the Clapeyron equation of state. A discussion of the derivation of the equation is given. The entropy of vaporization of the same compounds was also calculated and the conclusion arrived at that all form normal liquids. Tables for observed and calculated vapor pressures were given for each compound. In each case the calculated agrees favorably with the observed.

Carbazole, its purification and vapor pressure determination: C. E. SENSEMAN and O. A. NELSON. Carbazole of 82 per cent. purity was washed three times with benzene at a temperature of 50° C. Successive crystallizations from benzene and toluene followed, giving a product melting at 244.8° C. Analysis showed the presence of 8.22 per cent. of nitrogen, while the theoretical per cent. present is 8.38. Using this material vapor pressure determinations were made by the method and apparatus described previously by the authors in *J. Ind. Eng. Chem.*, 14 (1922), 58. Two tables were given. Table I records the pressures and corresponding temperatures. Table II gives the pressures at 5° temperature intervals read from a curve made from the observed readings. The boiling point was found to be 354.76° C. This constant was previously reported in the literature to be 351.5° C. From the Clapeyron equation of state a formula was derived for calculating the vapor pressures at the various temperatures. These calculated pressures closely approximate the observed ones.

The influence of change in concentration on the absorption spectra of dyes: W. C. HOLMES. A brief review of the literature on the subject is given. An outline of the preliminary results obtained by varying the concentration of a large number of dyes over a wide range is presented, together with representative absorption curves illustrating various types of behavior. The interpretation of results and their bearing upon the condition of dyes in solution is discussed.

The synthesis of dicyanine A: S. PALKIN. In the synthesis of dicyanine by the action of sodium ethylate on an alpha, gamma quinoline intermediate it was found that the relative proportion of dicyanine and cyanine produced varied considerably with the *same sample of intermediate*, in different experiments. The possible presence of other intermediates was not thought to be wholly responsible for the formation of contaminating dyes. A study of the influencing factors resulted in the development of an improved process for this dye, which depends upon the action of sodium sulfide and chloroform on an alpha, gamma quinoline intermediate in alcoholic solution. At least two other types of dyes are formed simultaneously by this method, one showing an absorption spectrum maximum at 6200 Å (kryptocyanine). Optimum conditions have been worked out for the preparation of dicyanine A IV (absorption maximum about 6720 Å). The resulting product was found to have sensitizing power equal to Hoechst Dicyanine. The yield of dye by this method is over twelve times that obtainable by any previous method.

The preparation and separation of the ortho- and nara-chloro-anilines: H. C. BASHIOUM and P. O. POWERS. The work was done to find a method capable of technical development for the preparation of the intermediates. Chloro-benzene was nitrated, and the mixture of o- and p-nitro-chloro-benzene was cooled, separating a part of the para isomer. The remaining mixture of nitro compounds was heated to distill off any remaining chloro-benzene and then reduced by boiling with iron and dilute hydrochloric acid. Steam distillation was used to remove the ortho-chloro-aniline which was obtained very nearly pure. Para chlor-o-aniline can be obtained by neutralizing and continuing the distillation with steam. Several other methods of separation were investigated.

The preparation of phenyl-thioglycol-o-carboxylic acid, thioindoxyl-carboxylic acid, thioindoxyl and thioindigo: M. X. SULLIVAN. The brick-red precipitate obtained by running H_2S into diazotized anthranilio acid at 0°-5° C. was treated with chloro-acetic acid in slightly alkaline medium and warmed to 75° C. The filtrate therefrom cooled and acidified with HCl gives phenyl-thio-glycol-o-carboxylic acid. This heated with 5 parts NaOH and a little water gradually to

160° with stirring and kept at 160° for 1 hour gives on dissolving in water and acidifying the cooled solution (in ice) thioindoxyl-carboxylic acid. Warming the acidified solution or heating the solid with acetic anhydride gives thioindoxyl distillable with steam. In alkaline solution thioindoxyl-carboxylic acid and thioindoxyl are converted by potassium ferricyanide to thioindigo, the former on heating the latter directly. The motive for the work is, in the present case, biothenical.

Division of Chemistry of Medicinal Products
Edgar B. Carter, *chairman*
E. H. Volwiler, *secretary*

SYMPOSIUM—DEVELOPMENT OF AMERICAN SYNTHETIC MEDICINALS

The American-made "chloramine" antiseptics: P. N. Leech.

Progress in the manufacture of arsphenamine: G. W. Raiziss.

Present status of the field of local anesthetics: E. H. Volwiler

Recent developments in the chemistry of organic mercurials: Frank C. Whitmore.

New medicinal mercurials: Oliver Kamm.

Chemical and pharmacological studies of benzyl compounds: David I. Macht.

A synthesis of thymol from p. cymene. II: Max Phillips. A process for making synthetic thymol from p. cymene is described. The method consists in first preparing nitrocymene, reducing this to cymidine, sulfonating the cymidine to cymidine-sulfonic acid, diazotizing the cymidine-sulfonic acid to diazo-cymene-sulfonic acid, reducing the latter to cymylhydrazine p. sulfonic acid, removing the hydrazine group cymene-3-sulfonic acid, fusion of the sodium salt of this acid with potassium hydroxide and obtaining thymol. An over-all yield of about 15 per cent. of the theoretical one is obtained.

A method for assaying unguentum stramonii: A. R. Bliss, Jr. The U. S. P. IX gives no method for standardizing unguentum stramonii. Bliss and Brown present a method adapted from the U. S. P. assays of extractum stramonii, extractum belladonnæ foliorum, and fluidextractum belladonnæ radicis, which gives very accurate results as shown by experiment data reported. The method consists of the usual treatment with ether-chloroform mixture and ammonia water; followed by thorough shaking and subsequent standing or by centrifuging; extraction with weak sulfuric acid; subsequent addition of ammonia water with final extraction with chloroform, and titration of the chloroformic residue in the usual fashion.

Some hypnotics of the barbituric acid series: H. A. Shonle and A. Moment. Of the various di-alkyl and alkyl-aryl barbituric acids prepared and tested, isoamyl-ethyl barbituric acid was found to have the greatest hypnotic activity combined with a low toxicity. Isobutyl-ethyl and n-butyl-ethyl barbituric acids were next in activity. Benzyl-ethyl and benzyl-propyl barbituric acids, while possessing hypnotic activity, caused tetanic convulsions. Increasing the length of the chain of both alkyl groups tends to cause muscular incoordination. It appears possible that the optimum activity lies in those members of the series which are more oil soluble and also chemically less stable. The usual method of synthesis was used in the preparation of this group of compounds.

Germicidal assays with special reference to colloidal silver compounds: Herbert C. Hamilton. Tests of germicides other than the coal tar compounds should be carried out under conditions similar to those under which the substance would be used, particularly time of reaction and organism. The values so obtained have more practical significance than the official hygienic laboratory coefficients. Colloids appear to vary in value more greatly than some other disinfectants, making it difficult to obtain a true valuation. Tests were made with some common disinfectants on a variety of organisms including those isolated from a typical case of "pink eye," also *B. pyocyaneous*, diphtheria, pneumonia and others. The substances tested include colloidal silver iodide, colloidal metallic silver, silver nitrate and other well-known disinfectants. Considerable data are included.

The chemistry of digitalis: Herbert C. Hamilton. This is a continuation report on the active agents of digitalis with some additional data on their purification and activity.

Hypnotics of the nirvanol series—phenyl butyl hydantoin: E. H. Volwiler and E. B. Vliet. Nirvanol, or phenyl-ethyl hydantoin, was at first acclaimed as the hypnotic *par excellence*, but in recent years it has been found to occasionally produce severe rash and fever. A number of other substituted hydantoins have already been prepared and investigated, but none of them appeared promising. The various analogous members of the hydantoin series and of the barbituric acid series seem to have no particular relationship from the hypnotic side, for example, the dialkyl hydantoins have practically no hypnotic action. Phenyl n-butyl hydantoin was prepared and found to have no hypnotic action whatsoever.

Chemotherapeutic studies of various aromatic organic arsenicals: GEORGE W. RAIZISS and JOSEPH L. GAVRON. The authors have found that in experimental trypanosomiasis due to infection with *T. equiperdum* complete cures may be effected by employing very pure samples of the two pentavalent organic arsenicals—p-arsanilic acid and 3-amino-4-hydroxyphenylarsonic acid. The chemotherapeutic indices $\frac{\text{maximum tolerated dose}}{\text{minimum curative dose}}$, which are 6.7 and 10, respectively, are of particular interest in view of the favorable results obtained by varions French investigators in the treatment of human syphilis with the above arsenicals. Furthermore, by utilizing these compounds as coupling agents the authors have prepared various arsenical dyes and found them to possess but feeble trypanocidal properties. Methods for the preparation of pure p-hydroxyphenylarsine and 3-animo-4-hydroxyphenylarsine have also been developed.

Experimental work in the prediction of physiological action: OLIVER KAMM. Considerations from the standpoint of molecular magnitude are of value in predicting certain toxicity data of mono-hydroxy alcohols. From the physiological results obtained with aliphatic members it was possible to predict corresponding effects of alcohols of the benzyl type, thus showing that benzyl compounds are devoid of certain specific effects sometimes credited to them.

CHARLES L. PARSONS,
Secretary

THE AMERICAN ASTRONOMICAL SOCIETY

THE twenty-eighth meeting of the society was held at the Yerkes Observatory, Williams Bay, Wisconsin, on September 5 to 8, 1922. This was the twenty-fifth anniversary of the opening of the observatory and also of the founding of the society, which grew out of the conference of astronomers held in connection with the dedication of the observatory in 1897. The members and visitors, who numbered about one hundred, were quartered at the Y. M. C. A. Camp on the shore of Lake Geneva.

Sessions for papers extended over three days, and the social events included a reception at the home of Director and Mrs. Frost, a boat ride on Lake Geneva, and the annual dinner. On one evening Professor E. E. Barnard gave an illustrated lecture on "Some Peculiarities of the Comets," and the anniversary celebration included reminiscences of the twenty-five years of the observatory and of the society. A series of astronomical moving pictures was also exhibited.

Nineteen new members were elected to the society, bringing the total membership up to three hundrd and ninety. The society elected to honorary membership Professor H. H. Turner, director of the University Observatory, Oxford, England.

Officers for the ensuing year are as follows:

President: W. W. Campbell.

Vice-presidents: John A. Miller, Henry Norris Russell.

Secretary: Joel Stebbins.

Treasurer: Benjamin Boss.

Councilors: Philip Fox, Caroline E. Furness, A. O. Leuschner, John M. Poor, Charles E. St. John, Frank Schlesinger, Frederick Slocum.

Members of the National Research Council: W. W. Campbell, Edwin B. Frost, Henry Norris Russell.

The next meeting of the society will be held in affiliation with the American Association for the Advancement of Science at Boston and Cambridge in December, 1922.

The program of papers was as follows:

A spectroscopic method of deriving the parallaxes of A-type stars: WALTER S. ADAMS and A. H. JOY.

Partial explanation, by wave-lengths, of the K-term in the B-types: SEBASTIAN ALBRECHT.

Trigonometric parallax of the Pleiades: HAROLD L. ALDEN.

The variable star, M 5, Bailey 33: E. E. BARNARD.

Saturn's rings when the earth passed through their plane in 1920-1921: E. E. BARNARD.

Redetermination of secondary standards of wave-length from the new international iron arc: KEIVIN BURNS, C. C. KIESS and W. F. MEGGERS.

The orbit of the spectroscopic binary H. R. 6532: J. W. CAMPBELL.

Nova Scorpii No. 3 (1922): ANNIE J. CANNON.

Measurements of planetary radiation: W. W. COBLENTZ and C. O. LAMPLAND.

On the light variations of Beta Lyræ and Delta Cephei: R. H. CURTISS.

The parallax of Capella from desentitized plates: ZACCHEUS DANIEL.

A new spectrocomparator: RALPH E. DELURY.

The Steward Observatory of the University of Arizona: A. E. DOUGLASS.

The variable double star X Ophiuchi: C. H. GINGRICH.

Parallax of the nebula surrounding B.D.+31°643: C. H. GINGRICH.

The orbits of the spectroscopic components of Boss 3793 (foll.): W. E. HARPER.

Two long period spectroscopic binaries: W. E. HARPER.

The relation between the stars of the Beta Canis Majoris type and the Cepheid variables: F. HENROTEAU.

Proper motions of stars from micrometric measures: LAURA E. HILL.

A table of x — sin x: HERBERT A. HOWE.

The variable star SX Herculis: M. F. JORDAN.

Wave-lengths in the red and infra-red spectra of oxygen and nitrogen: C. C. KIESS.

Photometry of moon: EDWARD S. KING.

Color-index apparatus: EDWARD S. KING.

Photographic observations of nebulæ: C. O. LAMPLAND.

A new scouting spectroscope for prominences: OLIVER J. LEE.

On the determination of magnitude error by Kapteyn's "spot" method: OLIVER J. LEE.

The distribution of novæ: KNUT LUNDMARK.

Historical note concerning the fundamental equations in stellar statistics: KNUT LUNDMARK.

The proper motions and mean parallax of spiral nebulæ: KNUT LUNDMARK.

The influence of a general cosmic curvature on the Einstein phenomena in the solar system: A. C. LUNN.

Internal motion in the spiral nebulæ: N. G. C. 2403, 4736 and 5055: A. VAN MAANEN.

The quantum theory of photographic exposure: C. E. K. MEES.

The graininess of photographic negatives: C. E. K. MEES.

Some new sensitizing dyes: C. E. K. MEES.

The relation between intensity and exposure: C. E. K. MEES.

Interferometer measurements of the longer waves in the iron arc spectrum: W. F. MEGGERS and C. C. KIESS.

Recent advances in nebulæ: D. H. MENZEL.

Interferometer measures of star diameters: A. A. MICHELSON and F. G. PEASE.

Trigonometric parallaxes of Cepheids and early type stars determined by photography at the Leander McCormick Observatory: S. A. MITCHELL.

On the daily variation in clock corrections: H. R. MORGAN.

Photometric results in certain Kapteyn areas: J. A. PARKHURST.

The total radiation of variable stars observed with the vacuum thermocouple at Mt. Wilson: EDISON PETTIT and SETH B. NICHOLSON.

A pendulum method of recording radio time signals: EDWARD C. PHILLIPS.

The ultra-violet spectrograph of the 72-inch telescope: J. S. PLASKETT.

The spectra of three O-type stars: H. H. PLASKETT.

Some fine occultations coming: WILLIAM F. RIGGE.

Planetary photography: FRANK E. ROSS.

Accuracy of photographic registration: FRANK E. ROSS.

Notes on ionization and pressure in the stars: HENRY NORRIS RUSSELL.

Further observations on wave-lengths in the spectrum of Venus: CHARLES E. ST. JOHN and SETH B. NICHOLSON.

The problem of three bodies and the spectrum of neutral helium: LUDWIK SILBERSTEIN.

A possible new method of stellar photometry: LUDWIK SILBERSTEIN.

Observation of temporary white areas on Mars: E. C. SLIPHER.

The star fields for the 1923 and 1925 total eclipses of the sun: FREDERICK SLOCUM.

On ionization in stars: JOHN Q. STEWART.

On the spectroscopic binary Gamma Ursæ Minoris: OTTO STRUVE.

Chronographic recording of wireless time signals: R. MELDRUM STEWART and J. P. HENDERSON.

Comparison between Paris and Washington time services based on chronographic registration of Bordeaux, Annapolis, and Arlington radio time signals: F. D. URIE.

Observations of Jupiter's faint satellites, and of Phœbe, with the two-foot reflector of the Yerkes Observatory: G. VAN BIESBROECK.

Radial velocity of the Præsepe cluster from objective-prism neodymium plates: H. C. WILSON.

Eclipsing variables showing two spectra: C. C. WYLIE.

Proper motions of some faint stars: EVERETT I. YOWELL.

Uniform clock rates for a period of an entire year: M. L. ZIMMER.

JOEL STEBBINS,
Secretary

SCIENCE

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CONTENTS

WILLIAM STEWART HALSTED, 1852-1922

Professor Halsted, certainly one of the most cultivated, and regarded by many as the most eminent surgeon of his time, in view of the character of his contributions, died at noon on Thursday, the seventh of September, in the Johns Hopkins Hospital, of which he had been surgeon-in-chief since soon after its opening. At that time, in 1889, neither he nor his clinical colleagues, Osler and Kelly, had as yet turned forty.

A man of unique personality, shy, something of a recluse, fastidious in his tastes and in his friendships, an aristocrat in his breeding, scholarly in his habits, the victim for many years of indifferent health, he nevertheless was one of the few American surgeons who may be considered to have established a school of surgery, comparable, in a sense, to the school of Billroth in Vienna. He had few of the qualities supposed to accompany what the world regards as a successful surgeon. Over-modest about his work, indifferent to matters of priority, caring little for the gregarious gatherings of medical men, unassuming, having little interest in private practice, he spent his medical life avoiding patients—even students, when this was possible—and, when health permitted, working in clinic and laboratory at the solution of a succession of problems which aroused his interest. He had that rare form of imagination which sees problems, and the technical ability combined with persistence which enabled him to attack them with promise of a successful issue. Many of his contributions, not only to his craft but to the science of medicine in general, were fundamental in character and of enduring importance.

As a schoolboy at Phillips-Andover and as an undergraduate at Yale, he was prominent in sports rather than in the class-room, and in his senior year was captain of one of the early university football teams. Like many other young men his ambition was not fired until his entrance into a professional school, and when, after his graduation in 1874, he entered the College of Physicians and Surgeons (Columbia) in New York, he settled down to prove his mettle with the result that three years later, on getting his degree, he was awarded a prize for leading his class in scholarship. After serving as interne at Bellevue he was appointed house physician to the newly erected New York Hospital. Subsequently, two years were passed in Europe where he devoted himself more especially to the subjects of anatomy and embryology. He studied at Vienna, Leipzig and Würtzburg, and his later surgical trend and investigative proclivities were distinctly colored by the German and Austrian surgery of the day.

On his return from abroad in 1880, he was made assistant demonstrator and subsequently demonstrator of anatomy at the College of Physicians aud Surgeons. He also held a number of hospital positions, first at the Charity Hospital where from 1881 to 1887 he was an attending surgeon and director of the out-patient department. For three years he was also surgeon-in-chief to the Emigrant Hospital, Ward's Island; and later, from 1885 to 1887, an attending surgeon to both the Bellevue and Presbyterian Hospitals. During this period in New York, following his return from abroad, he supported himself mainly by teaching, and with Dr. George E. Munroe he organized a famous extramural course for students, consisting of practical exercises in the laboratory and at the bedside, to take the place of the time-honored quizzes which it was long the fashion for the New York students with hospital aspirations to attend.

During his last few years in New York he undertook an anatomico-surgical investigation on the anæsthetizing effect of the then little-known and newly introduced drug, cocaine. In this research, which had been begun in 1885, he was the first to utilize for surgical purposes the principle of nerve blocking, and was accustomed to demonstrate to dentists how painless extractions or even more extensive operations on the jaws might thus be carried out. He was the first, also, at this time, to demonstrate spinal anæsthesia by introducing the drug into the lumbar meninges. In the course of these studies he used himself as a subject, injecting his own peripheral nerves in order to map out the areas of anæthesia, and, unaware of the danger he was running, contracted an habituation to the drug, from which, with the help of a devoted professional friend, he effectually broke himself.

It was natural enough that cocaine was subsequently abhorred by him, and after Schleich's solution came to be generally employed as a local anæsthetic, he usually preferred to infiltrate with salt solution alone, which has certain anæsthetizing properties, rather than use even the diluted drug. Fifteen years later when the writer of this note, as Dr. Halsted's resident surgeon, stumbled anew upon the principle of nerve blocking for operations on hernia and published a paper on the subject, he was utterly unaware that his chief had ever made studies with cocaine of any sort, so reticent was he about this particular matter and so little did questions of priority interest him. It has remained for the dentists to call attention to his original work on regional anæsthesia, and a few months before his death they made due public acknowledgment of what Dr. Halsted himself had never laid claim to, and the knowledge of which he had even withheld, at least until recent years, from his house officers.

Before this tragic episode interrupted what would doubtless have been a brilliant career in New York, he had published a number of papers which showed promise of his technical gifts and abilities as an investigator, but it was not until he was brought to Baltimore in the late eighties by William H. Welch and got to work in the original pathological building there with Franklin P. Mall, Councilman, Flexner and others, that his unusual capacity for research was shown at its full worth.

The studies of compensatory thyroid hypertrophy, one of his early researches, published in the first volume of the Johns Hopkins Hospital Reports, remained for twenty years the basis of our views regarding exophthalmic goitre as an expression of functional over-activity. The correctness of his observations and interpretation of them, indeed, remained unquestioned until he himself repeated the experiments and, failing to corroborate his original results, promptly reported the fact before one of the biological societies. It was a striking example of his scientific honesty, and it remained for someone else to point out, on the basis of new facts relating to iodine, how it was that his original interpretation had been nearer the truth than his later one.

Another of his early studies was on intestinal resection and suture, and he introduced a method of anastomosis of the bowel, based on the distribution of the blood supply and on the correct placement of the sutures, far superior to that of any of his predecessors. These two subjects, the surgery of the thyroid and intestine, continued to engage his attention to the end, and among his last publications was a monograph entitled "The Operative Story of Goitre" published two years before his death; and another on the bulkhead principle of intestinal anatomosis.

His interest lay not in the number of cases he might operate upon but in working at certain principles of surgery, and in the course of his experiments upon the thyroid and parathyroid bodies, he hit upon what is known as Halsted's Law, namely, that "a transplant of a portion of a ductless gland will survive only when a physiological deficit has been produced."

On the opening of the hospital in 1889 he turned his attention to questions of technique, and was among the first American surgeons to grasp fully the principle of the new aseptic surgery. The introduction of silver as suture material and as a covering for wounds because of its bactericidal qualities was due to him. He studied the healing of an aseptic blood-clot in closed wounds. He introduced gutta-percha in the form of "protective" as a dressing for open wounds. He showed how silk could be safely buried in the tissues, an important principle many surgeons are incapable of learning. He was among the first to insist upon absolute blood-stilling in the course of operations in days when operations were bloody affairs, and he introduced the form of delicate pointed forceps for hæmostosis now universally in use. He also introduced rubber gloves into surgery in the early nineties, and, being himself a painstaking rather than a brilliant or spectacular operator, it was long before gloves came into use in other clinics—indeed, for years they were very much scoffed at as clumsy impediments to manipulation.

His operation for cancer of the breast revolutionized the treatment of these cases, and the same might be said of his hernia operation, though in this he shared the honors with Bassini, an Italian, who introduced a high inguinal operation with repair of the canal at about the same time. In the late nineties his attention was chiefly centered upon the diseases of the gall-bladder and its ducts, and the early radical operation on the common duct emanated from his clinic. Possibly few men in the country knew more than did he about the condition from which he was destined to succumb—a stone in the ampulla of Vater.

In later years he devoted himself chiefly to studies relating to the blood-vessels and evolved a method whereby in cases of aneurysm the major trunks could be slowly constricted, and in this as in all other subjects which his studies illuminated, his inventive genius was displayed, as well as his thorough knowledge of anatomy and pathology. He was the first successfully to ligate the left subclavian artery in its first portion for aneurysm and the only surgeon who is recorded to have performed this rare procedure twice.

Halsted's honors were many. In 1900 at the centennary of the Royal College of Surgeons of England he, with J. C. Warren of Boston, W. W. Keen of Philadelphia, and Robert F. Weir of New York, were the four Americans chosen to receive an honorary fellowship. A few years later he was made an F. R. C. S. of Edinburgh, and also an LL. D. both of Edinburgh and of his alma mater, Yale. Columbia gave him a D. Sc. and he was a member of the National Academy of Sciences as well as of many other foreign and American scientific bodies. Though his publications were comparatively few—rarely more than one or two a year—he wrote well and painstakingly, and many of his papers will remain among our surgical classics. The one surgeon he perhaps admired more than any other was the late Theodore Kocher of Berne, Switzerland, and the two men, in manner and methods surgical, in imagination and ideals, had very much in common. Both of them held their professorships for an unusual number of years—Kocher for forty-five years, Halsted for thirty-three.

Halsted was a man who taught by example rather than precept. He was a safe, fastidious and finished surgeon, by no means a brilliant and showy operator after the style cultivated by many of his contemporaries. He cared nothing for administration, and up to ten years ago at least, his staff never met as a body. He was not a successful teacher of undergraduates. A bed-to-bed ward visit was almost an impossibility for him. If he was interested he would spend an interminable time over a single patient, reviewing the history, taking notes, having sketches made, carrying the problem to the laboratory and perhaps working on it for weeks. Meanwhile his associates and assistants would run his clinic as best they could. In this way his school developed—none of his pupils after his own fashion, to be sure—it would have been impossible to imitate him—all of them, nevertheless, influenced enormously by his attitude toward surgery, and by his operative methods.

His loss to the Johns Hopkins Hospital which he served so faithfully and long, and to which he bequeathed his property, will be irreparable. It will be equally so to his many and devoted disciples. One of his long series of resident-surgeons, who, as others have done, came to know him better after leaving his service, just as many sons learn to know their fathers not until after they have grown up, has in all respect and affection written this inadequate note of appreciation.

"Who knows whether the best of men be known, whether there be not more remarkable persons forgot than any that stand remembered in the known account of time?"

H. C.

EARTH CURRENTS AND MAGNETIC VARIATIONS

WHENEVER two metallic conductors are buried in the earth and are connected by a wire through a galvanometer a current is found to flow through the galvanometer.

Such a current may be (and sometimes is) caused by a difference of electrolytic action upon, or a difference of temperature of the ground plates, but it is often much stronger than could possibly be produced by such action. It is also regularly the case that the farther apart are the ground connections the greater is their potential difference, and this would not be the case if the currents were due to electrolysis. Since no one has been able to explain these currents by any of the properties of the metallic part of the circuit, it has come to be believed that the currents are flowing in the earth before the two ends of the wire are grounded, and that the wire merely serves as another conducting path between the two earth connections and acts as a shunt for a part of the current. Thus the currents are not regarded as flowing around a circuit consisting partly of the metallic conductor and partly of the earth between its terminals, as they would flow if they were electrolytic or thermo-electric currents, but they are believed to flow in the same direction in both the earth and the metallic conductor.

Since no place has been found, either on land or sea, where these currents will not flow through a long conductor whose ends are earthed, it is believed that there are currents flowing everywhere in the outer layers of the earth's crust and in the sea.

As soon as telegraph lines began to be established it was observed that currents were often set up in these lines when no battery was connected in the circuit. In 1847, a brilliant aurora was observed in Europe and simultaneously with this telegraph lines were greatly disturbed. This led to a careful observation of the diurnal and seasonal variations of the earth currents which were known to be always present in the lines, and to the establishment of a correspondence between these variations and the diurnal and seasonal variations of the magnetic elements of the earth. Since that time it has been known that the two phenomena are physically related, but there is, as yet, no agreement as to the exact nature of this relation.

In this connection it should be mentioned that two classes of magnetic and electric variations have been observed and are frequently, if not universally, assumed to have the same explanation. It is well known that at times of great sun-spot and auroral disturbances there are also very great and irregular magnetic and earth-current disturbances. It was these abnormal earth-currents which first attracted the attention of physicists, and it is these which have received the most attention from writers on the subject. But in addition to these there is a regular diurnal variation in both the magnetic declination and inclination and in the direction and intensity of the earth-currents. In the literature of terrestrial magnetism, variations of the irregular class are called magnetic *disturbances* while the regular daily and seasonal changes are known as the magnetic *variations*. The relation between the magnetic changes and the earth-current changes seems to be different in the two cases. Thus in the case of the magnetic *disturbances* the corresponding earth-current changes seem to be simultaneous with the magnetic changes, while in the case of the regular diurnal *variations* the magnetic changes seem to lag behind the corresponding earth-current changes by a period which may be as great as two or three hours.

This would seem to suggest that if the regular variations in terrestrial magnetism and earth-currents are related in the sense of cause and effect the irregular magnetic and earth-current disturbances are not so related, but are both apparently due to some external phenomenon which acts simultaneously upon both classes of phenomena. This fact seems not to have been heretofore recognized by writers upon the subject.

The first extensive study of the relation of earth-currents to terrestrial magnetism seems to have been started at the Greenwich Observatory in 1863. Two earth-current lines, one north and south and the other east and west, were established in that year, and continuous records of the earth-currents in these two directions were made. In 1868, Airy, the astronomer royal, published the results of his comparisons of these variations with accompanying magnetic changes. As a result of this comparison, he says:

> I think that on repeatedly examining the agreement of the two systems of curves, it is impossible to avoid the conclusions that the magnetic disturbances are produced by terrestrial galvanic currents below the magnets. . . . At the present time we are unable to say whether the records of the galvanic currents throw any light upon the origin of the diurnal variations in the magnetic elements.

In 1870 Airy published another paper in which he undertook to account for the diurnal magnetic variation, as well as the magnetic disturbances, by earth-currents; but the theoretical curve of magnetic variation which he constructed from earth-current data, while agreeing in general shape with the observed curve of variation, is not coincident with it in time.

Since the work of Airy, the most extensive comparison of the variations in earth-currents and in the magnetic elements of the earth has been made in Germany. In 1883, two underground telegraph lines, one from Berlin to Thorn and the other from Berlin to Dresden, were set apart for the measurement of earth currents, and continuous records of these currents were kept from that time until 1891. The material thus collected was turned over to Professor B. Weinstein, who, with a corps of competent assistants, went over all the records and established for the five years 1884-1888 what he regarded as the constant resultant earth-current in the region between these cities. The diurnal and seasonal variations of this current were then compared with the corresponding variations in the magnetic elements at Vienna and Wilhelmshaven. As a result of this comparison, Weinstein says:

> Personally, I have arrived at the conviction that almost the whole of the changes observed by means of a magnetometer and classed as terrestrial magnetic variations are due to earth-currents which act upon the magnetometer as a galvanometer.

Notwithstanding the very close relation which the curves published by Weinstein show between the two classes of phenomena, his conclusions as to the immediate relation of the two have not met with universal acceptance. Very few physicists have given any attention to the study of earth-currents in recent times, and most of these have been influenced largely by their theories as to the cause back of both earth-currents and terrestrial magnetism. Some physicists, of whom Balfour Stewart is perhaps the most important, have gone so far as to reach conclusions the reverse of those of Airy and Weinstein, and to attribute the earth currents to the magnetic variations. The fact that the diurnal variations in magnetic direction and intensity which would seem to follow from the changes in the earth-currents regularly lag behind the latter certainly indicates that the current does not immediately act upon the magnetic needle, as in the case of the current and needle of a galvanometer, and as is maintained by Weinstein in the quotation given above; but that the variations of the needle follow changes in the magnetic field of the earth, and that whatever effects are produced upon the needle by earth-currents must be due to changes which these currents have produced in the magnetic field of the earth at that place.

Looked at in this way, a time lag between the changes in current and the magnetic variations growing out of them does not seem improbable. Ewing has shown that in the case of a soft iron wire placed in a magnetizing coil an appreciable time is required for the wire to become fully magnetized. Rayleigh found that with a piece of annealed iron wire only 1.6 mm. in diameter and 17 cm. long the time for complete magnetization in a weak field was from 15 to 20 seconds. Hopkinson, after an extensive study of the rate at which magnetic induction penetrates iron, says:

> Suppose a magnet such as we have here constructed, but of the dimensions of the earth, and that some almighty electrician reversed its currents in the copper coils, the magnetizing force being 2 or 3. It would take some thousands of millions of years before the rate of change of induction at the center of its core would attain a maximum.

It is perhaps not allowable to compare the earth magnetically with a sphere of soft iron, and it is plain that the variation in the magnetic elements at a given place are not due to changes in the whole magnetic field of the earth, as in that case they would occur simultaneously over the whole earth instead of moving around with the sun, as they do, but it does not seem incredible that a change in the direction or magnitude of an earth-current at a given place should require two or three hours to produce its maximum effect upon the magnetic elements at that place. In such a contingency, it seems almost certain that the *rate of change* of the magnetic field at a given time would be proportional to the current intensity at that time. If we assume this to be the case, it is possible to compute from the curve of magnetic variation the direction and relative intensity of the current which is the cause of this magnetic variation.

Thus, when a current flows from north to south below a compass needle it deflects the north end of the needle toward the west. The north-south component of the earth current at Berlin was usually toward the south, and was much stronger in the day time than at night. Its greatest intensity was usually just before noon, and its least intensity in the morning and evening. In Figure 1, the curve A is Weinstein's curve for average diurnal variation in the north-south component of the observed earth-current for the year 1884. Curve B gives the average diurnal variation in the west component of the earth's magnetic field at Vienna for the same period. It will be seen

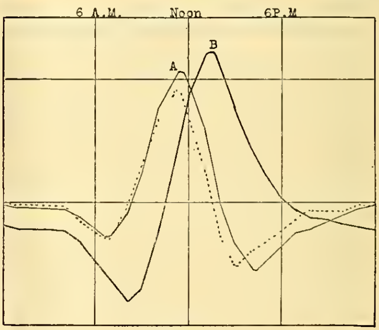

FIGURE 1

that the earth-current toward the south was strongest between eleven o'clock and noon, while the magnetic force toward the west was at its maximum between one and two P.M.

If a curve be drawn showing the *rate of change* of magnetic force throughout the twenty-four hours, we have the dotted curve, which resembles Curve A so closely as to give probability to our assumption that the magnetic deviation is caused by the earth-current, and that the magnetic force is always changing at a rate which is proportional to the intensity of the earth-current.

This relation between the rate of change of the magnetic declination and the intensity of the north-south earth-current has also been observed by Bauer[1] in data taken from the records of *Observatorio Del Ebro,* at Tortosa, Spain, but his conclusion drawn from this relation differs from that given above. Bauer says:

The general conclusion is that the north-south earth-current might be the result of electro-magnetic induction, caused by the fluctuation during the day of the west-east component of the earth's magnetism.

In reaching this conclusion Bauer has overlooked a very elementary and very fundamental law of electromagnetic induction, *viz.,* that a current induced by a change in a magnetic field is in the *opposite direction* to the current which would be required to produce the given change in the magnetic field. If the north-south earth-current and the westward deflection of the magnetic needle are causally related, the magnetic deviation is induced by the current. The contrary can not be true.

In the case of the west-east component of the earth-current conditions are somewhat different. This current weakens the magnetic component toward the north by a very small fraction of its total force, the diurnal range of this weakening being less than one two-thousandth part of the whole, and probably not all of this is attributable directly to the earth current. The resultant effect of the total earth current at a given place is to make the day side of the earth electropositive to the night side, and this condition would, of itself, weaken the north magnetic force on the day side of the earth. That is, a positive charge carried around by the earth's rotation from west to east would set up a north-south magnetic field in the opposite direction to the principal magnetic field of the earth. Such a charge would not, however, affect the east-west magnetic field of the earth.

[1] *Terr. Mag.*, XXVII, 14 (March-June, 1922).

That the day side of the earth is, on the whole, electropositive to the night side is plainly shown by a series of observations which the present writer has carried on for about three years, and for which he has continuous photographic records for more than two years. That this difference of electric potential on the opposite sides of the earth is due to the electrostatic induction of the negative charge of the sun seems beyond question. A smaller, but still a very definite effect of the moon's induction is also shown by the records.

In Figure 2, Curve A shows the diurnal variation of the earth's potential at Palo Alto for one year, from August, 1920, to July, 1921. Curve B shows the corresponding mean variation of the west-east earth current at Berlin for the year 1884. It is seen that while the earth-current reaches its maximum intensity at between ten and eleven A.M., the electropositive potential of the earth is at its maximum at between one and two P.M. In both cases the time of maximum has a seasonal variation. The same may be said of the variation in the north-south magnetic component of the earth's magnetic field, which for the year 1884 attained its maximum between eleven o'clock and noon at Vienna and Wilhelmshaven, as shown by the dotted curve C. In this case, as in the case of the variation in magnetic

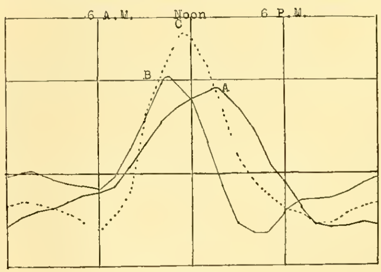

Figure 2

declination, the change in the earth's magnetic field is in the direction that would be produced by the change in the earth-current intensity and in the electric potential of the earth, hence the current can not be caused by the variation in the magnetic intensity.

Both the earth-currents and the diurnal magnetic variations are in the direction which they would take if they were caused by the electrostatic induction of the sun's negative charge, while the permanent magnetic field of the earth is such as would be caused by the rotation of its own permanent negative charge.

Figure 3 shows the relation between the observed mean diurnal variation of the earth-current in a line about two miles long at Palo Alto and the diurnal variation of the earth's potential for the same three days, as shown by the photographic record. On account of the disturbances in the earth due to trolley lines and other causes, and to possible disturbances in the line, which has been kindly put at my disposal by the Pacific Telephone and Telegraph Company, it is impossible to record the earth-currents photographically with any instrument at my command, and I have been compelled to make all the observations visually. As I have no assistance, I am compelled to make the continuous twenty-four hour runs myself, and for this reason I have at the present time but three such complete records, *viz.*, for June 2, July 18 and August 10, of the present year. The mean

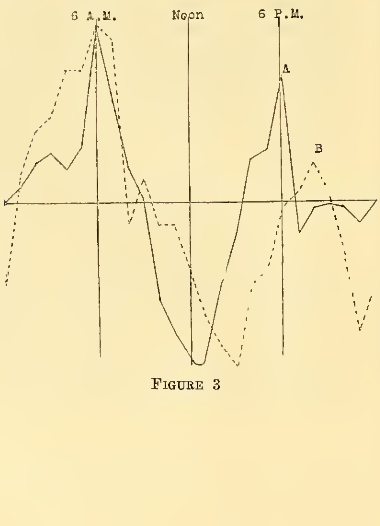

FIGURE 3

diurnal variation for these three days is shown in Curve A in Figure 3, while the mean diurnal variation in earth potential for the same three days is shown by the dotted curve, B. In this curve the signs of the potential are inverted to show better the agreement of the two curves. Both curves show many irregularities which would probably disappear in the mean of a large number of observations, but their similarity in general outline is such as to make it hard to doubt that they are physically related. Their time relation seems to indicate that the positive charge on the day side of the earth is due to the movement of electrons away from the sun.

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RESEARCH AT THE TORTUGAS LABORATORY

THE untimely death of Alfred Goldsborough Mayor and the consequent interruption of the plans of the Tortugas Laboratory of the Carnegie Institution of Washington naturally arouses renewed interest in the work of the laboratory and especially in the investigations now being carried on there. It may therefore be desirable to bring to general notice a brief résumé of the activities of the laboratory and also to point out the purposes of some of the researches now in progress.

The laboratory has been in existence for eighteen years and during that time it has published seventeen large volumes of "Papers from the Tortugas Laboratory," with one or two volumes more in preparation. In addition, a large number of papers, based in whole or in part on work done at the laboratory, were published elsewhere, one of the most important of these being Mayor's own work of three volumes on the Medusæ. (Further discussion of Mayor's researches is found in Davenport's interesting paper in SCIENCE, August 4, 1922). Among the contributors of these papers are many of America's most productive biologists. In estimating the productive activity of the laboratory it is necessary to remember that the laboratory has been open only from eight to fourteen weeks each year and that the greater part of the work has been done by university and college men who were busy with professional duties during the rest of the year.

An examination of these papers shows that they may be placed, for convenience, into three groups, as follows: 1, *Systematics and Distribution.* The works of Mayor on the Medusæ, Vaughan on the Corals, H. L. Clark on the Echinoderms, Treadwell on the Annelids, Cushman on the Foraminifera and others show that, contrary to general belief, the tropics still offer extraordinarily rich fields for this fundamental and important branch of biology. Work of this character, which necessarily precedes all other biological work on the organisms involved, has been carried on continuously since the establishment of the Department of Marine Biology by the Carnegie Institution. 2, *Embryology.* In the earlier years of the existence of the laboratory numerous papers were published on embryological subjects, but latterly this phase of biology has received relatively little attention, although there has been no abatement of facility or opportunity for this kind of work. The explanation of this is near at hand. It will be recalled that the laboratory was established at the time when the chief interest of biologists generally was in embryology, but that soon thereafter more and more attention was given to genetics, almost wholly at the expense of embryology. At the present time a relatively small number of descriptive embryological researches are being prosecuted. 3, *Crucial Physiological Experiments and Observations.* It frequently happens that some general conclusion based on a considerable amount of experimental or observational work already completed by one or more investigators, depends for its validity upon some crucial experiment or observation. It seems that because of the organisms, the climate or other conditions peculiar to the tropics, a large number of experimental or descriptive papers depended for their crucial data on work done at the Tortugas laboratory, or on expeditions from that laboratory to other points in the tropics.

Owing to the brief season during which the laboratory has been open each year, problems in the science of genetics, which at present occupies so large a place in biology, can not be carried on with entire satisfaction because of the fact that such work as a rule requires continuous attention for long periods.

Of the researches now in progress at Tortugas may be mentioned, first, that of Professor Longley, of Goucher College, on the coloration of reef fishes, an investigation which he has been carrying on for a number of years by means of a specially designed diving hood which enables him to study the habits of fishes in their natural environment. In addition to making important contributions to the general subject of animal coloration, he has collected what is perhaps the largest body of data in existence on feeding and other fundamental reactions of coral reef fishes. Doctor Bartsch, of the National Museum, has been engaged in breeding experiments on *Cerion,* a genus of land snails inhabiting the Florida Keys and the Bahamas, with a view to determining their specific relationships and their evolutionary history. Professor Lipman, of the University of California, has begun a comprehensive study of the activities of marine bacteria. The indications are that bacteria play as large a part in the life of the sea as they have been found to play in the life on land. It is consequently difficult to overestimate either the importance or the magnitude of this investigation. Captain Potts, of Cambridge, England, is continuing his studies, begun elsewhere, on factors influencing growth rates among various species of invertebrates. Dr. Morgulis, of the University of Nebraska Medical School, has begun a biochemical study of the blood of certain crustaceans, and finally, I may mention my own work on marine amebas, of which a monograph is now ready for the press.

A number of researches which were inaugurated at Tortugas require traveling to distant points for the successful prosecution of these researches. Among such investigations which are in progress at present may be mentioned those on marine Annelids by Professor Treadwell, who has visited a number of the West Indian Islands, Hawaii and several of the South Sea groups; Professor Harvey, who has visited various parts of the world in search of luminous organisms for his studies in bioluminescence; Professor Setchell, who has spent several seasons in the South Pacific in floristic studies. And in this connection must be mentioned also the unfinished researches of Doctor Mayor himself, who visited the Samoan Islands for the purpose of making observations on the rate and the conditions of the growth of corals, and who was laying plans, up to within a few days of his death, for another expedition to the South Pacific for the purpose of continuing his own and other investigations.

The life of the tropical sea presents unlimited opportunities for fruitful scientific investigation and it is the stated purpose of the laboratory to provide facilities for such investigations from a broad point of view. The published results clearly indicate that this purpose is being achieved in full measure. Students of marine biology confidently hope that the Carnegie Institution of Washington will continue to support the Department of Marine Biology so that the study of life in the sea may be continued with undiminished energy and with unrestricted scope.

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THE MOUNT EVEREST EXPEDITION

In an account of the expedition *The Geographical Journal* says that the early climbing season of 1922 was very brief. The expedition reached its base camp below the Rongbuk glacier at the end of April, when winter still held in the valley: and in the first days of June the monsoon broke and the season was over—at any rate until September. In the few weeks available there were two highly successful climbs, and a third which ended badly in the avalanche. Within six weeks most of the best climbers were out of action by frostbite, and the whole party so exhausted by the prolonged exertion above 16,000 feet that there could be no thought of renewing the attack in the autumn.

The final conquest of the mountain must wait, then, for a third year's campaign, organized in the light of this year's experience and this year's great though not complete success. Closer acquaintance with the mountain has shown that the physical difficulties are more formidable, the physiological difficulties decidedly less, than had been supposed: the organization and equipment were on the right lines and in most respects perfect. But the weather introduces each year an incalculable factor, against which the best schemes may be laid in vain.

In October those members of the expedition who went out from England will reassemble on the platform of the Central Hall to recount their adventures and to receive the hearty congratulations they have earned so well. The meeting will regret that they can not welcome and congratulate with them the four officers of the Indian service whose duty will keep them in India.

By the last reports we are glad to learn that Major Morshead is doing well, and that he will lose no more than the tips of three fingers of the frost-bitten hand. The other members of the party who suffered less are already quite recovered: several are already home and others well on their way. General Bruce with headquarters arrived in Darjeeling on August 2, and the only member of the expedition left in Tibet is Captain Noel, who has established a photographic dark-room at Gyantse, and is hard at work developing many thousands of feet of cinematograph film and a great quantity of plates and panoram films. His leisure he spends in "filming" Tibetan life and customs; and he is not due in England until the middle of October. It will therefore not be possible to show any of the film at the joint meeting of the society and the Alpine Club at the Central Hall on Monday, October 16, when General Bruce and several members of the party will give the first account of their work. A second joint meeting will be held on November 21 for the first show of the film, which will be awaited with great interest. Captain Noel did extraordinarily well in getting his cinematograph camera, fitted with an enormous telephoto lens, to 23,000 feet on the Chang La, and photographing the climbing to about 26,000 feet. He writes that the Sinclair camera and the big lens by Taylor, Taylor & Hobson have been a great success. The latter was a heavy addition to the outfit, but it saved his life in the diaster which befell the third climbing party, for it proved too heavy for the climb in the new soft snow below the Chang La, and he had been compelled to turn back from the rear of the party only a few minutes before the train of porters was carried away by the avalanche.

Captain Noel in his letters mentions many difficulties in photography at extreme altitudes: the most curious is the effect of the dry Tibetan climate on the cinematograph film, which cracks and sparkles with electric sparks when pulled through the hand, so that it is necessary to work with a wet hand when threading the film on the developing frames. Happily this effect was anticipated, and the makers of the Newman-Sinclair camera succeeded in making the film run through the gate without friction, and provided open-mouthed film boxes, so that damage from electrical markings is reduced to a minimum.

The official photographs which have come home from the expedition up to the time of writing comprise about 200 quarter-plate negatives on glass, a certain number of large panorama films, and two small V.P.K. films. These are supplemented by good series of pictures taken by Dr. Longstaff and Captain Finch, which have been placed at the disposal of the committee. A selection of enlargements is shown in the Photograph Room of the society, but the record must be very incomplete until the arrival of Captain Noel in October with all the larger plates. Enlargements from these will be shown as soon as possible, and the Mount Everest Committee will probably arrange for a public exhibition of the pictures in the Alpine Club Hall after Christmas, as was done last January.

SCIENTIFIC EVENTS

NITRATES IN SOUTHEASTERN CALIFORNIA

Nitrogen is needed in large quantities for use in fertilizers, in explosives required in engineering and mining, and in munitions made for national defense in war. During the war the demand for nitrates became so urgent that every known source of them in the United States was ransacked to find enough to supply our ever-increasing needs. The world's storehouse for nitrates is Chile, but the growing menace of the submarine made it imperative to divert to other uses the shipping then engaged in the Chile nitrate trade.

Small quantites of nitrates are found in almost every region where the rainfall is very small. The most promising deposits in the United States were those in the Amargosa region, in southeastern California. Before the war some of these deposits had been examined several times, chiefly by private companies that sought to obtain capital for their exploitation, but the reports made were so conflicting that the United States Geological Survey, Department of the Interior, decided to make a careful study of all the deposits in that region.

The nitrate-bearing material, or "caliche," as it is called in California, resembles in character and mode of occurrence the well-known caliche found in Chile, but it is much poorer and thinner. It forms a layer a few inches thick that lies less than a foot below the surface, at the plane of contact between the unaltered bedrock, which there consists chiefly of beds of Tertiary clay shale and the overlying clay soil. A white powdery layer, composed chiefly of sulphate of sodium and calcium, nearly everywhere lies between the caliche and the clay soil. The caliche cuts across successive tilted beds of the underlying clay shale and is thus clearly independent of the geologic structure.

In the examination made by the Geological Survey maps and cross sections were made at many places. Scores of trenches and hundreds of pits were dug down to or into the bedrock, and the soil, caliche and bedrock were then systematically sampled. Many hundred qualitative tests and nearly a thousand quantitative analyses of the caliche were made. The commercial development of the deposits, though they are the most promising in the country, was found to be impracticable, but the results of the investigation should set at rest any uncertainties as to the nature or quantity of the nitrates in the areas examined and should serve as a guide in the exploration of other supposedly nitrate-bearing regions.

An account of this investigation is given in the Geological Survey's Bulletin 724, on "Nitrate Deposits in the Amargosa Region, Southeastern California," by L. F. Noble, G. R. Mansfield and others.

THE DEDICATION OF THE STERLING LABORATORY OF YALE UNIVERSITY

The dedication of the new Sterling Chemical Laboratory of Yale University will occur on April 4, 1923, during the spring meeting of the American Chemical Society at New Haven. This arrangement has just been completed by national officers of the society and officials of the Yale Corporation.

The scientific meeting will be under the auspices of the New Haven and Connecticut Valley sections of the society. Professor Treat B. Johnson, of Yale University, is chairman of the executive committee in charge, chosen from members of the two sections.

The dedication ceremony, with probably 1,500 or 2,000 members of the American Chemical Society in attendance, as well as the Yale faculty and student body, will be impressive. The new building is one of the finest in the world and is built on an entirely new architectural principle. The main building is constructed on three sides of a square, three stories high and is in harmony with other buildings on the campus. In this building are class and lecture rooms, private laboratories and offices.

Inclosed in the square is a one-story, saw-tooth roof type of factory building, with movable partitions. This structure can be varied to suit the various needs of the teaching staff. It is constructed to give the maximum of light and air and is equipped so that it can be converted into several small workshops or one large shop, equal in size to a small commercial chemical plant.

The following are chairmen of the several committees for the meeting: Program, T. B. Johnson; Finance, J. S. Gravely; Dedication, John Johnston; Registration, Blair Saxton; Arrangement, A. J. Hill; Hotels and Transportation, Ralph Langley; Smoker, P. T. Walden; Reception and Entertainment, C. H. Matthewson; Publicity, W. T. Read; Ladies' Entertainment, Mrs. John Johnson. The Chi chapter of Alpha Chi Sigma is to have charge of the information service of the meeting.

THE JOSEPH SULLIVANT MEDAL

Mr. Benjamin Garver Lamme, chief engineer of the Westinghouse Electric and Manufacturing Company, has been nominated to be the first recipient of the Joseph Sullivant Medal of the Ohio State University. In October, 1920, on the occasion of the celebration of the fiftieth anniversary of the founding of the university, Dr. T. C. Mendenhall, a trustee and emeritus professor of physics of the university, presented a sum of money, the income of which is to be used for a gold medal to be known as the Joseph Sullivant Medal of the Ohio State University.

The conditions of the gift provide that this medal shall serve as a memorial of the eminent services in behalf of the university of Mr. Joseph Sullivant who, as a member of the first board of trustees, was influential in determining the character and future of the university. The medal is to be awarded once in five years in recognition of an admittedly notable achievement on the part of a son or daughter of the university, whether that achievement be in the form of an important invention, discovery or contribution to science, the practical solution of a significant engineering, economic or agricultural problem; or the production of a valuable, literary, artistic, historical, philosophical or other work.

Persons eligible to receive the medal shall be, in the order of preference, as follows: graduates of the university; non-graduates who have studied at the university not less than two years; members of the faculty who are not graduates of the university, who have served as such for at least ten years, when the work offered as entitling them to the award has been done during their connection with the institution.

From the list of nominations made by the faculties of the different colleges of the university, the graduate council selected three, *viz.*, George Wesley Bellows, artist; Benjamin Garver Lamme, chief engineer, Westinghouse Electric and Manufacturing Company; Herbert Osborn, research professor in the department of zoology and entomology, the Ohio State University.

The names of these three candidates were then presented to a committee selected by the graduate council and composed of the following members: Chairman, Dr. Elihu Thompson, of West Lynn, Mass., electrical engineer; Mr. Arthur Fairbanks, director of the Museum of Fine Arts, Boston, Mass.; Dr. William Morton Wheeler, director of the Bussey Institution, Boston, Mass.

This committee, after making a thorough study of the achievements of the three candidates proposed by the graduate council, unanimously selected Mr. Benjamin Garver Lamme as the one who should receive the Joseph Sullivant Medal. The medal will be awarded to Mr. Lamme later in the year at a special meeting to be held in honor of the occasion.

INSTALLATION OF THE PRESIDENT OF LEHIGH UNIVERSITY

Before an audience of delegates from other institutions, alumni and undergraduates of Lehigh University and friends of the university which crowded the Packer Memorial Chapel, Dr. Charles Russ Richards, former dean of the College of Engineering of the University of Illinois, was on October 14 inaugurated president of Lehigh University.

It was Founder's Day at Lehigh and on that day commemorating the founding of the university by Judge Asa Packer its presidents have been inaugurated. Dr. Henry R. Price, president of the board of trustees, presided. After the induction address by Bishop Ethelbert Talbot and the greetings from the alumni by Dr. Henry S. Drinker, president emeritus, and from the faculty by Professor John L. Stewart, Dr. Richards delivered an address which indicated his plans for Lehigh's future.

Dr. Richards outlined the influence on human history of discoveries and inventions. He made clear how the lack of scientific knowledge has retarded, sometimes for centuries, the utilization of known forces of nature. He traced the history of our present civilization and indicated the specific discoveries on which it rests. He outlined also the trend of education from the establishment of the University of Alexandria, and argued that industry and education must go hand in hand if we are to be saved in the future from the wasteful methods of the past.

Dr. Richards told his audience that Lehigh, for sixty years a teaching college, was to embark in the great work of engineering research when he stated, "While teaching is the obvious and apparently the chief function of a university, it should be its purpose to place scientific research in a position of equal importance with the work of instruction for the world must largely depend upon it to extend the boundaries of knowledge and to show its applications to the affairs of life."

Lehigh took this occasion to honor some of her distinguished alumni with doctor degrees. The list is as follows:

DOCTOR OF SCIENCE

William Bowie, C.E., '95, M.A., Sc.D., chief of the Division of Geodesy, U. S. Coast and Geodetic Survey.

Morris Llewellyn Cooke, M.E., '95, former commissioner of public works, Philadelphia.

Walter Savage Landis, Met.E., '02, M.S., '06, chief technologist American Cyanamid Company, New York City.

Harlan Sherman Miner, B.S., '88, Sc.D., chief chemist, Welsbach Light Company, Gloucester, N. J.

Harvey Harkness Stoek, B.S., '87, E.M., '88, Sc.D., head of the department of mining engineering, University of Illinois.

Richard Hawley Tucker, C.E., '79, astronomer, Lick Observatory, Mt. Hamilton, California.

DOCTOR OF LAWS

Manuel Victor Domenech, C.E., '88, former commissioner of the interior, Porto Rico.

Charles William Macfarlane, C.E., '76, Ph.D., economist and author, Philadelphia.

DOCTOR OF ENGINEERING

Henry Gerber Reist, M.E., '86, mechanical and electrical engineer, General Electric Company, Schenectady, N. Y.

After the inaugural ceremonies a luncheon was served to the guests of the university and later in the afternoon a reception and tea was given to President and Mrs. Richards in Drown Memorial Hall. In the evening the Lehigh Home Club gave a dinner to Dr. and Mrs. Richards in the new Hotel Bethlehem. The principal speakers at this dinner were President David Kinley, of the University of Illinois, and E. G. Grace (Lehigh '99), president of the Bethlehem Steel Corporation.

SCIENTIFIC NOTES AND NEWS

The American College of Surgeons met this week in Boston with Dr. John B. Deaver, of the University of Pennsylvania, as president, and Dr. Harvey Cushing, of Harvard University, as president-elect.

At a meeting of the Swedish Society of Physicians at Stockholm on October 3, it was decided to bestow the Anders Reizius' Medal on Professor Sir Charles Sherrington, of the University of Oxford, for his researches in physiology and the nervous system.

Professor Borrel, director of the Institute of Hygiene and Bacteriology at Strasbourg, formerly connected with the Pasteur Institute at Paris, has been appointed director of the Exposition of Hygiene to be held at Strasbourg on the occasion of the centenary of Pasteur.

A tablet bearing the name "Fernow Hall" was unveiled on October 5 over the main entrance of the Forestry Building of Cornell University. This name is given in recognition of the services rendered forestry in America by Dr. Bernhard E. Fernow, who was dean and director of the first school of forestry on the American continent, the former New York State College of Forestry. Serious ill health prevented Professor Fernow being present at the ceremonies.

On the occasion of the fiftieth anniversary of the professional career of Professor Domenico Barduzzi and his retirement from the chair of skin diseases and syphilis at the University of Siena, a gold medal was presented to him and a history of his career was published and presented to him by his students.

The following Latin American surgeons attended the meeting of the American College of Surgeons held this week in Boston: Dr. José A. Presno and Dr. Rafael Menocal, of Havana, Cuba; Dr. Gabriel M. Malda and Dr. Unises Valdes, of Mexico; Dr. Jose Arce of Buenos Aires, Argentina; Dr. Claudio J. Sanjines, of La Paz, Bolivia; Dr. Olympia da Fonseca, of Rio de Janeiro, Brazil; Dr. Gregorio Amunotegui and Dr. Lucas Sierra, of Santiago, Chile; Surgeon General Alberto Adriasola and Dr. Guillermo E. Muennich, of Valparaiso, Chile; Dr. Pompilio Martinez, of Bogota, Colombia; Dr. Francisco Graoa, of Lima, Peru; Dr. Enrique Pouey, of Montevideo, Uruguay, and Dr. Louis Razetti, of Caracas, Veneznela.

The Harvard faculty of medicine held a reception on October 16 for the delegation of visiting professors from the medical department of the University of Strasbourg. The visiting group is made up of Dean George Weiss and Drs. Camille Duverge, Leon Blum, Paul Masson and Maurice Nicleux. They are making under the auspices of the Rockefeller Foundation a study of the methods used in American medical schools.

Professor Ernest Merritt, head of the department of physics of Cornell University, has been granted leave of absence for the second half of the present academic year. His place will be taken by Professor Frederick Bedell.

Professor L. A. Fitz, head of the department of milling industry at Kansas State Agricultural College, has been granted a leave of absence for one year to work in the research laboratories of the Fleischmann Company in New York City.

George F. Weber, Ph.D. (Wisconsin, '22), has been appointed assistant plant pathologist in the Agricultural Experiment Station of Florida at Gainesville.

Dr. H. J. Hamburger, professor of physiology, University of Groningen, Holland, delivered an address on October 19 on "The increasing significance of chemistry in medical thought and practice" before a joint meeting of the Washington Academy of Sciences, the Biological Society of Washington and the Chemical Society of Washington. Dr. Hamburger will give an address on the same subject as the first Harvey Society lecture at the New York Academy of Medicine, on Friday evening, November 3.

Dr. Arthur L. Day, director of the Geophysical Laboratory of the Carnegie Institution, lectured on October 8 on "The study of earth movements in California" before the Franklin Institute of Philadelphia.

Dr. C. E. K. Mees, director of the research laboratory, Eastman Kodak Company, gave an illustrated lecture entitled "Chemistry and the motion picture" before the Society of Engineers at Troy, N. Y., on November 14; the Detroit Section of the American Chemical Society on November 15; the Purdue Section, American Chemical Society, at Lafayette, Indiana, on November 16; and the Chicago Section, American Chemical Society, on November 17.

Dr. W. R. Ham, head of the department of physics, addressed the Pennsylvania State College Branch of the American Association for the Advancement of Science October 18 on "Experimental evidence for and against the variation of mass with velocity and its bearing on the special theory of relativity."

L. E. Warren addressed the American Association of Food, Dairy and Drug Officials at its twenty-sixth annual convention, at Kansas City from October 3 to 6, on the subject, "The laboratory of the American Medical Association and its work."

A state university for Massachusetts was the subject discussed at a public dinner meeting arranged by the Boston Ethical Society on October 16. Among the speakers were Dr. Paul H. Hanus, professor of education at Harvard University, and Dr. Arthur Gordon Webster, professor of physics at Clark University.

The new building for the Institute of Pathology for the University of Freiburg was inaugurated in September. The address was given by Dr. Ludwig Aschoff, professor of pathology and pathological anatomy in the university, on "The importance of pathological anatomy for social medicine."

A memorial tablet was placed on the house at Tulle of the late Edmond Perrier, on September 24. The Paris Academy of Sciences was represented at the ceremonies by M. Ch. Gravier.

It is proposed that the new 50-centime stamp which France is about to issue in compliance with the Madrid Postal Convention shall bear the portrait of Louis Pasteur, in honor of the hundredth anniversary of his birth.

Dr. Guy Henry Cox, for many years professor of geology at the Missouri School of Mines, and more recently geologist for the Josey Oil Company, was killed on August 20, in an automobile accident near Bristow, Oklahoma.

John Forrest Kelly, the electrical engineer, died on October 15, aged sixty-three years.

Lawrence Reynolds, an entomologist and collector in Central and South America, has died in Boston at the age of forty-four years.

The death is announced of Professor E. Bergmann, director of the Chemisch-Technische Reichsanstalt, Berlin.

Professor Emilio Noelting, for many years director of the Chemical School at Mülhausen, died on August 7 aged seventy-one years.

Through the will of Dr. William Frear, late vice-director of the Agricultural Experiment Station, the Pennsylvania State College has received a valuable collection of scientific books and reports which will be given a permanent place in the library of the School of Agriculture.

The department of pathology of Columbia University has received a gift of $4,000 from the Commonwealth Fund, to be used for research into the causes of rickets.

The *Journal* of the American Medical Association states that the Supreme Lodge, Knights of Pythias, has donated $1,000,000 for the lepers on Culion Island. This money is to be used for the following purposes: (1) Permanent living quarters to be known as "Stevens Memorial Hall" for all white lepers at the colony. (2) Erection of an experimental laboratory with full equipment to carry on experiments in search of an absolute cure. (3) Establishment of an endowment fund amounting to approximately $900,000, to provide money for carrying on the experimental work and to further the benefit work at the colony among all lepers. The amount represents an assessment of $1 on every member of the lodge, which has a membership of nearly 1,000,000 men.

It is announced in the *British Medical Journal* that the National Council for the Promotion of Race-renewal, which established the National Birthrate Commission, is organizing an International Congress for the Reaffirmation of the World's Moral Ideal to be held in London, October 15 to 22. The congress will be opened at Caxton Hall, under the presidency of the Bishop of Southwark, on Tuesday morning. The afternoon session, presided over by Dr. Mary Scharlieb, will discuss marriage and parenthood and the relation of the sexes, the speakers including Dr. H. Crichton Miller, Mr. C. J. Bond, F.R.C.S., and Dr. J. W. Ballantyne. On Wednesday morning the subject for consideration will be the economic, social and racial aspects of morality and the rise and fall of population, migration, etc., the speakers including Sir Arthur Newsholme, K.C.B., M.D., Dr. C. W. Saleeby and Professor William Caldwell, D.Sc., of McGill University.

The returns of births in the ten largest towns in France for the first quarter of 1922 show a falling off of 10 per cent. as compared with the corresponding quarter of last year, the total figures being 48,528 and 53,551 respectively. No individual town shows an increase. Paris had 24,238 births, as compared with 27,489, Marseilles 6,176, as against 6,303, and Lyons 4,583, as against 5,088. It is estimated that the second quarter of the year will show a further lowering of the birth rate, as the marriage rate has been falling heavily for two years.

The Geographical Journal notes that the celebration, in April, 1921, of the death of Magellan in the Philippines, was virtually a celebration of the first circumnavigation of the globe, by far the greater part of the task—the first crossing of the vast Pacific Ocean—having been successfully accomplished solely through the initiative and hardihood of the great navigator who, by his tragic death before the finishing of the enterprise, failed to reap the ultimate reward of his achievement. But the actual first circuit of the globe was only completed on the return to Spain of the *Victoria* under the command of Juan Sebastian del Cano. This happy return of the survivors of the expedition was celebrated with much ceremony in Spain on September 5, 6 and 7, the sum of 250,000 pesetas having been voted by the Spanish government for the purpose. The celebrations took place at San Sebastian, and at Guetaria, a small fishing village some 30 kilometers to the west, which was the birthplace of Del Cano. This strip of the Spanish coast has further associations with the great voyage in that the *Victoria,* the only vessel of Magellan's fleet to complete the circuit of the globe, was built at Zarauz, which lies between Guetaria and San Sebastian. The king of Spain was expected to be present at the celebration. Institutions in other countries concerned with the progress of navigation and discovery were invited to send representatives.

The London *Times* reports that the Danish biologists, Dr. T. H. Martensen and Dr. Hjalmar Jensen, who went in November last on an expedition to the Kei Islands, in the Malay Archipelago, with the main object of finding a suitable site for a marine biological station planned by Scandinavian biologists for the study of deep-sea fauna, have now returned to Java. The *Challenger* and *Siboga* expeditions had found in dredging operations near these islands an extraordinarily rich deep-sea fauna in comparatively shallow water. It was expected that the Kei Islands would prove a suitable spot for a laboratory. Closer investigation of the sea was, however, necessary before the site could be definitely chosen. The expedition, after having completed its task, reports considerable success. Hitherto only very few soundings had been made in the neighborhood of the islands outside the one hundred meter [fifty fathom] line. The expedition has discovered an extensive area two to four hundred meters [one hundred to two hundred fathoms] deep, near which a rich and varied deep-sea fauna may be found. It includes, beside the forms found by the *Challenger* and *Siboga,* many others new to science. It is met with at a distance of six to eight miles from the site proposed for the future station. The study of the living deep-sea animals will thus be possible with a relatively small outlay. Although, of course, a rather remote place, the Kei Islands are within easy reach. There is a regular monthly mail service from Java. The expedition carried out research work at Amboina and the Bunda Islands. These spots proved far inferior to the Kei Islands. The expedition received much courteous help from the administration of the Dutch East Indies. It was accompanied by two Dutch biologists, Dr. Siebers, ornithologist of the Buitenzorg Museum, and Dr. Boschma, who paid special attention to corals. The rich collections made by the expedition are being sent to the Copenhagen Museum.

In connection with its studies of the distribution and movements of larval fishes and other pelagic marine organisms, the Bureau of Fisheries recently has undertaken the investigation of ocean currents of the north Atlantic coast and for that purpose has deposited about 1,500 drift bottles. These have been dropped on three lines, running, respectively, for a distance about 75 miles off Cape Elizabeth, 150 miles seaward from Chatham, Mass., and 150 miles seaward from Sandy Hook. The stations are at intervals of about one half mile, two bottles being dropped at each, with drags at different depths, the bottles being weighted so as to float with but a small part of the neck exposed. Each bottle contains a card offering a reward of 25 cents if sent to the bureau with information concerning the date and location at which it was found. Upwards of 200 of these cards have been received already. This work is being conducted in cooperation with the International Committee on Marine Fisheries Investigations, on which, in addition to the United States, the Canadian and Newfoundland governments are represented.

The *Fisheries Service Bulletin* reports that after a period of scarcity for about twenty years menhaden have reappeared in the Gulf of Maine in considerable abundance. On the Maine coast this fishery attained its greatest importance about thirty-five years ago, with factories at various points along the coast; that is, Boothbay Harbor, Pemaquid and Round Pond. According to the bureau's local agent at Portland, the main body of fish this year were found between Portland, Me., and Massachusetts Bay, and it is doubtful whether many large schools appeared farther east than Boothbay Harbor, where about 2,500 barrels were frozen. There were landed at Portland during the month of July 1,564,800 pounds by fishing vessels and many more by smaller craft. The landings at Portland would have been much larger had not the freezers refused to accept more. A report from Boston early in August states that about 18 menhaden steamers from southern factories were operating in Massachusetts Bay. As the herring fishery this season has been a comparative failure, the stocks of menhaden were welcome to the freezers for bait, bringing nearly as much as the herring for this purpose. For bait purposes the menhaden will be used chiefly by the halibut fleet and to a lesser degree by line trawlers, cod and haddock fishermen. Reports of the presence of schools of menhaden in these waters caused the bureau to send the steamer *Halcyon* to conduct an investigation under the direction of Dr. H. B. Bigelow. Preliminary reports indicate the presence of larger quantities of diatoms, on which the menhaden feeds, than are normally found in Massachusetts Bay at this season, and it is probable that the unusually good food supply has controlled the movements of the fish into those waters.

UNIVERSITY AND EDUCATIONAL NOTES

The will of the late Winthrop Cowdin, of Mount Kisco, N. Y., disposes of an estate estimated at more than $1,000,000. After providing for Winthrop Cowdin memorials at Harvard University and at the St. Paul's School, Concord, N. H., Harvard University receives $50,000 and the entire residuary estate, the income to be used for general purposes.

Professor Henry Gordon Gale, of the department of physics of the University of Chicago and for ten years dean of the College of Science, has been appointed dean of the Ogden Graduate School of Science, to succeed the late Dean Rollin D. Salisbury, who occupied the position for over twenty years.

Professor Milo S. Ketchum, professor of civil engineering in the University of Pennsylvania, has resigned to become dean of the College of Engineering and director of the Engineering Experiment Station of the University of Illinois. He will be succeeded at Pennsylvania by Professor H. C. Berry.

Dr. A. M. Greene, formerly of the Rensselaer Polytechnic Institute, has been elected dean of the Engineering School of Princeton University.

DR. G. R. LYMAN has been appointed dean of the College of Agriculture of West Virginia University. Dr. Lyman is at present in charge of the Plant Disease Survey of the United States Department of Agriculture and will assume his new position on January 1. Dr. N. J. Giddings has been acting dean of the West Virginia College of Agriculture since the resignation of Dr. John Lee Coulter on September 15, 1921.

PROFESSOR ALFRED TENNYSON DELURY, head of the department of mathematics, University of Toronto, has been appointed dean of the faculty of arts. Sir Robert Falconer called a meeting of the council of the faculty of arts and announced that, while the appointment of a dean was by statute in his hands, he would like to receive nominations from the council. Nominations were then made and balloting was carried on by mail during the next week. The result was that Professor DeLury was the choice of the council and he was appointed by the president.

DR. BOWMAN C. CROWELL, formerly connected with the Oswaldo Cruz Institute of Rio de Janeiro, and with the Bureau of Science of the Philippine Islands, has been appointed professor of pathology at the medical college of the University of South Carolina.

DISCUSSION AND CORRESPONDENCE

SOME SEISMOLOGICAL EVIDENCE THAT IS NOT EVIDENT

IN the June number of the *American Journal of Science* an article appeared under the title "A Critical Review of Chamberlin's Groundwork for the Study of Megadiastrophism."[1] In it a number of statements are made in regard to seismological facts which would seem to require experimental proof.

In the early part of the article the author sums up what he considers the evidence of seismic transmission for a viscous liquid state of the core of the earth at depths below 0.6 of the earth's radius. Describing the types of waves sent out by an earthquake, he says: "Seismic disturbances send out vibrations of two types, compressional and distortional. These are called the primary and secondary waves respectively. The former waves are dependent on the elasticity or compressibility of the transmitting medium, while the latter waves are dependent both on the rigidity and the elasticity of the transmitting medium for their propagation." In the first place, it is not clear what the author means by elasticity. He would seem to use it as synonymous with compressibility, whereas it is usually taken as a generic term including both volume elasticity and rigidity as species. But, passing over that point, does not the author's statement require both mathematical and experimental proof, since it is in direct opposition to the accepted theory of elasticity,[2] borne out as the latter is to a great extent by observations on earthquake records? As is well known, the theory of elasticity teaches that compressional, or dilatational, or longitudinal waves involve not only the modulus of compression or bulk modulus of the medium but also its shear modulus or coefficient of rigidity; and on the other hand, that the distortional, or shear, or transverse elastic waves involve the modulus of rigidity of the medium but not its modulus of compression. Thus the formula for the velocity of the longitudinal waves is

$$V_1 = \sqrt{\frac{\lambda + 2\mu}{\rho}}$$

ρ being the density of the medium, λ Lamé's compression constant, and μ the modulus of rigidity. In the case of transverse waves, the formula for the velocity is

$$V_2 = \sqrt{\frac{\mu}{\rho}}$$

Another statement that would seem to be far from evident is the following: "The two types of waves travel at different velocities but can only become distinctly separated out in a

[1] Art. XXXVII, "A Critical Review of Chamberlin's Groundwork for the Study of Megadiastrophism" by William F. Jones. *Amer. Journ. Sci.*, Fifth Ser., Vol. III, No. 18, June, 1922.

[2] *Cfr. e. g.* A. E. H. Love: "A Treatise on the Mathematical Theory of Elasticity," Rev. Ed., 1920, Cambr. U. Press.

homogeneous medium; that is, homogeneous as to stress effects or, in other words, isotropic. The resultant vibrations which travel circumferentially from the shock center pass through what we know is a heterogeneous medium." Rudzki[3] has shown that a disturbance in a heterogeneous but stratified elastic solid will send out distinct types of waves. These waves will be propagated through the stratified medium at different velocities and will appear in separate groups. First a nearly longitudinal phase will arrive at a given point, then a double, approximately transverse phase, and finally a group of surface waves will travel on the free surface.

But when the author of the article goes on to say: "The wave types are not separated in the earth's surficial shell. At a minimum distance of 700 miles, or 10 degrees of arc, from the epicenter a three-phase record becomes decipherable," he is unfortunately allowing himself to be betrayed into statements at variance with a great and ever-increasing mass of observed and published facts. The reports of any of the better seismographic stations, equipped with modern damped apparatus, would have furnished him with examples to the contrary. So, too, would any of the bulletins that are being issued by the Seismological Committee of the British Association[4], or Angenheister's[5] recent study on Pacific earthquakes and the upper layers of the earth's crust. The Chittenden,[6] California, earthquake of July 24, 1921, was an unusually beautiful example of clean-cut separation of the three phases at very short distances. As published in the Bulletin[7] of the Seismographic Stations of the University of California, the epicentral distance obtained from the Berkeley seismograms was only 125 km. (78 mi.) and that measured on the Lick records was but 46 km. (29 mi.), both of which agree very well with the location of the epicenter at Chittenden on macroseismic evidence.

There is another argument in the paper that is open to controversy. Relying on the statements of Professors Knott and Oldham that compression waves are transmitted through the core of the earth while shear waves are not, the author argues to a viscous fluid state of the interior. Now it is by no means certain that the transverse waves do not pass through the core of the earth. Neither, on the other hand, is it an observed fact that the longitudinal waves do so penetrate. In fact, the evidence seems rather strong to the contrary. Weichert and Zoeppritz,[8] Zeissig[9] and Mohorovičić[10] were not able to trace the direct longitudinal waves much more than half way to the antipodes. Gutenberg[11] in 1914 followed them up to about 106° and thought he had evidence for their reappearance between 143° and 180°.

[3] M. P. Rudzki: 1. "Parametrische Darstellung der elastischen Welle in anistropen Medien," *Bull. Acad. d. Sciences de Cracovie*, 1911, pp. 503-536.

2. "Sur la propagation d'une onde élastique superficielle dans un milieu transversalement isotrope," *Ibid.*, 1912, pp. 47-58.

[4] "The Large Earthquakes of 1917," Oxford, 1921.

[5] G. Angenheister: "Beobachtungen an pazifischen Beben. Ein Beitrag zum Studium der obersten Erdkruste," *Nachr. d. Ges. d. Wiss. zu Göttingen, Math.-Phys. Kl.*, 1921.

[6] Located at Chittenden, Santa Cruz Co., Cal., by Wm. J. Kemnitzer. See: William J. Kemnitzer, "The Chittenden Earthquake of July 24, 1921," *Bull. Seism. Soc. Am.*, Vol. XI, pp. 189-191, September-December, 1921.

[7] James B. Macelwane: "The Registration of Earthquakes at the Berkeley Station and at the Lick Observatory Station, April-September, 1921," *Univ. of California Publ., Bull. of the Seism. Stat.*, Vol. 2, No. 2, 1922.

[8] E. Wiechert und K. Zoeppritz: "Über Erdbebenwellen I u. II," *Nachr. d. K. Ges. Wiss. zu Göttingen, Math.-Phys. Kl.*, 1907.

[9] K. Zeissig: "Tabelle," Akad. Nauk, St. Petersburg, Comptes rendus des séances de la Commission sismique permanente, Tome III, Liv. III.

[10] S. Mohorovičic: "Die reduzierte Laufzeitkurve. II. Mitteilung: Die Ausbreitung der Erdbebenstrahlen in den tiefen Schichten der Erde," *Gerlands Beiträge zur Geophysik*, Bd. XIV, Heft 3, 1916.

[11] B. Gutenberg: "Über Erdbebenwellen VII A. Beobachtungen an Registrierungen von Fernbeben in Göttingen und Folgerungen über die Konstitution des Erdkörpers (mit Tafel)," *Nachr. d. K. Ges. d. Wiss. zu Gött., Math.-Phys. Kl.*, 1914.

But Rudolf and Szirtes[12] and Angenheister[13] have since shown that the latter belong to a branch of the first reflected waves. However, Angenheister was able to follow the direct compressional waves to about 145°, which is a great achievement. Beyond this we have no proof for their existence as yet. Hence it will be seen how weak is the author's argument for a viscous fluid state of the earth's core. If it is a viscous fluid, the longitudinal waves should be transmitted and the transverse waves should not. If it is an elastic solid, both the longitudinal and the transverse waves should be able to traverse it along some path, not necessarily a straight one. Do they? Future investigation may tell us. For the present, modern seismologists and geophysicists[14] suppose the core of the earth to be a rigid solid.

James B. Macelwane
University of California

THE BEGINNING OF AMERICAN GEOLOGY

To the Editor of Science: I have been reading with very great pleasure Dr. J. M. Clarke's interesting account of the beginnings of American geology in his life of James Hall, which has recently been published.

On page 218 he refers to the statement that Charles T. Jackson "drew a plan for the New York Survey, a statement repeated in Appleton's Cyclopedia of American Biography" but concerning which he (Clarke) has "never seen documentary evidence."

Without in any way desiring to dispute Dr. Clarke's contention it may be worth while to say that the sketch in the Cyclopedia referred to was written by me and that a proof of the sketch received the approval of one member of Jackson's family. The circumstances are quite clear in my memory. Owing to Jackson's death I did not know to whom to send the proof until, telling my trouble to Henry Carrington Bolton, he called my attention to the fact that Jackson's son or nephew had been with him in the class of '62 in Columbia. This information resulted in my submitting the sketch to some proper person who not only approved the article but sent me a portrait of Jackson showing him seated on a chair with both hands on his knees extending outward holding medals.

It is possible that the item about the New York Survey came from the younger Silliman's masterly article on the "Contributions of American Chemists" that he delivered at the Centennial of Chemistry held in Northumberland in 1874, and which was published in the *American Chemist.* If so, then the information came to Silliman directly from Jackson.

May I add for the information of students of the history of chemistry in America that Jackson received pupils in his laboratory in Boston, just as Booth and Garrett did in Philadelphia, and that it was in his laboratory that Charles A. Joy, who later held professorial appointments in Union and Columbia, received his early knowledge of chemistry before going to Göttingen.

Dr. Clarke persists in writing O. M. Mitchel's name with two l's. Mitchel was a very remarkable man and like Jackson was conspicuous for not being able to carry out the great things that he had in his mind. He died of yellow fever during the Civil War, and, while holding important commands, so persistently pestered Halleck with plans and recommendations to cut the Confederacy in two that he was removed and sent to Hilton Head.

If Dr. Clarke should issue a second edition of his valuable contribution to the history of science, I would suggest that Newberry's connection with the Sanitary Commission was rather administrative than medical, as can be seen by his printed report of which a digest appears in the article on Newberry in the "Cyclopedia of American Biography."

The unfortunate experiences of many of the early State surveys has been very fully told by Merrill in his valuable "History of Ameri-

[12] E. Rudolf und S. Szirtes, *Phys. Zeitschr.*, August 1, 1914.

[13] *Op. cit.*, pp. 11, 24, 27.

Also: G. Angenheister: "A study of Pacific Earthquakes," *The New Zealand Journal of Science and Technology*, Vol. IV, No. 5, 1921, pp. 216-217, 224.

[14] *Cfr.* A. Sieberg: "Aufbau und physikalische Verhältnisse des Erdkörpers unter besonderer Berücksichtigung der Erdrinde," *Geologische Rundschau*, Band XII, Heft 6/8, 1922, pp. 346-359.

can State Geological and Natural History Surveys" but those of us who were so fortunate as to be students under Newberry can never forget the time when, owing to the changes in political administration in Ohio, he found himself displaced by one of his subordinates. Newberry had chosen from his pupils promising young men such as Hooker, Irving, Newton and others who worked up the results of their field work at Columbia under Newberry's immediate supervision. That the work was not done in Ohio was urged against it and he was forced out of his office as state geologist. It was the beginning of the end, and dear "old Uncle John" never recovered from the blow.

Perhaps in connection with these statements about Newberry it may be worth while to recall the first time I ever saw Hall. The National Academy of Sciences held its fall meeting in 1877 at Columbia University, and it was the last meeting over which the distinguished and venerable Henry presided. It was the only time that I ever saw that great outstanding figure in American science and I shall never forget the dignified manner with which he held the chair. I also recall the dapper appearance of T. Sterry Hunt, who never missed an opportunity of saying something about every paper presented.

In the afternoon a meeting had been arranged for the geologists in Newberry's lecture room in the old School of Mines building on Fourth Avenue, at which Hall was to present a paper. As I recall the experience, he spoke without notes and undertook to explain the relation between certain strata in New York State and how they extended into the neighboring State of Ohio. When he had finished, Newberry promptly contradicted his assertions, contending that while Hall might know all about the geology of the State of New York, yet the conditions in Ohio were not as he represented them to be. Then followed a scene somewhat similar to the one described by Dr. Clarke, in which Hall agreed to eat his hat, for in this outburst he expressed a willingness to wager any amount on the correctness of his assumptions. To which Newberry retorted that it was not a question of a wager or money but simply a question of facts, and that in this case the facts in Ohio failed to substantiate Hall's point of view.

Of course our sympathies were all with Newberry, for we felt that as state geologist of Ohio he ought to know what the conditions were in Ohio better than any one else. I wonder who was right?

Marcus Benjamin

AN OPPORTUNITY

Professor W. N. Boldyreff, M.D., for ten years chief assistant to the famous Russian physiologist, Pavlov, in Petrograd; from 1912 to 1918 professor of pharmacology in Kazan University and for two years lecturer in physiology in the universities of Tokyo, Kyoto and Osaka; recipient of several Russian and German prizes and honors for scientific work; author of about fifty scientific papers mostly on the physiology of digestion, some of which have been translated into English, French, German, Swedish, Spanish, Czech and Japanese, and associate editor of several Russian, German and English medical and pharmacological journals, is now in this country, without a position, and in real distress. He is most anxious to find a place in some American university or medical school. His special lines of work are physiology, biochemistry and pharmacology. He has also worked in therapeutics and surgery and analyses of water, foods and medicines. He has an offer of a position in a European university, but is unable to find means to go to Europe. He would be glad to receive even a temporary position as professor, lecturer or laboratory worker.

I have written to the heads of several American universities on behalf of Dr. Boldyreff, but his need is so urgent that there is no longer time for me to continue, by correspondence, the rounds of our institutions. Hence I take this means of calling the attention of university and medical school authorities to what seems to me an admirable opportunity not only to obtain the services of an unusually competent physiologist and pharmacologist, but to save a scientific man of merit from utter depair and whatever its consequences may be.

Vernon Kellogg

National Research Council,
Washington, D. C.

SCIENTIFIC BOOKS

Aus meinem Lieben. Von Emil Fischer. Verlag von Julius Springer, Berlin. 201 pages. 3 figs. Price $2 (about).

Fischer wrote this biographical sketch while recuperating from the "flu." "Geschrieben in dem Unglücksjahre 1918," he writes; and this sentence gives us an idea of what Germany's downfall meant to Germany's greatest chemist. The sketch is an incomplete autobiography; he died in the midst of writing it; but it gives us a very intimate and, to me, fascinating picture of one of the great ones in our field. Not much is said of the chemistry of the sugars, fats and purines, but very much is said of the laboratories in which the chemistry of these substances was elucidated, and very much more is said of the men, aside from Fischer, who were active in these laboratories. With this book in our hands we need not cross the ocean to know all about Munich, Strassburg, Erlangen, Würzburg and Berlin. Noteworthy pen pictures of Fischer's intimates, such as Baeyer and Victor Meyer, are also given us.

Two paragraphs in the book that are of peculiar interest to Americans must receive comment here. We shall make a free translation of both these paragraphs:

"One day an American professor of physiology made his appearance. A rich man had entrusted some money to him with the object of founding a university in Worcester, U. S. A. The professor had the rather romantic notion of filling an entire ship with European professors, assistants, apparatus, chemicals, etc., and bringing the ship and baggage to America. He opened his conversation with me by asking me whether I would be willing to accompany him to America, there to become one of the professors at the new institution. I was too amazed to reply, and thought the whole thing a huge joke until he very carefully and very earnestly outlined his entire plan to me. He proved to be a worthy gentleman, and had much of interest to tell me.

"Soon after this an American lady, 'Miss Helene Abott,' appeared on the scene. A personal attendant who accompanied her proved to be a negress. The lady wanted to enroll as a student, and was quite astounded to find that women were not admitted to the courses. I showed her around the laboratory and introduced her to the younger men, Knorr, Wislicenus and Tafel. Her intelligent comment showed that she possessed a sound theoretical background. After her departure the discussion arose among us as to whether we ought to approach the university senate so as to get the necessary permission to allow the girl to work in the laboratory. One or two individuals were very much for her, but it did seem to the rest that the introduction of the female element into the laboratory would disturb the otherwise harmonious surroundings. Since the majority ruled against her, I wrote her to that effect. Her letter in reply was courteous, but it did not lack energy. She commented rather severely upon the backwardness of Germany in preventing women from getting a higher education."

The book is a treasure "for those who like that kind of thing." Can he call himself a chemist who does not?

Benjamin Harrow

NOTES ON METEOROLOGY AND CLIMATOLOGY

A NEW AEROLOGICAL SUMMARY

For many years, the free air has been recognized as the abode of many interesting phenomena, and much information has been gained concerning the distribution of the meteorological elements above the earth's surface. But, in the United States, with the two exceptions of the Blue Hill Observatory, associated with Harvard College, and the Mount Weather Observatory, maintained for about seven years by the United States Weather Bureau, there had been only sporadic efforts at upper-air investigation previous to the World War.

Free-air data stand in close relation to aeronautical activities, but their usefulness is by no means so restricted. The relation between surface weather and conditions in the free air is one that is coming to be recognized by the weather forecaster to an increasing degree, although the lack of aerological stations is a serious obstacle to a comprehensive correlative knowledge of these conditions. It is necessary, therefore, to extend, as rapidly as possible, the network of aerological stations in the

United States, and to summarize and publish the accumulated data at such intervals as seem convenient. In this way, we need not sit idly awaiting that golden day when we may trace upon the daily chart the coursing of the air streams above our country, but may study the results of observations thus far obtained.

The Aerological Division of the Weather Bureau, Mr. W. R. Gregg in charge, has recently summarized and published the results of observations at the several kite stations of the Weather Bureau, under the title "An Aerological Survey of the United States, Part I. Results of observations by means of kites.[1]

In addition to the summarizing of data, a useful contribution has been made in the portion dealing with the "standard atmosphere." The "standard atmosphere" is a term which has come into general use among aeronautical engineers and artillerists, and denotes the general or average condition of the atmosphere with respect to temperature, pressure, and density, to as great heights as are employed in the several fields. As far as aviation is concerned, there is a relatively large amount of data available for the maximum height at which flying is likely to occur, but the great maximum ordinates employed in ballistics require a knowledge of conditions to much greater heights.

It is true that at no time does the standard atmosphere exist, but it does afford at all times a standard from which the departures will be quite small. Several plans have been offered in various countries to satisfy the need for such an average atmosphere, as, for example, the "isothermal atmosphere." But, owing to the dependence of atmospheric pressure and density upon the vertical distribution of temperature, and the importance of the temperature factor in power production calculations with reference to air-craft engines, as well as in the design of air-craft instruments, it has been thought best to base the standard atmosphere upon the standard lapse rate of temperature.

Up to 10 kilometers, Toussaint's formula,

$$T = 15 - 0.0065Z,$$

in which T is the temperature in degrees, Centigrade, and Z the altitude in meters, holds for the mean annual values, and is very satisfactory, providing, as Mr. Gregg says, "one set is deemed sufficient for use throughout the year." This formula has been adopted in France, Italy and England. Where values are needed for both winter and summer, new tables have been provided which will be more satisfactory than Toussaint's formula.

It happens that the aeronautical research stations and artillery proving grounds of the army and navy are all within three degrees of latitude 40° N. Moreover, three of the Weather Bureau kite stations are equally close to this parallel, and from these three stations, means have been computed up to five kilometers. Above five kilometers, sounding balloon data obtained at St. Louis (1904-1907) and at Fort Omaha (1911 and 1914) have been used. From the base of the stratosphere (about twelve kilometers) up to twenty kilometers, the greatest altitude considered, a constant temperature of —55° C. has been used. The pressures for the various levels were then computed by means of the hypsometric formula, making proper allowance for the water vapor content of the air and the variation of gravity with altitude and latitude.

The discussion of the standard atmosphere appears in both the *Aerological Survey* and in Report No. 147 of the National Advisory Committee for Aeronautics,[2] the latter being in

[1] *Monthly Weather Review Supplement No. 20.* Copies of this *Supplement* may be obtained from the superintendent of documents, Government Printing Office, Washington, D. C., at 25 cents each. Mr. Gregg has made a very full abstract of this work and published it in the *Monthly Weather Review* for May, 1922. Reprints of this abstract may be obtained gratis upon application to the chief of the Weather Bureau, Washington, D. C. It is believed that this abstract will satisfy the needs of all those who have an academic or popular interest in the work. Many of the charts are reproduced, but the tables are omitted and the discussion of the standard atmosphere is very much condensed.

[2] Gregg, Willis Ray: "Standard Atmosphere." 11 pp., 4 figs., 6 tables. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at five cents each.

somewhat greater detail than the former. These publications bring together the best data available approximately representative of latitude 40° in central and eastern United States; they carry the values to altitudes that are much higher than aviation will ever need, and which will only be exceeded by the ordinates of the most extraordinary trajectories in artillery practice.

Turning again to the *Survey*, we find that the information is conveyed largely by charts and tables. The former present the matter as a whole, showing the vertical and geographical distribution of the several meteorological elements over the entire central and eastern United States. The latter are more precise, and are so conveniently arranged that the basic computational material for innumerable aerological studies may be found there awaiting the student. The text is brief, but clear and cogent, and calls attention to the significant features of the "survey."

The summary is based not only upon the kite stations of the Weather Bureau at present operating (Due West, S. C., excepted, since this station has been in operation only about a year and a half) but also upon the records of the Blue Hill Observatory and the Mount Weather Observatory. Thus data from eight aerological stations fairly well distributed, whose records vary from about two to seven years, have formed the basis of the survey.

The author shows that the values based upon a five-year record do not vary to any significant extent from those based upon a three-year record. As one might expect, the differences between the averages of the three and five-year record

> . . . are greatest at or near the surface, where they amount in a few cases to 2° C., in temperature, 1 mb. in barometric pressure and vapor pressure, and 10 per cent. in relative humidity. Differences in density are in no case significant. The seasonal means of all elements naturally show better agreement than the monthly means, and the annual means for the shorter and longer period are almost identical. It is thus evident that for the determination of *normal* values, particularly those for the months, a longer series of observations is necessary than that upon which the present summary is based.

Nevertheless, it is deemed satisfactory, for practical purposes, to regard the present means as normals. The author explains further that a longer record is necessary for the northern than for the southern stations, for the winter than for the summer (owing to the greater variability at the colder stations and in the colder season), and at lower than at higher altitudes above the surface. Thus, while 20 to 40 years are desirable lengths of record for surface data, a much shorter period is necessary for the upper levels.

To attempt to present in abstract the many striking and interesting features of the numerous diagrams would be impossible, owing to the concise presentation in the original. The large field of information is indicated by the following topics selected from the legends: Seasonal average temperatures, relative humidities, vapor pressures, for each station from the surface to about five kilometers; geographical distribution of mean summer and winter and annual barometric pressures, temperatures, relative humidity, vapor pressure, density and resultant winds; means seasonal wind velocities and the percentage frequency of different wind directions. All of these data extend from the surface to levels three to five kilometers above sea-level.

The study of aerological data is two-fold, embracing average conditions and current data. This publication from the Aerological Division of the Weather Bureau forms an admirable contribution to the former field. Such contributions form a setting for the study of current data. But, in spite of the resounding challenge of the upper air to the forecaster, the adequate and complete application of current aerological data must await the extension and amplification of the aerological *réseau*.

C. LeRoy Meisinger

Washington, D. C.

SPECIAL ARTICLES

DEFICIENCY OF ATMOSPHERIC DUST IN COAL

In connection with studies in eolian sedimentation the writer recently has become interested in an apparent discrepancy among (1) the rate of deposition of atmospheric dust, (2) the amount of ash in coal and (3) the rate of accumulation of vegetation leading to the formation of coal. To the casual observer it appears that there is not enough mineral matter in average coal to allow for the amount of atmospheric dust which would be deposited with the vegetation in the time ordinarily assumed to be required for the accumulation of vegetable matter in coal.

From everyday observation the universal presence of atmospheric dust is apparent. The work of Free,[1] Huntington,[2] Reid[3] and others emphasizes the quantity as being much greater than commonly supposed. However, it is not the amount of dust *in* the air, but the amount that is *caught* in standing water or by vegetation that is significant in the present connection.

An average of the analyses of ash content for representative coals of the United States given by M. R. Campbell[4] shows the following:

GRADE OF COAL	PERCENTAGE OF ASH
Lignite	8.25
Sub-bituminous	7.8
Bituminous	8.7
Semi-bituminous	8.7
Semi-anthracite	11.75
Anthracite	13.7

The last two averages are based only upon a few analyses.

It has been stated in text-books that about 9,000 years is required for the accumulation of sufficient vegetable matter to make one foot of bituminous coal. There is no reason to believe that this estimate is not at least approximately correct.

If dust was deposited from air during the coal-making periods at a rate of 1/1000 inch per year—which at the present does not seem excessive—9 inches of dust would be accumulated during the period of 9,000 years. Consequently, with every foot of bituminous coal there should be 9 inches of atmospheric dust; that is, every foot of average coal would be about 75 per cent. dust. Even 1/10000 inch of dust a year would result in coal with 7½ per cent. dust. And this does not take into account the vegetable mineral matter!

Apparently the problem leads to three questions: (1) Is the importance of dust grossly exaggerated? (2) Has the time so commonly assigned to the accumulation of a foot of coal been overestimated? (3) Were the areas which would serve as sources for dust during the coal-forming periods—and especially the Pennsylvanian—exceedingly restricted? The articles cited above emphasize the presence of dust in a way to induce the reader to believe that the importance of atmospheric dust has been overlooked rather than overestimated. If the time allotted for coal formation is fairly accurate, we would be led to believe that the sources and perhaps the means of transportation of dust were very much restricted and that the current evidence for a fairly moist, uniform climate on a land surface heavily covered by vegetation and restricted in area, becomes better established.

WALDO S. GLOCK
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[1] Free, E. E.: "Movement of Soil Material by the Wind," U. S. Dept. of Agriculture, *Bull.* 68.

[2] Huntington, E.: "The Pulse of Asia."

[3] Reid, Clement: "Dust and Soils," *Geol. Mag.*, N. S., December, III, Vol. I, 1884, p. 165.

[4] Campbell, M. R.: "The Coal Fields of the United States." General Introduction, *U. S. Geol. Survey, Professional Paper* 100-A.

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF ORGANIC CHEMISTRY
H. T. Clarke, *chairman*
Frank C. Whitmore, *secretary*

The selective activation of alumina for decarboxylation or dehydration: HOMER ADKINS. In seeking experimental verification of the idea that the activity of a catalyst for an organic reaction in a heterogeneous system is conditioned by the magnitude of the distance between the atomic nuclei of the solid catalyst, five distinct kinds of alumina have been prepared from the aluminum alkoxides, aluminum hydroxide and hydrated alumina. It has been shown that the size and shape of the alkoxyl group is a determining factor in the relative extent to which decarboxylation or dehydration is induced in esters, alcohols and acids by the alumina prepared from the solid alkoxides. An increase in "molecular porosity," *i. e.*, of the distances between aluminum atoms in the solid, is favorable to decarboxylation and unfavorable to alkene formation.

On the synthesis of thiazolidine and thiazane derivatives: F. B. Dains, R. Q. Brewster, J. S. Blair and W. C. Thompson. The present report is part of a larger investigation. The immediate object of this part of the work was to devise methods for the synthesis of thiazolidine and thiazane derivatives of known structure. This was accomplished as follows: (1) The addition of mustard oils, RNCS, to aryl-allylamines, $RNHC_3H_5$, formed diaryl-allyl-thioureas, which by the action of acids were converted to 2-aryl-imino-3-aryl-5-methyl thiazolidines. (2) Aryl-N-ethanols, $RNHCH_2CH_2OH$, gave with arylisothiocyanates and cyanates ureas which condensed easily to thiazolidines and oxazolidines. (3) From aryl-N-propanols and mustard oils were obtained thioureas and then thiazanes, $SC(NR)NRCH_2CH_2CH_2$. (4) Alpha-arylamino-beta-hydroxl-gamma-chloro-propane combined with aryl mustard oils to give 5-hydroxythiazanes.

Urethanes from chlorine-substituted secondary and tertiary alcohols: Lester Yoder. Certain tertiary alcohols, for example, trichlorotertiary butyl alcohol, which do not react directly with phosgene, give the chlorocarbonates when the dilute solution in benzene is treated with sodium and then with phosgene. The products react readily with ammonia and with aniline chloral condenses with glycerol to form a substituted 1, 3-dioxole. The readiness with which this product reacts with phosgene indicates a primary rather than a secondary hydroxyl, hence the assumption of a five-membered rather than a six-membered ring. This dioxole derivative and some of the chlorine substituted urethanes prepared were found to have hypnotic properties.

Gamma-chloropropyl urethanes and a synthesis of the 1, 3-oxazine ring: Arthur W. Dox and Lester Yoder. Gamma-chloropropyl alcohol reacts readily with phosgene to form a chlorocarbonate, and the latter reacts ammonia and with aniline to form the carbamate and the carbanilate respectively. Removal of hydrochloric acid from gamma-chloropropyl carbanilate results in the formation of the six-membered 1, 3-oxazine ring. This reaction is analogous to that studied by Otto and by Johnson and Langley in which the beta-halogen alkyl carbanilates lose hydrochloric acid and form the five-membered 1, 3-oxazole ring.

Removal of iodine from aromatic iodo compounds, and its bearing on electromerism: Ben H. Nicolet and Reuben B. Sandin. Several new derivatives of 2-iodo-4-aminotoluene are described. With stannous chloride and hydrochloric acid, iodine is removed from m-iodoamino derivatives, as well as from o-iodoamino compounds; but the rate of removal is some hundreds of times slower. The results are explained on the basis of a one-sided reaction taking place on a mixture of electromers. The behavior of such a mixture is discussed.

The spontaneous decomposition of unsaturated aliphatic iodochlorides: L. B. Howell. Previous work (*J. A. C. S.*, 42, 997-9) upon iodochloride-1, 2-dichloro-2-iodoethylene and iodochloride-2-chloroethylene has shown that their spontaneous decompositiion is not accompanied by loss of chlorine (*cf. Ann.* 369, 135). Further investigation has shown that the expected shift of the 2 Cl atoms from the group $—ICl_2$ to the double bond is not the only change involved. Thus, when $CHCl = CHICl_2$ decomposes the products include $C_2H_2I_2Cl_2$ and $C_2H_2Cl_4$ as well as $C_2H_2Cl_3I$ (in addition to iodine monochloride and free iodine). Evidently either iodine chloride or chlorine may add to the residue —CHCL—CHCL— or iodine may be entirely replaced and the residue chlorinated. The compound $Cl_2ICCl{=}CClI$ upon decomposition gives $C_2Cl_2I_2$, C_2ClI_3 and what is apparently a constant boiling mixture of C_2Cl_6 and C_2Cl_3I. Constants for the new halo-ethanes and ethenes have been determined.

The chlorination of 2-amino-p-cymene: A. S. Wheeler and J. V. Giles. p-Cymene was obtained from spruce turpentine. It was nitrated at 0° and reduced. The acetyl derivative was chlorinated at room temperature in carbon tetrachloride solution. The product contains one chlorine. This is in position 5 as shown by its conversion into 2, 5-dichloro-terephthalic acid. Salts of the chloro aminocymene were prepared. By diazo reaction a new chloro carvacrol was prepared. The amino group was also replaced by the carboxyl group, yielding a new benzoic acid. A new series of dyes was prepared by coupling with the following: phenol, resorcinol, salicylic acid, alpha naphthol, beta naphthol, naphthol-2-sulfonic acid, 1-naphthol-4-sulfonic acid, 2-naphthol-7-sulfonic acid. A variety of colors was obtained, some of great brilliancy. The amino chlorocymene was also coupled with itself, forming a neutral compound. By oxidation a new cuminic acid was obtained.

The catalytic preparation of divinylacetylene: J. A. Nieuwland. Acetylene is passed into a solution of cuprous chloride (three parts), ammonius chloride (one part) and water (one part). The absorption takes place indefinitely, and when subsequently distilled, a mixture of oils comes over. The one which distills over at 54° C. is presumably vinylacetylene of the formula, $CH_2{=}CH{-}C{\equiv}CH$. Between 75° and 95° a highly refractive oil, of formula C_6H_6, supposed to be divinylacetylene, comes over. About one kilo of the above liquid is used in each flask. After repeated distillations the mixture continues to absorb the gas even for years without deterioration of the catalyst. About 80 to 110 g. of product are obtained at each distillation. The divinylacetylene forms stable tetra and octobromides which crystallize well from alcohol and have definite melting points. When allowed to stand even in sealed tubes the oil slowly changes to a gel and finally to a solid which is extremely explosive. If the original substance is put back into the copper mixture mentioned above it can be kept indefinitely for use when needed by distilling it off at a temperature not exceeding 13° C. When cupric chloride is added to the mixture dichloroethylene is formed, and no hydrocarbons.

The application of the Friedel and Craft reaction to non-benzenoid compounds: JAMES F. NORRIS and RAM PRASAD. Continuation of previous work showed that benzoyl chloride condenses, under the influence of aluminium chloride, with ethylene, propylene, butylene, isobutylene, trimethylethylene and isopropylethylene. The product of the reaction in each case was the unsaturated ketone formed as the result of the replacement of one hydrogen atom in the hydrocarbon by a benzoyl group. Hydrogen chloride addition products of the unsaturated ketones were also formed. Condensation was also effected between benzoyl chloride and malonic ester and diisopropyl. The study of the application of the reaction to saturated hydrocarbons is being continued.

Some condensations with olefines. A contribution to our knowledge of the Friedel-Craft reaction: C. E. BOORD and R. S. HANSON. Olefines condense in the presence of anhydrous aluminum or ferric chloride to form oily addition products. These addition products are very reactive, undergoing the following series of transformation: (1) With benzene they form intermediate condensation products which upon hydrolysis yield alkyl benzenes; (2) with phenol they form intermediate condensation products which upon hydrolysis yield alkyl phenols; (3) by direct hydrolysis by cold concentrated hydrochloric acid they yield alkyl chlorides; (4) with acetyl chloride they yield chloro and unsaturated ketones. Ethylene, butylene and amylene give similar results. A scheme of reactions is given as a simple explanation of the above reactions as well as of the Friedel-Craft synthesis of hydrocarbons. The explanation offered agrees perfectly with that given by Steele for the formation of aromatic ketones by the Friedel-Craft reaction.

The action of titanium tetrachloride upon certain organic compounds: JOSEPH F. HASKINS and WILLIAM MCPHERSON. The work described in this paper is the outgrowth of an attempt to prepare an optically active compound of titanium. In the course of this work it was found necessary to study more in detail the fundamental reactions between titanium tetrachloride and representatives of the important groups of organic compounds. The paper gives the results of some of these experiments. Among other reactions, it was found that titanium tetrachloride could be substituted for aluminum chloride with advantage in the synthesis of certain compounds by the Friedel-Craft reaction. For example, benzoyl chloride and benzene in the presence of titanium tetrachloride react to give benzophenone a reaction which serves as a good laboratory method for preparing this substance. The work is being continued.

A comparison of ferric and aluminum chlorides in their action on chloral, bromal and organic compounds: G. B. FRANKFORTER and E. E. HARRIS. A continuation of the work of Frankforter and Kritchevsky. The two chlorides have been compared in their condensing properties, using chloral and bromal with the phenolic ethers and other organic compounds. Among the most important compounds prepared are the following: Diphenetyltribromoethane, tetrabromodiphenetyltetrabromoethane, diphenetyldibromoethylene, diphenetyldiethoxythylene, diphenetyldiacetoacetylethylene, dibromophenetyldibromoethylene, tetraphenetyldimethylacetylene. The properties of these compounds have been carefully worked out in addition to the comparison of the action of the two chlorides in their preparation.

Optically active dyes: A. W. INGERSOLL and ROGER ADAMS. A study of the action of optically active dyes on fibers should throw light on the mechanism of dyeing. The preliminary work of which this is a report has involved the study of an easy method for preparing pairs of active dyes. An extremely convenient way has been found by first synthesizing and resolving into optically active isomers certain amino acids, in particular phenyl amino acetic acid. These amino acids can be converted into dyes by the following general reactions which take place very satisfactorily in the laboratory:

$$\frac{\text{R-CH-CO}_2\text{H}}{\text{NH}_2} \rightarrow \frac{\text{R-CH-CO}_2\text{H}}{\text{NHCOC}_6\text{H}_4\text{NO}_2\text{(p)}} \rightarrow$$

$$\frac{\text{R-CH-CO}_2\text{H}}{\text{NHC}_6\text{H}_4\text{NH}_2} \rightarrow \frac{\text{R-CH-CO}_2\text{H}}{\text{NHCOC}_6\text{H}_4\text{N}_2\text{Cl}} \rightarrow$$

Dyes.

The oxidation of lactose, d-glucose and d-galactose with potassium permanganate: C. A. BUEHLER and W. L. EVANS. (*a*) These carbohydrates are oxidized by permanganate solutions to carbon dioxide, acetic acid and oxalic acid, the presence of the latter being determined by the concentration of the alkali present and also by the time of the reaction. The oxalic acid production shows a maximum point and the carbon dioxide a minimum point. (*b*) Mixtures of d-glucose and d-galactose equivalent to a lactose solution of a given concentration are not oxidized to the same amounts of the reaction products as the disaccharide at the same concentration of alkali. (*c*) The amounts of the reaction products obtained from the two hexoses at 25° and 50° are not the same, while at 75° they are nearly equal.

Some relationships of the work on halogenated phenols: W. H. HUNTER. The work on halogenated phenols at the University of Minnesota gives promise of giving information on the following problems: (1) Substitutes in phenols; (2) oxidation of phenols; (3) reactions of unsaturated radio; (4) rearrangements related to the benzidine rearrangement; (5) relation between para (and ortho) groupings.

A method of measuring the reactivity of the halogen atoms in organic chlorides: J. B. CONANT, W. R. KIRNER and A. C. GLENNIE. In order to compare the reactivity of a series of chlorides of the types RCH_2Cl, $R(CH_2)_2Cl$ and $R(CH_2)_3Cl$, it is necessary to have some reaction whose speed can easily be measured and which will not be attended by side reactions. Alkaline reagents and nitrogen compounds are unsuitable, as they cause the formation of unsaturated and cyclic compounds. Potassium iodide in acetone solution has been found satisfactory. The reaction giving the corresponding organic iodide proceeds smoothly. The amount of inorganic iodide used up can be determined by titration. The results show that the reaction is bimolecular. The temperature coefficient is about normal. The values so far obtained indicate the following relative reactivities at 25° as compared to butyl chloride: BuCl 1.00, $MeS(CH_2)_2Cl$ 1.64, $MeS(CH_2)_3Cl$ 4.5, $PhCH_2Cl$ 149, $NO_2C_6H_4CH_2Cl$ 11,800, $PhCOCH_2Cl$ 33,200.

Molecular structure: Benzene, cyclohexane and naphthalene: JARED KIRTLAND MORSE. Molecular space is considered discontinuous is such a way that the ratio of the distances between any three points on a straight line is rational. For a given molecule the number of these point positions is restricted by the valency condition that all saturated atoms (carbon and above in atomic number) have eight valency electrons equidistant from the nucleus. By applying these criteria, models have been constructed for cyclohexane, benzene and naphthalene, from which can be derived the geometric properties of the dynamic isomers, the relations between chemically related compounds and the mechanism by which molecules form crystal lattices. For naphthalene the crystal lattice agrees with Bragg's X-ray measurements but not with his molecular theory. Cyclohexane has a simple cubic lattice containing one molecule, benzene a centered orthorhombic lattice containing two molecules. A method for calculating the lattice constants, axial ratios and densities of solid benzene and cyclohexane from the density and crystallographic data for naphthalene is given. Cyclohexane: Calc.—lattice constant 5.697×10^{-8} cm., density (solid) 0.75. Obs. density (liquid) Young 10.7° 0.78715 M.P. 4.7°. Benzene: Calculated; lattice constants 5.697×10^{-8} cm.; 6.996×10^{-8} cm.; 6.137×10^{-8} cm.; density 1.0531; axial ratios 0.814 : 1 : 0.877. Observed; axial ratios Groth 0.799 : 1 : 0.891; density Richards 1.0513. Calculated diameter spherical benzene gas molecule 6.86×10^{-8} cm. Effective diameter on collision from kinetic theory using Schumann's viscosity measurements vapor 20°, 6.78×10^{-8} cm.

Some derivatives of the lactone produced by condensing cyclo-hexene oxide with malonic ester: E. C. KENDALL and A. E. OSTERBERG. Tetrahydro benzene adds hypochlorous acid to form ortho-chloro-cyclohexanol. This with sodium hydroxide forms cyclo-hexene oxide, which condenses with sodium malonic ester in the same way that ethylene oxide does. The resulting lactone reacts with additional sodium ethylate giving a product which will react with alkyl halides. The properties of the resulting compounds as well as those of certain nitrogen derivatives obtained from the lactones and ammonia have been studied.

Derivatives of 2,4-dinitrobenzaldehyde: T. B. DOWNEY with ALEXANDER LOWY. 2,4-Dinitrobenzaldehyde was condensed with a number of aromatic amines, phenols and their derivatives, giving monomolecular and dimolecular condensation products. Monomolecular condensations were effected with tolidine (also addition product), p-aminoazobenzene, chloroanilines, etc. Dimolecular condensations were effected with phenol, o-chlorophenol, resorcinol, bromoresorcinol, guaiacol, dimethylaniline, diethylaniline, etc. Some of the products are dyes and indicators.

The quantitative determination of acetic anhydride: G. C. Spencer. The proposed method is based upon the action of acetic anhydride and aniline in cold chloroform. An equivalent amount of acetanilide forms. Slight amounts of alcohol and water as found in U. S. P. chloroform do not interfere. The first attempts were made to separate the acetanilide by washing the chloroform solution with dilute sulfuric acid to remove aniline separating the chloroform solution, and evaporating to dryness in a tared beaker. The gravimetric method was unsatisfactory. The method adopted was to hydrolyze the residual acetanilide with 10 per cent. sulfuric acid and titrate the resulting aniline sulfate with half-normal potassium bromate-bromide solution. Results satisfactory for both high and low concentrations of acetic anhydride.

The estimation of aliphatic nitrate esters in the presence of certain nitro-aromatic compounds: Wilbert J. Huff and Richard D. Leitch.

On the basis for the physiological activity of certain onium compounds. I. Nitrogen derivatives: R. R. Renshaw and J. C. Ware. The possible bases for the different types of physiological action of the simple and the substituted tetra-alkyl ammonium compounds are briefly considered. The following new substances are described: Iodo methyl acetate, acetyl formocholine salts, methoxymethyl dimethyl amine, beta-dichloroarsine-ethyl trimethyl ammonium chloride, beta-arsenous oxide-ethyl trimethyl ammonium chloride. Improved methods for the preparation of formocholine and certain other choline derivatives are given.

Deaminization of methyl-cis-3-amino-1,212-trimethyl pentanoate: Glenn S. Skinner. The decomposition of this ester with nitrous acid has been carried out on a large scale. Reaction products are formed in the following proportions: Methyl esters of unsaturated acids, 62 per cent.; methyl esters of hydroxy acids, 36 per cent.; methyl esters of chloroacids, 2 per cent. The unsaturated ester upon saponification gave lauronolic acid which was identified by conversion to the bromolactone. Three crystalline hydroxy acids have been isolated from the saponification products of the various fractions obtained by distillation under diminished pressure. One of these acids has a tertiary beta-hydroxyl and is identical with the acid of M. P. 101-2°, obtained by the decomposition of the methyl ester of the trans-isomeric amino acid. A second hydroxy acid of M. P. 121° has a secondary hydroxyl as shown by oxidation with Beckmann's chromic acid mixture. The third hydroxy acid of M. P. 208-10° also has a secondary hydroxyl and is optically inactive. d-Ciscamphonolic acid could not be isolated. No ether acid was formed whereas the methyl ether d-ciscamphonolic acid constitutes 13 per cent. of the decomposition product of the methyl ester of the trans isomeric amino acid.

Ammono formaldehydes: Edward C. Franklin. The ammonia analog of formaldehyde, compound of the formula $CH_2{=}N{-}CH_2{-}N{=}CH_2$, is only known in the form of its dimer, hexamethylene tetramine. The methods of formation and the properties of hexamethylenetetramine are in harmony with the view that it is a polymeric form of an ammono formaldehyde. Hydrocyanic acid, represented by the form HCN, is also to be looked upon as an ammono formaldehyde. It undergoes polymerizations and condensations, reacts with acid sulfites and hydroxylamine, and otherwise behaves in a manner closely resembling the well-known behavior of ordinary formaldehyde.

International numberings of ring complexes: Austin M. Patterson and Carleton E. Curran. There is at present no uniform system for numbering parent cyclic compounds. The authors have drawn up a simple set of rules for such numbering, with the avowed purpose of preserving as many as possible of the accepted numberings, while achieving consistency. About three fourths of the numberings used in Richter's "Lexikon," Meyer and Jacobson's "Lehrbuch," and the *Chemical Abstracts* indexes conform to the proposed rules. The matter has been taken up with the proper committees of foreign chemists with encouraging results. If their cooperation can be secured it is proposed to publish a classified collection of known ring complexes, the number of which now approaches a thousand.

Steric hindrance in the migration of acetyl: L. Chas. Raiford and Chas. M. Woolfolk. In previous work (*J. A. C. S.*, 41, 2068) one of us has shown that when an ortho acetylaminophenol is benzoylated by the Schotten-Baumann reaction, benzoyl goes to nitrogen, while the acetyl shifts to oxyxgen. In further study of this behavior the present work was done to learn whether this rearrangement would be prevented by the presence of bromine atoms adjacent to the reacting groups. Acetyl-benzoyl derivatives were prepared from 2-amino-3, 6-dibromo-4-methylphenol, 2-amino-3, 5, 6-tribromo-4-methylphenol, and 2-amino-3, 4, 5-tribromo-6-methylphenol. In every case the migration was observed, which seems to indicate that the bromine atoms cause no hindrance. The amino cresols used in this work were secured through the nitration of the corresponding brominated ortho and para cresols. When tetrabromo-o-cresol was nitrated by Zincke's method (*J. Pr. Ch.*, (2) 61, 564) we obtained two isomeric mononitrotribromo-o-cresols, in which we were able to prove that the hydroxyl and nitro radicals occupied ortho and para relationships, respectively, in the two compounds. In this nitration Zincke was able to isolate only one of these substances—the ortho product.

The hydrolysis of alkyl sulfates. II: RUSSELL MORGAN and H. F. LEWIS. The hydrolysis of dimethyl sulfate under the influence of acids, alkalis and salts is described and the following conclusions are drawn: (1) The higher the dimethyl sulfate : water ratio in the water hydrolysis, the more rapid the hydrolysis; (2) strong acids in low concentration increase the rate of hydrolysis, but in high concentration retard it; (3) the tendency in alkaline solution is for the second alkyl to come off less easily. No difference between NaOH and KOH in low concentration; (4) acetic acid greatly depresses hydrolysis; (5) salts depress the rate of hydrolysis, even preventing the splitting off of the first group; (6) the only substances acting as positive catalysts are the dilute mineral acids, a large number of which have been studied.

The interaction of primary aliphatic alcohols and beta-gamma-dibromopropyl-thiocarbimide: RAYMOND M. HANN. Primary aliphatic alcohols react with this substance to form 2-hydroxy-5-bromomethyl-thiazoline,

$$\begin{array}{l} BrCH_2\text{—}CH\text{—}S \\ \quad CH_2\text{—}N{=}C\text{—}OH \end{array}.$$

This result is contrary to that assumed by Dixon and also to the correction of Dixon's work by Gabriel, who assumed that the product was

$$\begin{array}{l} BrCH_2\text{—}CH\text{—}S \\ \quad CH_2\text{—}N{=}C\text{—}OEt \end{array}.$$

Aluminum arylamines: M. L. CROSSLEY. Aluminum reacts with primary and secondary arylamines producing aluminum arylamines and hydrogen. Tertiary amines do not react with aluminum. Mixtures of the three types of amines can be separated by refluxing with aluminum, distilling off the tertiary amine and recovering the primary and secondary amines from the residue. The aluminum compounds are readily decomposed by water and alcohol, giving the original amines, aluminum hydroxides and small quantities of secondary products such as diphenylamine. The aluminum compound is very reactive and makes possible the introduction of alkyl and aryl groups under atmospheric pressure.

The action of nitrogen trichloride upon unsaturated hydrocarbons: G. H. COLEMAN and H. P. HOWELLS. Nitrogen trichloride reacts with amylene in carbon tetrachloride to form ammonium chloride and nitrogen gas. No more than traces of other nitrogen compounds are obtained. With butylene nitrogen forms, in addition to ammonium chloride and nitrogen, a n-chloroamine in about 20 per cent. yield. When this product is shaken with concentrated hydrochloric acid the chlorine atoms attached to nitrogen are replaced by hydrogen. The resulting amine still contains chlorine attached to carbon. With propylene the reaction takes place more slowly but the products are similar to those from butylene. A possible explanation of the failure of amine formation in case of amylene is offered.

The equilibrium between benzoin and benzaldehyde: ERNEST ANDERSON, R. A. JACOBSON and M. J. STUTZMAN. The benzoin condensation is found to be reversible. An equilibrium is reached between benzaldehyde and benzoin when either substance is dissolved in alcoholic sodium cyanide. Both pure substances can be recovered from such solutions. The equilibrium is of the general type A = 2B. The amounts of benzaldehyde and benzoin present at equilibrium in various mixtures check closely with the amounts calculated from the equilibrium constant.

Di-beta-hydroxyethyl aniline and some of its derivatives: F. W. UPSON and D. W. MCLAREN. This substance has been obtained in 70 per cent. yield by refluxing one mol. of aniline with three mols. of ethylene chlorohydrine in the presence of 30 per cent. aqueous sodium hydroxide. The product is obtained by ether extraction and fractional distillation of the extract under reduced pressure. Phenyl morpholine has been obtained by a similar process from beta-beta-dichloro diethyl ether. Di-beta hydroxyethyl aniline and phomo-morpholine have been coupled with diazotized sulfanilic acid giving color substances related to methyl orange.

The preparation of pure ortho and para xylenes: H. T. CLARKE and E. R. TAYLOR. The literature dealing with the separation of the xylenes is contradictory and misleading. It has been found that fractional distillation, selective sulfonation, crystallization of the sulfonic acids and selective hydrolysis of the xylene sulfonic acids all tend to bring about a partial separation of the three xylenes present in coal tar xylene, but that none of these processes alone is entirely suitable for the isolation of the ortho and para derivatives. A satisfactory procedure is described in which the above processes are combined.

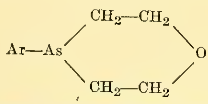
The preparation of tetramethylene bromide: C. S. Marvel and A. L. Tanenbaum. Tetramethylene bromide is a research chemical often needed. Several methods have been devised for its synthesis, but none of these is satisfactory. It has been found possible to obtain the substance easily by the following reactions: $Br(CH_2)_3Br + C_6H_5ONa$ — $Ph\text{-}O(CH_2)_3Br$, + $NaCN + EtOH + H_2SO_4$ — $Ph\text{-}O(CH_2)_3CO_2Et$, + $Na + EtOH$ — $Ph\text{-}O(CH_2)_3CH_2OH$, + HBr — $Ph\text{-}O(CH_2)_3CH_2Br + Br(CH_2)_4Br$. The yields in the steps are 80, 90, 80, 65, 40 and 40 per cent. respectively. As will be noticed the yields are good in every step except the last, where equal amounts of phenoxybutyl bromide and tetramethylene bromide are obtained. The former can be converted into the latter by prolonged treatment with hydrobromic acid. Hydriodic acid reacts like hydrobromic acid, giving about the same yields of the iodine compounds.

Some derivatives of ethylbenzene: F. W. Sullivan, Jr. Ethylbenzene was prepared in good yield by the action of ethylene on benzene in the presence of aluminum trichloride. It was found that chlorine acts on boiling ethylbenzene giving alpha chloroethyl benzene and not the beta compound as is stated in the literature. The corresponding bromide was prepared. Both give phenyl methyl carbinol on hydrolysis. They also give an acetate when boiled with sodium acetate in glacial acetic acid. Styrene is obtained by passing the vapors of chloroethyl benzene over soda lime. The same substance is obtained in quantitative yield when the chloro compound is heated with quinoline. Ethyl benzene gives very good yields of the nitro derivatives when nitrated according to the standard procedure for the nitration of toluene.

The preparation of aromatic alpha hydroxy acids and their esters from the cyanhydrins: G. E. Seil and Is. Kalugai. Seil's method of hydrolysis of the cyanhydrins by means of sulfuric acid dihydrate was used on mandelic nitrile prepared from benzaldehyde. The yield of mandelic acid was 83 per cent. The ethyl ester was prepared by different methods. The isopropyl ester of mandelic acid was synthesized and its properties were determined.

The preparation of methyl red: A. W. Schorger. Methyl red is prepared by diazotizing anthranilic acid and coupling with dimethylaniline, following in general the procedure of Tizard and Winmill. Free methyl red in the form of violet crystals is best obtained by crystallization from acetic acid, the crystals retaining two molecules of the solvent. From the standpoint of ease of crystallization and purity of product, the best procedure is to crystallize from dilute hydrochloric acid, obtaining the hydrochloride of methyl red. The sodium salt has also been prepared and like the analogous compound, methyl orange, is readily soluble in water.

New heterocyclic arsenic compounds: C. S. Palmer. In the presense of two moles of sodium ethylate, one mole of primary arsine condenses with one mole of beta-beta-dichlorodiethyl ether or gamma-gamma-dichlorodipropyl ether to give compounds such as



The products are high-boiling, stable oils. They give the reactions of tertiary arsines, the arsenic readily passing to the pentavalent state by the addition of oxygen, sulfur, halogens, alkyl halides. Chloroplatinates and mercurichlorides are also formed. The above synthesis is a new reaction of primary arsines. Preliminary experiments show that the method can be applied to secondary arsines and to other halides as well as to dihalogenoethers.

Action of arsenious chloride on quinoline: John H. Schmidt. (By title). Carbostyril and a product which preliminary analyses indicate to be tricarbostyril arsonic acid have been prepared by the action of arsenious chloride upon quinoline at comparatively high temperatures. Further investigation of this reaction is in progress.

On the basis for the physiological activity of certain onium compounds. II. Arsenic derivatives: R. R. Renshaw and E. R. Wagner. Several new arsonium compounds are described. Trimethyl arsine dihalides condensed with ethylene and with formaldehyde to form the arsenic analog of neurine and formaldehydo trimethyl arsonium halides respectively.

The behavior of the mercuric salts of carboxylic acids toward heat and the structure of mercuric cyanide: Morris S. Kharasch and

Frederick W. Stavely. The behavior of the mercuric salts of various substituted acetic acids toward heat has been investigated. It has been found that the reaction products depend to a very large extent upon the nature of the substituted groups. In the case of the mercury salts of alkyl substituted acetic acids the mercury either replaces a hydrogen of the alpha carbon atom, or, if there is none available, no reaction takes place (compare, however, the behavior of trichloroacetic acid). In the case of the mercury salts of the phenylated acetic acids the mercury enters the ortho position in the benzene ring. However, upon heating the mercury salts of substituted acetic acids, which lose carbon dioxide upon heating rather easily, a different reaction takes place: the mercury usually taking the place originally occupied by the carboxyl groups. Thus, dimethyl and diethyl acetoacetic acids behave that way. The stability of the various compounds, prepared in the course of this work, towards various reagents has also been studied, and the significance of the tests pointed out.

The action of mercury on certain alkyl iodides and substituted alkyl iodides: J. Louis Maynard. During the present work it has been shown that the direct union of metallic mercury and methyl iodide is not hastened by ultraviolet light but is hastened by a specially arranged arc light. The reaction is preceded by the formation of a small amount of mercurous iodide. If mercurous iodide is used with methyl iodide, methyl mercuric iodide is formed rapidly. The action of metallic mercury is confined almost entirely to methyl iodide. The use of mercurous iodide makes possible the extension of the reaction to higher iodides and even to benzyl iodide. The work is being extended both to a study of the limits of the reaction and of the particular wave lengths which increase the speed of the reaction.

The structure of the compounds from mercuric salts and olefines: Roger Adams, F. L. Roman, W. M. Sperry. Two different general formulas have been suggested for the products of mercury salts and olefines, true addition compounds such as $HOCH_2CH_2HgX$, and molecular compounds such as $CH_2{:}CH_2{:}Hg(OH)X$. The former have been shown to be correct by a study of the action of mercury salts on o-allyl phenols, which give products for which no reasonable "molecular" formulas can be written. o-Allyl phenol reacts with mercuric chloride to form 2-chloromercurimethyl-2, 3-dihydro-benzofuran and hydrochloric acid. Treatment of this product with sodium amalgam gives the corresponding mercuribis compound. Treatment with potassium iodide and iodine gives the corresponding iodomethyl compound which, on reduction, gives 2-methyl-2, 3-dihydrobenzofuran. Allyl amine and mercuric chloride give a substance of the following structure, which also can not be easily explained on the basis of a "molecular" formula:

$$\begin{array}{l} ClHg—CH_2—CH—CH_2NH.HCl— \\ \quad HCl—NH—CH_2—CH—CH_2—HgCl \end{array}$$

The electromotive force of organic compounds: Aldehydes: S. B. Arenson and D. J. Brown.

The polymerization of the amylenes: James F. Norris and J. M. Joubert. The action of various concentrations of sulfuric acid on the five amylenes was studied. Trimethylethylene and unsymmetrical methylethylethylene were the most soluble and the most readily polymerized. In the case of these hydrocarbons no alkyl sulfuric acids were formed. The mechanism of the polymerization appears to consist in the dehydration of the alcohol first formed from the hydrocarbon. Isopropylethylene was the only isomer which was polymerized without previous solution in the acid. The study of the products formed as the result of the decomposition of the ozonides of the polymers led to conclusions as to the structure of the dimers of trimethylethylene and isopropylethylene. Improved methods of preparation of the compounds studied were found.

The relationship between structure and oxidation potential of quinones: J. B. Conant and L. F. Fieser. The oxidation-reduction potential of a number of quinones is being measured in alcoholic hydrochloric acid by a titration method. The results at 25°, expressed on the hydrogen electrode scale for certain typical quinones are: benzoquinone 0.711, 1, 2-naphthoquinone 0.579, 1, 4-naphthoquinone 0.484, phenanthraquinone 0.471, anthraquinone 0.155. Measurements of various derivatives show that substitution of hydrogen by Cl, SO_3H, CO_2H or CO_2R increases the potential, substitution by alkyl lowers it. The effect of substituents is not entirely cumulative as the following values obtained with chloroquinones show: monochloro 0.736, 2, 6-dichloro 0.746, 2, 5-dichloro 0.707, tetrachloro 0.695.

The oxidation of tribromoaniline: W. H. Hunter and A. G. Mayers. The oxidation of 2, 4, 6-tribromoaniline by chromic acid yields almost quantitatively the 2, 4, 6-tribromoanil of 2, 6-dibromquinone. This reaction may be formulated as a benzidine rearrangement, or as a reaction of unsaturated radicals.

The oxidation of d-mannose with potassium permanganate: W. L. Evans and R. A. Crawford. The oxidation of d-mannose with alkaline potassium permanganate at 50° proceeds with the production of carbon dioxide, oxalic acid and acetic acid. The relative amounts of these products depend on the concentration of alkali used. In neutral solutions only carbon dioxide and acetic acid are formed. At low alkalinities, all three are formed, the carbon dioxide falling off rapidly and the oxalic acid rising rapidly with an increase in alkalinity to about 0.15 N, after which carbon dioxide increases slowly and the oxalic acid decreases slowly to 1.0 N alkali. Above this point the relative amounts of carbon dioxide and oxalic acid remain practically constant. Acetic acid remains almost constant over the whole range.

Catalytic ammonolysis of beta-naphthol in the vapor state: A. M. Howald with Alexander Lowy. Mixtures of ammonia gas and beta-naphthol vapor were passed over a number of anhydrous oxide catalysts in a Pyrex tube at definite temperatures. A study of the yield of beta-naphthylamine was made as dependent on temperatnre, catalyst, rate of flow and ratio of reactants. Over a considerable range of conditions, yields in excess of 90 per cent. were obtained, together with some beta-dinaphthylamine. Curves illustrating a marked effect of temperature on catalyst efficiency are shown.

Deaminization of the methyl and ethyl esters of dl-alanine and aminoisobutyric acid: A. L. Barker and Glenn S. Skinner. The methyl and ethyl esters of aminoisobutyric acid yielded largely the esters of alpha-methyl acrylic acid together with a small amount of hydroxy isobutyric acid. The methyl ester yielded 3 per cent. of acid material which contained, according to the Zeisel determination, 70 per cent. of the ether acid. The ethyl ester yielded 0.5 per cent. of acid material which contained 30 per cent. of ether acid. The esters of alanine yielded the unsaturated, chloro and hydroxy esters together with a high boiling nitrogenous residue. The methyl ester gave 15 per cent. of acid material, of which 60 per cent. was the ether acid. The ethyl ester gave 2 per cent. of acid material containing 70 per cent. of ether acid.

The recovery and refining of pyridine: Wilbert J. Huff.

Intermediate complex formation and electronic valence: Ben H. Nicolet. Ortho and para iodo-amines have their iodine in a mobile state which may be described by calling the iodine "positive." Two nitro groups, when o-p, produce an even more recognizably negative halogen. But, although two nitro groups thus exceed one amino group, 3, 5-dinitroiodobenzene shows no test for positive iodine; and yet, 3, 5-diamino-chlorobenzene, boiled with alcoholic sodium ethylate, shows no trace of negative chlorine. It is concluded that certain conditions favoring formation of necessary "intermediate complexes" are necessary for reaction, and that such considerations must be taken into account in judging electronic structures.

The catalytic synthesis of the acetals and their halogenation: Joseph S. Reichert, James H. Bailey aud J. A. Nieuwland. The acetals were prepared by passing acetylene into the corresponding alcohols in the presence of concentrated sulfuric acid and a mercury salt as a catalyst. The products of the chlorination and bromination of dimethyl and diethyl acetals were determined. The chlorination of diethyl acetal gave a good yield of chloral. Chloral was also prepared by the successive action of acetylene and chlorine on ethyl alcohol. After the required amount of acetylene had been absorbed, the reaction mixture was chlorinated directly without the separation of the acetal. In this process one mol. of acetylene takes the place of one mol. each of alcohol and chlorine as compared to the ordinary process of making chloral from alcohol.

New derivatives of 2-bromo-5-hydroxy-1, 4-naphthoquinone: Alvin S. Wheeler and B. Naiman. The preparation of 2-bromo-juglone as given by Wheeler and Scott was improved upon. Its benzoate was prepared. Its bromine was replaced by chlorine by means of alcoholic hydrochloric acid. The benzoate of the chloro compound was prepared. A dibromojuglone was made by brominating a hot glacial acetic acid solution of the monobromo compound. The second bromine entered the quinone ring and none entered the phenol ring in spite of the fact that juglone readily takes up two in the quinone and one in the phenol ring. Both bromines can be replaced by chlorine by means of alcoholic hydrochloric acid. Acetates and benzoates were prepared.

The polymers of pinene. II: G. B. Frankforter and Betty Sullivan. Improved methods have been worked out for the preparation of the compounds already described, namely, colophene, $(C_{16}H_{16})_2$, and colophonene, $(C_{10}H_{16})_5$, together with new derivatives of the same. In addition to the above, new compounds have been obtained which complete the series, namely, the sesquicolophene, $(C_{10}H_{16})_3$, and the dicolophene, $(C_{10}H_{16})_4$. The properties of the latter resemble the former in their remarkable stability and in the difficulty with which they form derivatives.

Some sulfonic acid esters of phenylazophenol and its substitution derivatives: C. E. BOORD, M. D. COULTER and HELEN L. WIKOFF. (Lantern). Several esters of benzene sulfonic acid, p-toluene sulfonic acid and alpha naphthalene sulfonic acid with phenylazophenol and its substitution products were prepared by the Baumann-Schotten method. The twenty-one esters thus prepared for the first time, together with the fourteen previously described (*Ber.*, 28, 800, 31, 1782, 2116; *J. Pr. Ch.*, 78, 386), are all stable, easily purified, beautifully crystalline compounds melting between 50° and 200°. It is suggested that this type of derivative may be of value in characterizing the sulfonic acids. The para derivatives such as p-tolylazophenol and p-chlorophenylazophenol seem best adapted to this purpose.

Practical preparation of oxalic acid from acetylene: SISTER MARY LUCRETIA, LEO J. HEISER and J. A. NIEUWLAND. Oxalic acid can be prepared on a practical scale by passing acetylene into a mixture containing three volumes of nitric acid to one volume of water and about two per cent. mercuric nitrate. The formation and loss of nitrogen oxides in the reaction prevents the commercial use of the process. The reaction proceeds through the formation of an intermediate compound which yields aldehyde, which is then oxidized to oxalic acid. Oxalic acid can be prepared by the direct action of nitrogen oxides on acetylene, by the action of acetaldehyde with nitric acid (3 : 1), and by the action of nitrogen oxides on aldehyde vapor. Acetaldehyde can be prepared by the action of acetylene on dry mercuric nitrate, by the action of acetylene on the compound obtained by treating metallic mercury with nitrogen oxides.

The oxidation of propylene glycol with lithium, sodium and potassium permanganates: E. C. HYTREE and W. L. EVANS. (*a*) Propylene glycol is oxidized by neutral permanganate solutions to carbon dioxide and acetic acid at 25° and 50°. Above certain minimum concentrations of alkali oxalic acid is also obtained. (*b*) The amount of each oxidation product at low alkalinities is influenced not only by the concentration of the alkali, but also by the use of either lithium, sodium and potassium hydroxides in connection with each of the several permanganates.

Hexabromodiphenyldisulfide: W. H. HUNTER and A. H. KOHLHASE. This compound is obtained by treating the silver salt of tribromothiophenol with iodine in benzene solution. This action is normal, and by so much is contrary to the action of iodine on the salts of halogenated phenols to form polyphenylene oxides. Further, molecular weight determinations in various solvents give consistently low results, apparently showing dissociation of the substance and consequent existence of the free radical $C_6H_2Br_3S$, which does not lose halogen spontaneously.

Formation of goumaric acids and substituted gamma-butyric acids from resorcinol, orcinol and phloroglucinol: W. D. LANGLEY and ROGER ADAMS. While attempting to prepare certain complex ketones, it was found that beta-chloropropionitrile and gamma-chlorobutyronitrile do not condense with resorcinol, orcinol or phloroglucinol in the presence of zinc chloride and hydrogen chloride as nitriles ordinarily do to give ketones, but instead condense to give acids, $(HO)_2C_6H_3CH_2CH_2CO_2H$, etc. Alpha-beta-unsaturated nitriles give the same type of condensation product, indicating without doubt that with these compounds the first step is the addition of hydrogen chloride to the double bond.

A new method of preparing unsaturated 1,4-diketones: J. B. CONANT and R. E. LUTZ. Substances of the general type RCOCH=CHCOR are of interest because they contain the characteristic linkage of quinone and indigo. Only a relatively few representatives have been previously prepared and the methods of preparation are difficult. We have prepared a number of aryl unsaturated 1,4-diketones by the action of fumaryl chloride, aluminum chloride, and an aromatic hydrocarbon. The yields are good. It is interesting that these substances are all smoothly reduced to the corresponding ethane derivatives by sodium hydrosulfite or titanous chloride in contrast to ketones of the type RCH=CHCOR, or acids of the type $HO_2CCH{=}CHCO_2H$, which are not reduced by these reagents.

The preparation of hydroxypyruvic acid: W. L. EVANS and G. P. HOFF. The following steps were used: (1) pyruvic acid, (2) monobromopyruvic acid, (3) its methyl ester, (4) methyl ester of hydroxypyruvic acid, (5) hydroxypyruvic acid. The conversion of (3) to (4) was accomplished by means of methyl alcohol and potassium formate, (5) is easily obtained from a slightly acidulated aqueous solution of (4).

CHARLES L. PARSONS,
Secretary

SCIENCE

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CONTENTS

THE ABSTRACTING AND INDEXING OF BIOLOGICAL LITERATURE[1]

WHEN Dr. Lillie asked me to discuss some phase of the general abstracts-indexes-bibliographies problem in one of these evenings I hesitated considerably before accepting because it appeared to me such a discussion would be rather foreign to the general character of these evenings, occupied, as they are, primarily with the results of biological or related research. However, it was rather because of this difference that I ventured to accept. I found a certain justification on the ground that if in the main these evenings are given over to the reporting of advances in knowledge, one evening might conceivably be profitably devoted to a consideration of whether we are preserving these advances in such a way that the greatest use may be made of them with a minimum expenditure of time, energy, and funds. We expend considerable funds and enormous amounts of energy and time in ascertaining new facts and publishing them *in extenso*. I believe it is pertinent to inquire whether we have established adequate means for so recording these facts that the greatest and most economical use is made of them and progress made as largely cumulative as possible.

No doubt some of you are wondering what special license I have to discuss this problem. I can answer only that I have none. My contact with the subject has been a brief one. I happen to be one of a number who for the past four years have been carrying some of the responsibility in connection with *Botanical Abstracts,* and as such have been impressed with the magnitude of the problem of properly recording our information and have become convinced that in a large measure we have not in

[1] An invitation paper given at the Marine Biological Laboratory, Woods Hole, Massachusetts, August 4, 1922.

our present methods reached a fundamentally correct solution of this important problem.

The ideal—I take it all are agreed here—is to have all new information so recorded that any part of it, major or minor, can be located promptly and certainly. Classified bibliographies and indexes, in book or card form, abstracts with subject and author indexes in book form, etc., are some of the means in use to approximate this ideal. I should make it clear that I am here discussing only the recording of information, not criticism.

A review of most of these agencies, at least the biological ones, shows that they have been very inadequately supported, have been able at best to do the work incompletely, great as has been the service they have rendered. And, perhaps more important, continuity, because of inadequate financial support, has not been guaranteed, with the result that agencies have arisen, grown to great usefulness, declined, and disappeared, to be followed by gaps before other agencies have got under way. The result is that biological literature is not only inadequately recorded, but it is recorded in so many places that the task of rather exhaustively consulting the literature on many biological subjects is indeed exhausting. Moreover, an enormous amount of duplication exists, all agencies in the same general field covering the literature in well-known journals, but frequently being forced to neglect that in the less well known.

I believe it is worth while to inquire into the fundamental causes of the difficulty and just what sort of service the present worker demands. As the number of research journals and the amount of material published have steadily increased it has become more and more impossible for the individual worker personally to subscribe for an appreciable amount of the literature in his field. More and more he is depending upon bibliographic and abstract services to bring to his attention the contributions he must consult critically. It could not be otherwise. But in general the workers desire to own these bibliographies or abstracts, especially the latter, as they constitute, if well done, a sort of master key to the literature. I believe I am correct in saying that usually workers prefer a good abstract journal covering their field to a single or even several research journals. Granting that workers need and want most of all adequate abstract and index services, it is clear that if they are to avail themselves fully of such agencies these must be procurable at prices within their reach. In other words, the cost of the service must be relatively low—very low for most of us. Secondly, the service must approximate completeness. It should be of such character that reliance can be continuously placed on it to report adequately practically all the literature. Thirdly, the service must be prompt; the demands of the worker on his abstract journal are much like those on the newspaper. Fourthly, there should be reasonable guarantees of the continuity of the service.

As regards completeness and adequacy, I believe only one type of service has been developed which is generally satisfactory and that is the abstract journal with detailed indexes. Classified bibliographies, even though based on an examination of the texts, can at best but incompletely record the new information, though their utility has been and is very great, especially for libraries. In some instances, notably in the case of libraries, classified bibliographies in card form are preferred; but for individuals the expense and labor involved in filing and files have not made these very popular. Moreover, such bibliographies are cumulative and not periodic. The same objections presumably hold for abstracts in card form. Another objection to the latter is that it is difficult to accompany them by a usable detailed subject index.

The reason for the popularity of abstracts with detailed indexes is obvious. Unlike bibliographies, abstracts, if well prepared, quickly give the reader definite information as to the exact content of contributions. In many cases the titles can not do this even though formulated with care; and many of them are not formulated with care. Indeed, many are distinctly cryptic. From complete abstracts virtually complete subject indexes can be prepared, based, of course, on a careful analysis of the abstract as well as of the title. By and large, the complete subject index is perhaps of the greatest importance. But its preparation necessitates complete abstracts, unless indeed the indexing should be done wholly from the originals—which would not at the same time yield the much desired abstracts, indispensable for current and reference use. It seems logical, therefore, to prepare the abstracts, and from them the indexes. Annual indexes furnish periodic reference sources which may be cumulated from time to time, as desired, to furnish the cumulative reference sources.

If we are correct that the most useful instrument in general is the abstract journal, how are we to produce it completely, thoroughly, promptly, continuously and sufficiently cheaply to answer the requirements? Obviously the task requires funds.

At present there are a great many abstracting journals in biology, not to mention scores of research journals that make more or less abortive attempts at abstracting. The subscription list of each is small, as most of them serve small groups. We have set up a great many special abstracting journals—in bacteriology, physiology, entomology, endocrinology, systematics, phytopathology, etc., etc.,—in most cases without correlation, with the result that each can claim only a small list of subscribers and is forced to charge a high subscription rate. It is a fact too often lost sight of that composition, or type-setting, is expensive and that its cost per page is the same whether one or one hundred thousand copies are printed. The fewer the subscribers, the larger the share of composition charge each must bear. With a large subscription list, the amount borne by each becomes negligible and a copy costs little more than the paper, press work, binding, and distribution. An abstracting journal with a subscription list of one thousand or fifteen hundred, as is the case with most of them at present, can not hope to yield a surplus sufficient to carry on the large amount of exacting routine necessary in a good abstracting journal. Little wonder, then, that almost all our special biological services are embarrassed financially and unable to carry their work forward as it should be carried.

Let us at this juncture examine what has been and is being accomplished by another science group going at the problem in another way. I refer to the chemists, who are probably handling the proposition more successfully than any other group. Instead of abstracts of industrial chemistry, organic chemistry, pharmaceutical chemistry, analytical chemistry, inorganic chemistry, etc., etc., they have one chemical abstracts. They have made it one of the official organs of the American Chemical Society and thus insured a minimum circulation of well over 13,000. The following are the remarkable facts in this undertaking: *Chemical Abstracts* publishes annually approximately 5,000 pages of probably the best abstracts and indexes produced anywhere; it maintains an editorial office, consisting of an editor-in-chief, two associate editors and a clerical staff, and pays its abstractors at a per page rate, at an annual cost of approximately $26,000; but even so, the journal is produced at an annual cost of about $6.80 per member, this including entire cost of manufacture and distribution, support of the editorial office and compensation of abstractors.

Consider for a moment another journal, *Botanical Abstracts,* with which I happen to be familiar. It prints about 1,200 pages of abstracts annually at a cost of $12.00 to each of its 1,100 subscribers, and has not only yielded no income for editorial purposes or for compensating abstractors, but instead has been accumulating a deficit. In other words, *Chemical Abstracts* publishes four times as much material at less than half the price and is able to carry its work forward continuously and efficiently and be relatively free from serious financial embarrassment. Most of our special abstracting journals are being carried on by a few enthusiasts willing to devote much time and energy without compensation. But, however willing these individuals may be, such organizations are subject to frequent partial or complete breakdowns. Their continuity and uniform quality have no reasonable guarantees.

Is it possible for the biologists to profit by the experience of the chemists and achieve something equally good or better in the way of this important accessory mechanism? At once we realize that the biologists lack an organization sufficiently comprehensive and strong to grapple with so large and difficult a problem. There are in this country fifteen to twenty societies of biologists with an aggregate membership of over 6,000, but, with the exception of the Federation of American Societies for Experimental Biology which involves four societies, these have been almost wholly uncorrelated.

Recently, however, there has developed a movement which may provide an organization comprehensive enough to measure up to the task. I refer to the proposed federation of American biological organizations which are of a research character and which are essentially national in scope. This movement, as seems not generally realized, began over a year ago when the Botanical Society of America, the American Society of Zoologists, and the American Society of Naturalists endeavored to work out some plan to provide for the organization desired by the geneticists without at the same time increasing the already large number of separate and distinct biological organizations and thereby making it still more difficult to handle problems of common concern to all biologists. It was recognized that the opportunity for the organization of special groups must be provided, but also that there are certain large problems which can be properly handled only by a larger, stronger organization, including, if possible, all the societies. As regards the immediate problem of the genetics organization, the committee of the three societies recommended that sections in genetics with common officers be created in both the American Society of Zoologists and the Botanical Society of America. This recommendation was carried out by both societies, and programs of the joint sections were held at Toronto.

The committee went further, however. It recognized that similar organization problems would continue to arise and that something should be done to make such organization of special groups possible and at the same time maintain a certain solidarity of biologists for handling problems of common concern requiring concerted action for their successful solution. It was felt that this could be accomplished by a federation of at least the national research biological organizations.

The Division of Biology and Agriculture of the National Research Council was requested to call an informal conference at Toronto of officers of the national societies to consider the possibility of a federation. This meeting was held[2] and, after a general discussion, it was voted to hold an adjourned meeting in Washington in the spring. This was held in April of this year[3] and was participated in by official representatives from the following organizations:

American Society of Zoologists.
American Genetic Association.
American Society of Naturalists.
American Phytopathological Society.
Ecological Society of America.
Botanical Society of America.
American Society for Horticultural Science.
Society of American Foresters.
Society of American Bacteriologists.
American Association for the Advancement of Science, and its Sections G, F, O, and N.
American Association of Economic Entomologists.
American Society of Agronomy.
Entomological Society of America.
Federation of American Societies for Experimental Biology.
American Dairy Science Association.
American Society of Animal Production.

An executive committee *pro tem.* was appointed to draw up a constitution to be submitted this fall to the societies represented in the federation conference. While I am not authorized to speak for the committee, I think it may be said with perfect propriety that the federation, if established, will not in the least affect the autonomy of the member societies and that it will concern itself with problems of common concern to biologists.[4] The Washington conference recognized that one of these problems, perhaps the chief one at present, is publication, and, in particular, abstracts. It therefore appointed a committee to study the problem of providing all of biology with adequate abstracting and indexing services. This committee is a joint one, half appointed by the Conference and half by the Division of

[2] See Shull, A. F.: "The Proposed Federation of Biological Societies," SCIENCE, 55, 245-246, 1922.

[3] See Shull, A. F.: "Proposed Federation of American Biological Societies," SCIENCE, 56, 184-185, 1922.

[4] See Shull, A. F.: "Proposed Federation of Biological Societies," SCIENCE, 56, 359-361, 1922.

Biology and Agriculture of the National Research Council, and consists of the following:

Representing the proposed federation: A. Parker Hitchens, D. R. Hooker, C. A. Kofoid, I. F. Lewis.

Representing the Division of Biology and Agriculture: E. D. Ball, C. E. McClung, J. R. Schramm, A. F. Woods.

This committee is at work ascertaining the exact situation in abstracting, indexing, and other agencies for recording biological information throughout the world. Several facts are already obvious. Considering for the moment only the agencies published in English, we have in this country *Abstracts of Bacteriology, Index to the Literature of American Economic Entomology, Botanical Abstracts* (containing in addition to plant research animal cytology and genetics), *Endocrinology*, etc.; in England, *Physiological Abstracts, Review of Applied Entomology, Review of Applied Mycology, Zoological Record* (Part N of the International Catalogue of Scientific Literature), etc. The subscription list of each is small and in many cases the financial support is inadequate to insure that the work will be done thoroughly and in perpetuity. Zoology especially seems in a precarious position since the breakdown of continental agencies and the suspension of the International Catalogue, with the exception of Part N (Zoology), which, however, is financially handicapped. Only in physiology and entomology, and perhaps genetics, is the situation reasonably satisfactory at present. Many of the agencies are hanging on a relatively slender thread; some are likely to break down at almost any moment, indeed, are breaking down. The question is, shall we continue to leave the recording of biological information, only a mechanism, to be sure, but an absolutely indispensable one, to such a precarious existence?

Primarily there appear to be two methods of handling the situation. (1) The present one of a large number of special abstracting journals or bibliographic services. For such special journals there is a relatively small demand and a correspondingly small support. Here, too, it should be pointed out that the more numerous the journals and the narrower the field covered by each, the greater the amount of duplication—necessary duplication under this system since each specialty grades insensibly into neighboring ones on which it depends to a large extent. Furthermore, the conventional line so often drawn between plants and animals is no longer recognized in many lines of work, and rightly so. Separate botanical and zoological abstracting journals will not satisfy the geneticist or cytologist, and only imperfectly many pathologists, physiologists, and ecologists. (2) The other method is the publication of a single comprehensive biological abstracts, corresponding to *Chemical Abstracts*. Let us consider the second alternative in more detail.

(1) *Cost.* The joint committee has not yet completely determined the approximate volume of biological literature, after delimiting it roughly from clinical medicine, chemistry, physics, geology, psychology, etc. But it is safe to assume that it is at least as large as chemical literature. Let us assume, then, that a journal fully as large as Chemical Abstracts (5,000 pages annually) would be required. If such a journal were made the official organ of the proposed Federation, going to each member of the constituent societies as Chemical Abstracts goes to each member of the various sections of the American Chemical Society (thus insuring a subscription list of 7,000 or 8,000), I believe I am safe in saying on the basis of information in our hands on manufacturing costs that such a journal would cost little or no more than most of the special abstracting journals and considerably less than some of the larger ones like Botanical Abstracts. In other words, a very large journal with a large subscription list would cost less per subscriber than a small one with a small subscription list. Let me remind you again of Chemical Abstracts with its 5,000 pages annually and an overhead of $26,000 yearly produced at a cost of $6.80 for each member.

It may be objected that most biologists would be interested in but a small part of such a comprehensive journal. The same thing may be said of Chemical Abstracts. I doubt whether there would be greater diversity than in Chemical Abstracts, which includes anything from routine commercial analysis to theoretical physical chemistry. The material would, of course, be organized into sections according to the judgment of the biologists and the section or sections of interest could be as easily consulted as in a special journal. This objection resolves itself, I believe, into the relatively small item of space occupied on the shelf; this may perhaps be met by some plan of issuing parts without involving a sacrifice of the fundamentally important principle of uniform support by all members of the constituent societies of the proposed Federation.

(2) *Duplication.* Most of the duplication existing in special abstracting journals would be done away with and the problem would narrow itself down to the necessary overlapping with a few large abstracting journals in the other major fields—chemistry, physics, etc. Moreover, with such a widely distributed abstract journal, research journals might well discontinue their abstract sections and either devote such space to the publication of additional research, or to criticism, or both; or effect a reduction in size, and consequently in cost.

(3) *Cross referencing.* Though the material be segregated into special sections, as many as necessary, suggestive and pertinent material from other sections could be conveniently referred to by cross references, each sectional editor having complete control over cross references by having access to a complete duplicate galley proof. (In the special journals this can be done only by duplicating in large measure the abstracts appearing in other specialized journals.) This cross-referencing would make possible the very complete utilization, with practically no expense, of the valuable leads from related fields on which so much of progress depends.

(4) *Current files.* A single, large, strong journal could acquire by exchange or purchase much of the current serial literature in which its material appears. *Chemical Abstracts* now receives 550 serial publications, by exchange and purchase, which are available for abstracting purposes. The small journal does not have the resources to accomplish this, and yet such files are indispensable for properly carrying on the work. It is to be hoped that some day all American abstracting agencies at least may be brought into correlation in order that they may share each other's facilities; all the services would inevitably profit by such correlation.

(5) *Support.* Fundamental to the ultimate success of such a comprehensive undertaking would be the adoption of the journal as an official organ of the proposed Federation. Granting that it can be manufactured, as I believe it can, for from \$6.00 to \$8.00 annually, I am inclined to believe that practically all of us would be willing to pay that amount annually for a virtually complete abstracting and indexing service of the world's literature in our respective fields, especially when it brings in addition equal service in other biological fields in which we have an interest. If this were done, in other words, if a Biological Abstracts, or whatever you choose to call it, had the solid backing of the biologists of America at least, support, perhaps a permanent endowment, might be secured sufficient to cover the overhead, in which case the journal could be sold for practically manufacturing cost. Moreover, such an endowment would reasonably guarantee that the work would go forward properly under practically all conditions. There is little hope that the numerous separate journals with small backing can command such support. Indeed, the history of these shows that they can not.

Let me make it clear, however, that the joint publications committee has no power. Its function is to ascertain and report the facts. The decision rests with the societies. The committee is by no means ready to report, and I have little idea as to what will be the nature of its report when all factors have been taken into consideration. But I personally venture to predict that the permanent solution of the problem lies in the direction of the establishment of a single biological abstracting journal having the unified support of all, or practically all, American biological organizations at least. Obviously, such a solution would necessitate the merging of several existing biological abstracting and bibliographic agencies, and this, of course, should not be done unless it is certain that a real improvement will be effected thereby. We may rest assured that those controlling the existing journals will not proceed in this direction until such guarantees are forthcoming.

J. R. SCHRAMM
NATIONAL RESEARCH COUNCIL,
WASHINGTON, D. C.

DOES NITRIFICATION OCCUR IN SEA WATER

DESPITE the meager, observational and experimental data which are available on the subject, the idea of the occurrence and activity of nitrifying bacteria in the opea sea is widely prevalent among bacteriologists and botanists. This idea is based, in part, on the reasoning that ocean water should contain the bacteria discharged into it by the sediments and the drainage waters from terrestrial sources; more particularly, however, it is an outgrowth of certain studies which have been made in recent years on the bacterial flora of sea water which, as above indicated, are far from exhaustive and satisfying. For example, Thomsen[1] has discovered nitrite and nitrate producing bacteria in the ooze of the bottom of Kiel Fjord. It has also been reported that nitrite and nitrate forming bacteria have been found in the slime at the bottom of the Bay of Naples. In both cases, however, it is definitely pointed out that the samples studied were obtained from near land surfaces. Moreover, Thomsen failed to discover the nitrite or nitrate forming organisms in sea water or in the plankton or the fixed algæ. In commenting on the studies of Keding[2] and Keutner[3] on nitrogen-fixing bacteria of the sea, Drew[4] made the following statement which shows him to have been confused on the subject of two distinct groups of bacteria wholly different from each other in all respects. He said, "The existence of *nitrifying* bacteria which are *capable of absorbing and combining with the free nitrogen of the air*[5] and eventually give rise to nitrates, has been shown by Keding and Keutner, but these have so far only been found in the bottom close to shore or apparently living in symbiosis with algæ or plankton organisms." Later on, however, Issatchenko,[6] whose original papers are not available to me, claims to have found nitrifying bacteria in the Gulf Stream near Ekaterininsk 72° N. He observed, however, that the presence of such bacteria in the Arctic Seas is still unproved. Issatchenko made this statement eight years after having stated, as reported in a brief note,[7] that he had discovered a nitrifying bacterium in Arctic sea water. With these unsatisfactory results before him, Berkeley[8] decided, in the course of other studies on marine bacteria, to make some tests for a possible nitrifying power of sea water. He inoculated 2 per cent. solutions of ammonium sulfate in sea water with samples of the sea water to be studied. He does not state how much inoculum was employed, nor anything else relative to the technique of the experiments, but the result was that even after three months none of the cultures showed even traces of nitrite or nitrate.

In connection with a series of critical studies on the possible connection of bacteria with $CaCO_3$ precipitation in sea water, which are to appear in the reports of the Department of Marine Biology of the Carnegie Institution of Washington, the writer of this note, unaware of Berkeley's work which appeared at about that time, determined to make some tests for the possible nitrifying power of sea water.

[1] Thomsen, R.: "Ueber das Vorkommen von Nitrobakterien im Meere," *Wiss. Meeresunters*, Vol. XI, Kiel.

[2] Keding, M.: "Weitere Untersuchungen über stickstoffbindende Bakterien," *Wiss. Meeresunters,* Vol. IX, Kiel.

[3] Keutner, J.: "Ueber das Vorkommen und Verbreitung stickstoffbindende Bakterien im Meere," *Ibid.,* Vol. IX, Kiel.

[4] Drew, G. Harold: "On the Precipitation of Calcium Carbonate in the Sea, etc." *Papers from Tortugas Laboratory,* Carnegie Inst., Wash., Vol. 5, 1914.

[5] Italics mine.

[6] Issatchenko, B. L.: "Nitrogen Fixation, Nitrification, Denitrification and Production of Hydrogen Sulphide by Bacteria in the Arctic Ocean." *Rev. Agr. Expts.,* Vol. 17, pp. 175-9. Cited in *Bull. Agr. Intelligence,* 7, 1753 (1916).

[7] Issatchenko, B. L. Cited from *Centr. Bakt. etc.,* 2th Abt., No. 13-14, p. 430, 1908.

[8] Berkeley, Cyril: "A Study of Marine Bacteria, Straits of Georgia, B. C." *Trans. Roy. Soc. Can.,* Vol. 13, p. 15.

The first tests were carried out at Pago Pago in American Samoa, but they were later supplemented by several tests at Berkeley, California, with material collected in Samoa. In the tests just mentioned, the ordinary Omeliansky solutions for nitrite and nitrate formation were employed, and they were inoculated in two series, one with sea water and the other with calcareous sand taken from beneath that same sea water. Twenty-five cc. portions of sea water and about one gram of the calcareous sand were used as inocula. After three weeks, there was no trace of nitrite or nitrate in the sea water inoculation, but very good nitrification in the calcareous sand inoculations. The first result is, therefore, in agreement with that of Berkeley, though reached in ignorance of Berkeley's experiments. It will be noted, however, that Berkeley used sea water media containing 2 per cent. of $(NH_4)_2SO_4$, which is very different from the weak salt media of the Omeliansky solution which contains only .1 per cent. $(NH_4)_2SO_4$. In fact, there seems to be no real reason for the use of such high concentrations of ammonium sulfate, and especially in the presence of a concentrated salt solution like sea water. Nevertheless, the agreement in the results of the two tests is noteworthy. Before discussing further the significance of my second result, namely, with the calcareous sand inoculations, it is best to describe some subsequent experiments. Thinking that the period of incubation may have been too short in the sea water cultures above described, since the nitrifying bacteria could not in any case be expected to be present in sea water in great numbers, I repeated the experiments on my return to California from Samoa, and allowed the culture to run for eight months in one case. The results were, however, just the same as in the first series. The inoculations with sea water gave no tests for nitrite or nitrate, and the inoculations with calcareous sand taken directly below that sea water gave marked nitrification.

Even these tests did not entirely satisfy me, however, because I still thought that the number of nitrifying bacteria in sea water might be so small as to render possible their total absence from a 25 cc. sea water inoculum. An opportunity to make further tests came, however, during my continued studies on marine bacteria and the lime precipitation problem during the past summer (1922), this time at the Tortugas Laboratory of the Carnegie Institution of Washington. On June 9, two 150 cc. portions of Omeliansky's solution were placed in one liter Erlenmeyer flasks and sterilized. When the culture solutions were cool, they were inoculated as follows: one with about ten grams of calcareous sand obtained from the sea bottom near the Loggerhead Key shore; the other with 150 cc. of sea water obtained immediately above the calcareous sand. On June 16, tests were made with Trommsdorff's reagent of the cultures, which were incubated at room temperature (about 27° to 31° C. constantly). No test for nitrite was obtained in either culture. On June 22, the tests were made again. This time, the calcareous sand inoculation showed marked nitrite production, whereas the other culture showed nothing. A further test made on July 21 gave the same results as that on June 22.

All of these tests, taken in conjunction with those of Berkeley and possibly those of Isaatchenko, compel us to the conclusion that either the nitrifying bacteria are absent from the sea water, or they can not function in such concentrated salt solutions. The former alternative is probably the correct one, since it will be remembered that my first tests were with much weaker salt solutions, and as Miss Meek and I have shown in a paper soon to appear in the *Journal of General Physiology*, the nitrifying bacteria can withstand very high salt concentrations. It may, therefore, be concluded with reasonable safety that the nitrifying bacteria are absent from open sea water and that, therefore, no nitrification occurs in such sea water. What may be the state of affairs in small areas of the sea close to land and harboring much organic matter is not directly relevant to this particular inquiry. I hope to secure some information on that point soon.

Not the least interesting feature of my tests on this question, however, is the result obtained with the calcareous sand inoculations. It is remarkable that calcareous sand, which is in constant contact with sea water, should harbor vigorous nitrifying organisms, whereas that sea water with which it is in equilibrium in the system should not. It is difficult to account for this, except by assuming that the solution surrounding the sand particles is of a very different nature from that in the sea water above, and yet the possibility of that seems rather remote. Of course small amounts of organic matter covering the sand particles may afford protection for the bacteria. Further experiments which I am conducting may throw some light on this question.

Chas. B. Lipman
University of California

A RECENT SCIENTIFIC EXPEDITION TO THE ISLANDS OFF THE WEST COAST OF LOWER CALIFORNIA

At the Berkeley meeting of the Pacific Division of the American Association for the Advancement of Science in 1921 there was appointed a Committee on Conservation of the Marine Life of the Pacific, Dr. Barton Warren Evermann, chairman. One of the first tasks which the committee undertook was the making of recommendations for the protection of certain of the marine mammals or for the gathering of necessary information which would make it possible to advocate a concrete plan in the future. With regard to certain species, there already existed sufficient data so that definite action could be undertaken at once, but with other species practically nothing was known of their present status. This was notably true of the Guadalupe elephant seal, Guadalupe fur seal and southern sea otter, all of which once existed in great abundance along the shores of California and Lower California.

Through the activities of the committee, an expedition was dispatched from San Diego to the islands off the west coast of Lower California on July 9, 1922, for the primary purpose of securing data on the three above mentioned species of mammals. The government of Mexico provided the fisheries patrol boat *Tecate* for the work and met all expenses while the party was in the field. Professor Carlos Cuesta Terron, curator of fishes and reptiles of the National Museum of Mexico, was in charge of the expedition and the Mexican government was further represented by Professor José Mª Gallegos, of the National Museum, Srs. Joaquin Palacios, inspector, and Rudolfo Lascano, assistant inspector of lighthouses, Sr. Enrique Gonzalez, fisheries inspector, and Sr. Luis Rubio, taxidermist.

Through the intercession of Dr. A. L. Barrows, of the National Research Council, the National Geographic Society rendered financial assistance which made it possible for the committee to enlarge the scope of its work by securing the cooperation of the California Academy of Sciences, represented by Mr. Joseph R. Slevin, assistant curator of herpetology, Mr. Frank Tose, chief taxidermist, and the writer; of the San Diego Society of Natural History, which sent Mr. A. W. Anthony, curator of vertebrates, and Mr. Ernest Hinkley, assistant; and the Scripps Institution for Biological Research, represented by Mr. P. S. Barnhart. Mr. Anthony and the writer were placed in charge of the scientific investigations.

The motor ship *Tecate* was admirably suited to the work in hand and the success of the expedition was in no small measure due to the constant interest of Captain Victor Angulo and his well trained crew. Everything possible was done to aid the observers and collectors during the five weeks in the field.

The expedition returned to San Diego on August 16, after having visited the following islands: Guadalupe, San Martin, Cedros, the San Benitos, Natividad, San Roque, Asuncion, Magdalena and Santa Margarita. Landings were also made at Ensenada, San Quintin Bay, San Bartoleme Bay and Abreojos Point on the Lower California peninsula. Besides making collections at all of these places the coast line was studied at close range for considerable distances from the vessel, particularly the bight known as San Cristobal Bay, where elephant seals are known to have once hauled out in numbers.

The herd of elephant seals on Guadalupe Island was carefully studied and counted and, although the results can not as yet be announced, it may be stated that conditions were very encouraging for the perpetuation of this remarkable species. Many interesting photographs, including motion pictures, were taken of the animals.

The entire coast lines of Guadalupe and several of the other islands were examined carefully for evidence of the existence of the Guadalupe fur seal but not a single animal was seen. Many inquiries were also made regarding the species but no information was obtained which would indicate that there remained a living representative. It has apparently gone the way of the great auk, Steller's sea cow and several other valuable species; commercial hunters can cut another notch on their gun-stock.

The old fur-seal rookery grounds of Guadalupe were examined carefully. Three of these were found and the lava rocks were polished as smoothly as though they had been deserted but yesterday. An estimate based upon knowledge gained on the Alaska fur-seal rookeries placed the original number of animals on Guadalupe at 100,000. The great killing took place in the early part of the nineteenth century and we must look with remorse upon our ancestors who were so thoughtness as to destroy so valuable an animal. In 1892 and subsequently several expeditions have visited Guadalupe Island in the hope of securing specimens for museum purposes but met with no success. Four incomplete skulls upon which the species was founded and possibly a few disassociated bones (yet unidentified) taken by the last expedition seem to represent all there is of it except regrets.

No southern sea otters were seen by the members of the expedition, but information obtained would indicate that there are still alive a very few of these excessively valuable animals.

The natural history collections made by the expedition were large considering that the islands were visited during the dry season. Specimens in various groups were obtained in approximately the following numbers: birds and mammals, 300; reptiles and amphibians, 1,000; insects, 1,100; land shells, 2,000; marine fossils, many; and miscellaneous fishes, invertebrates and plants.

The representatives of the Mexican government are thoroughly alive to the necessity of conserving the natural resources of their western territory. It is not expected that measures will be adopted which will throttle the proper commercial development of the vast wealth of marine life of those waters but it is expected that the Mexican government will provide laws and regulations which will properly safeguard and conserve those resources so that they may continue for all time valuable assets of that government.

G. DALLAS HANNA
CALIFORNIA ACADEMY OF SCIENCES

AID TO RUSSIAN SCIENTISTS

THE American Committee to Aid Russian Scientists with Scientific Literature made an appeal through SCIENCE (June 23, 1922) to the scientific men and organizations of the United States for gifts of American scientific books, journals and papers to be sent, by aid of the generous cooperation of the American Relief Administration, of which Mr. Herbert Hoover is chairman, to Russia for distribution among Russian universities, scientific organizations and individual workers. In addition to the general appeal through SCIENCE, the committee made a special appeal by letter to various commercial publishing houses, university presses and scientific organizations which publish journals, memoirs, bulletins, etc.

The response to this appeal has been widespread and generous. Up to date nearly nine tons of American scientific books, journals and papers published since January 1, 1915, have been collected and sent to Russia. The contributors include 70 government and state bureaus and experiment stations, 40 universities and colleges and university presses, 23 national and state scientific societies and about 120 private individuals. To make special mention of any contributors among the many who have made such generous response to the appeal may seem unfair, but to reveal the interesting fact that commercial publishing houses, which are presumably not primarily philanthropic, or, at least, immediately benevolent in their aims, have exhibited a generosity not inferior to that shown by the more strictly science-supporting organizations, I want to call attention to such examples of good will as shown by the Yale University Press in its contribution of six copies each of twenty-four first class scientific books published by it, and by Doubleday, Page and Company in submitting a list of their publications and requesting the committee to choose what books it desired.

The only disappointment to the committee is that caused by the comparatively small number of private individuals so far represented in the list of donors. A partial explanation of this is undoubtedly to be found in the fact that the appeal was issued at just about the end of the academic year when many professors had left their laboratories for their summer vacation.

The committee wishes to express its thanks to all those organizations and persons who have responded to its call and to make known to these contributors an expression, recently received by cable, of the great gratitude of the Moscow representative committee of Russian scientists.

It also wishes to repeat its appeal to individual scientific workers for contributions of reprints to the number of six each, if possible, of their published papers since January 1, 1915. The committee has at its disposal only a limited fund to cover the necessary clerical work. It asks, therefore, that contributors of literature cover the cost of its transportation to New York, from which point all cost of handling and shipment will be borne by the American Relief Administration. Contributors should send, with each consignment, one copy of a list of the publications sent by them and five copies of this list (apart from the consignment) together with all letters containing advices of shipments, express and shipping receipts to the American Relief Administration, Russian Scientific Aid, 42 Broadway, New York City. The publications themselves should be sent by parcels post or express, or if very heavy, by freight, to the American Relief Administration, care Gertzen and Company, 70 West Street, New York City. Requests for further information should be sent to the American Committee to Aid Russian Scientists, 1701 Massachusetts Avenue, Washington, D. C.

The answer to one such request for information which has been received from numerous inquiries may be given here and now. The contributed material is not turned over to the Soviet government, nor is the distribution of this material determined by the Soviet government. The distribution is effected under the general direction of the American Committee by the American Relief Administration working in cooperation with a special committee in Moscow of Russian scientists representing various Russian universities and scientific organizations. The extraordinary independence of the American Relief Administration, extraordinary in the light of the existent circumstances, as regards its activities in Russia, is perhaps not generally realized here in America.

Vernon Kellogg,
Chairman
L. O. Howard
David White
Raphael Zon
American Committee to Aid Russian Scientists with Scientific Literature

SCIENTIFIC EVENTS

THE RECOVERY OF HELIUM

Satisfactory operation on a laboratory scale of a simplified and much cheaper method of recovering helium is reported through the American Chemical Society by H. Foster Bain, director of the U. S. Bureau of Mines. In a test made within the last month at the cryogenic laboratory in the Interior Department building, helium was recovered from natural gas in one operation in sufficient purity for use in dirigibles or balloons.

"This development," Mr. Bain said, "indicates that very soon commercial production of helium for lighter-than-air craft is probably feasible." Not only will this work insure safety from fire and explosions, but it is almost certain to result in an entirely new type of airship design. The motor, for instance, could be placed inside the envelope of a helium ship if necessary.

The research work leading up to this achievement was directed by the United States Helium Board, composed of Lieutenant Commander F. M. Kraus, representing the Navy, Colonel R. F. Favel, representing the Army, and Dr. R. B. Moore chief chemist of the U. S. Bureau of Mines, H. S. Mulliken, production engineer, alternate. The actual work of development was directed by a group of men known as the Board of Helium Engineers, with the following membership: M. H. Roberts, Franklin Railway Supply Company; R. C. Tolman, of the California Institute of Technology; W. L. DeBaufre, University of Nebraska; Edgar Buckingham, of the U. S. Bureau of Standards, and John W. Davis, of the U. S. Bureau of Mines. The government also had the assistance of Dr. Frederick Keyes, Massachusetts Institute of Technology, and Dr. Harvey N. Davis, Harvard.

Helium recovery as carried on at government plants in Texas, results in a gas of about 64 per cent. purity, and necessitates a second operation to remove impurities. By the old method the flow from the natural gas wells is directed through a series of compressors which reduce the various gases in the mixture to liquid form. Methane (illuminating gas) becoming liquid at a higher temperature is taken off first. The remaining gases are then, one by one, liquified and helium, having an exceedingly low liquefying point, remains. The difficulty with this method is to liquefy all of the nitrogen in the mixture.

THE USE OF OXYGEN IN METALLURGICAL OPERATIONS

USE of oxygen in connection with the enrichment of the blast in the blast furnace and in practically all phases of pyro-metallurgical work will furnish the key to success in the further development of such metallurgical operations, according to Dr. F. G. Cottrell, formerly director and now consulting metallurgist of the United States Bureau of Mines, who first directed the bureau's attention to this subject. Through this enrichment process, it is hoped to increase the efficiency of metallurgical operation with a resultant production of metals at lower cost and possibly the use of lower grade ores.

The Bureau of Mines now has outlined plans for two studies which will be carried on simultaneously. The first will cover the present-day processes for the production of oxygen, in order to determine the feasibility of attempting to produce oxygen, or oxygenated air, in such amounts and at such a cost as to permit of its use in metallurgical operations. The second study will be devoted to the feasibility of using oxygen, or oxygenated air, in metallurgical operations.

Because of his interest in this investigation, M. H. Roberts, vice-president of the Franklin Railway Supply Company, was asked to select an advisory committee to work with the Bureau of Mines and to act as chairman of this committee. The committee will consist of Dr. F. G. Cottrell, director of the Fixed Nitrogen Research Laboratory; Professor W. L. DeBaufre, chairman of the mechanical engineering department of the University of Nebraska; Dr. D. A. Lyon, chief metallurgist of the Bureau of Mines; Dr. R. B. Moore, chief chemist of the Bureau of Mines; Dr. R. C. Tolman, professor of physical chemistry and mathematical physics, California Institute of Technology; J. W. Davis, mechanical engineer of the Bureau of Mines; F. W. Davis, metallurgist of the Bureau of Mines; Frank Hodson, president of the Electric Furnace Construction Company, and P. H. Royster, assistant metallurgist of the Bureau of Mines.

Previous to the war, some work was done in Belgium on the enrichment of the blast with oxygen in connection with the smelting of iron ores in the blast furnace. In the United States, the late J. E. Johnson, Jr., was interested in the possible use of oxygen in metallurgical operations and carried on some experimental work along these lines previous to his death.

ACOUSTICAL RESEARCH

THE London *Times* writes editorially in regard to the desirability of cooperation in the conduct of acoustical research as follows:

Architects are still unable to predict with certainty the acoustic properties of the halls and chambers they design. Commenting a few weeks ago on the failure in this respect of the new London County Hall, we suggested that bodies such as the Royal Institute of British Architects and the National Physical Laboratory might get together for the devising and conduct of experiments for future guidance. But, so far as we are aware, no practical steps have been taken in this country. Meantime similar problems are engaging attention in the United States, where, indeed, the late Professor Sabine, of Harvard, had already made valuable progress in exploration of the acoustic properties of architectural interiors. A scheme is on foot to establish an American Institute for Acoustic Research. Professor C. A. Ruckmick, of Wellesley College, Massachusetts, to whom the proposal is due, calls attention to the progress which has followed combined intensive research in the photographic and lighting industries, and thinks that the time has come when equal advantages might be gained for acoustics. Already there exist more than a dozen American laboratories where investigations into different branches of the subject are in progress, but these could be encouraged and expanded by cooperation and concerted attacks on special problems. There is no doubt as to the scope of the work that might be undertaken. The acoustic qualities of confined areas, such as halls and chambers, improvements in telephone and phonograph reproducers, sound localization, consonance and dissonance are the mere headings of sections covering many subjects of scientific interest and practical value. We wish well to the American scheme, and would give a still more hearty welcome to a similar British scheme.

THE AMERICAN SOCIETY OF ZOOLOGISTS

The American Society of Zoologists, in conjunction with Section F of the American Association and in association with other biological societies, will hold its twentieth annual meeting under the auspices of the Massachusetts Institute of Technology on Wednesday, Thursday and Friday, December 27, 28 and 29, 1922.

Zoological papers by persons not members of the society may be placed on the program on recommendation of a member of the organization. All titles should be in the hands of the secretary by November 22, accompanied by an abstract of not more than 250 words. Titles and abstracts for the genetics program should be sent to Professor L. J. Cole, Madison, Wisconsin, secretary of the genetics section of the society.

Abstracts of papers to be presented will be published for distribution before the meeting and will appear in *The Anatomical Record* for January, 1923. Non-members of the society who desire copies of the preliminary program and abstracts should notify the secretary immediately.

The biologists' smoker will be held on Wednesday evening in the Walker Memorial Building of the Massachusetts Institute of Technology. All biologists are invited. The zoologists' dinner will occur at the Parker House on Thursday evening. Professor Kofoid will give the address. All zoologists are invited.

The Parker House will be the hotel headquarters of the society. Fifty rooms are available at rates from $2.50 up. Reservations should be made directly with the hotel management.

W. C. Allee,
Secretary

Zoology Building,
The University of Chicago

SCIENTIFIC NOTES AND NEWS

Dr. Jacques Loeb, member of the Rockefeller Institute for Medical Research, has been elected an honorary member of the Société Royale des Sciences Médicale et Naturelles of Brussels.

Dr. Casimir Funk, associate in biological chemistry at the College of Physicians and Surgeons, Columbia University, has been elected a foreign member of the Halle Academy of Science in the division of scientific medicine.

Dr. Frederick Belding Power, of the U. S. Bureau of Chemistry, has been awarded the Flueckinger gold medal by the Society of Swiss Chemists for "invaluable work on alkaloids and etheral oil."

The first Warren Triennial Prize of $500 has been awarded for an essay on "The Circulation in the Mammalian Bone-Marrow," by Drs. Cecil K. Drinker, Katherine M. Drinker and Charles C. Lund, of Boston. A second prize was awarded to an essay on "The Effect of Roentgen Rays on the Nuclear Division," by Dr. James Mott Mavor, Union College. A second prize of $250 was awarded this year because of the difficulty in determining the relative merits of the first two papers.

Lady Manson was the recipient on September 26 of the first presentation of the medal struck in memory of Sir Patrick Manson, from funds collected by the Manson Memorial Fund. This medal, which is in bronze, bears on the obverse a profile of Sir Patrick, and the device "Tropical Medicine and Hygiene." It will be presented triennially to any specially distinguished worked in tropical medicine, the recipient to be selected by the council of the Royal Society of Tropical Medicine and Hygiene.

King Haakon of Norway has bestowed the Medal of Merit in gold on Dr. Ingeborg Rasmussen of Chicago, in recognition of her work among the Norwegians in this country.

Professor P. J. van Rhijn has been appointed director of the Astronomical Laboratory at Groningen.

Dr. M. Dorset, chief of the Biochemic Division, Bureau of Animal Industry, Department of Agriculture, has been appointed by the United States government to cooperate in an unofficial and consultative capacity with the advisory committee on anthrax set up by the International Labor Organization.

It is announced in *Nature* that at a meeting of the Chemical Society on October 5 Professor J. F. Thorpe had been nominated to fill, until the next annual meeting, the office of treasurer, rendered vacant by the resignation of Dr. M. O. Forster, recently appointed director of the Indian Institute of Science at Bangalore. Dr. J. T. Hewitt was nominated to fill the vacancy in the list of vice-presidents caused by Professor Thorpe's appointment.

At a meeting of medical women held recently in Toronto preliminary steps were taken to form a Canadian Medical Women's Association. Dr. Sproule-Mason was appointed acting president and Dr. Isabel Ayre, of Toronto, was appointed acting secretary. Dr. Jennie Smillie attended the recent International Conference of Medical Women at Geneva as a delegate from this Canadian association.

At the Cleveland meeting of the American Pharmaceutical Association, the following grants were made from the Research Fund: To D. I. Macht, of the Johns Hopkins University, for pharmacological work on benzyl compounds, $200; to Albert Schneider, Portland, Oregon, for chemical and pharmacological work on chaparro amargosa and on sodium cinnamate, $200.

Francis Maidl, of the National Museum of Vienna, has been appointed curator of the department of entomology at Cornell University.

Dr. Benjamin C. Gruenberg has resigned from the United States Public Health Service, Washington, where he has for the past two years worked on the government's program of sex education in high schools and colleges, to study the problems of the educational use of motion pictures with the Urban Institute, Irvington-on-Hudson, New York.

Professor William Trelease, head of the department of botany of the University of Illinois, spent the past summer in a study of types of American peppers at the botanical centers of Kew, Brussels, Paris, Geneva, Berlin and Copenhagen.

Dr. Barton Warren Evermann, director of the California Academy of Sciences and the Steinhart Aquarium, sailed from San Francisco on the *S. S. Maui*, on October 18, to attend the Pan-Pacific Commercial Conference held in Honolulu from October 25 to November 8. Dr. Evermann was appointed the official delegate to represent the following institutions: National Research Council, National Academy of Sciences, California Academy of Sciences, Pacific Division of the American Association for the Advancement of Science and the San Francisco Chamber of Commerce. A paper was presented by him at the conference entitled "Conservation of the marine life of the Pacific."

Dr. and Mrs. Alexander Hamilton Rice are planning another expedition to South America during the coming winter, to continue their explorations.

Professor Emmanuel De Margerie, director of the Geological Survey of Alsace and Lorraine, who has just arrived in the United States, will deliver a lecture on "France's contribution to geology and geography in the last hundred years," before the Section of Geology and Mineralogy of the New York Academy of Sciences on the evening of November 6, at the American Museum of Natural History. At the last meeting of the section on October 2, Professor E. W. Berry, of the Johns Hopkins University, lectured on "The geological history of South America."

Dr. Augustus Trowbridge, of Princeton

University, on October 26 lectured before the Franklin Institute on "Highspeed photography of vibrations."

THE *Journal* of the American Medical Association states that the faculty of medicine of the City of Mexico recently organized a ceremony in honor of Laveran, the French army surgeon who discovered the malaria parasite. Representatives of various scientific societies, the directors of the faculties and the dean of the university took part in the tribute. Laveran died in May.

THE library committee of the New York Academy of Medicine will be glad to receive memorabilia, such as letters, manuscripts, photographs, engravings or pictures of any kind relating to the life or work of Louis Pasteur. These will be used for the academy Pasteur celebration from December 27 to January 10. All communications should be addressed to Mr. J. S. Browne, librarian.

DR. ALBERT AVERN STURLEY, instructor in physics at Yale University and formerly professor of physics at the University of King's College, Windsor, N. S., died in New Haven on October 22, at the age of thirty-five years.

COLONEL E. H. GROVE-HILLS, F. R. S., treasurer and ex-president of the Royal Astronomical Society, died on October 2.

THE death is announced of Dr. Tourneux, professor of histology at the University of Toulouse.

PROFESSOR H. BATTERMAN, formerly professor of astronomy at Königsberg University and director of the University Observatory, has died at the age of sixty-two years.

WE learn from *Nature* that in the will of Prince Albert of Monaco, who died on June 26 last, there are several gifts for scientific purposes. His farm at Sainte Suzanne is left to the French Academy of Agriculture, and the wish is expressed that the estate should remain a place for agricultural experiments, to demonstrate what science can obtain from sterile lands. Dr. Jules Richard will receive 600,000 francs to enable him to complete literary and scientific works in progress, including the results of the oceanographic cruises and the preparation of the Bathymetric Chart of the Oceans. The proceeds of the sale of the yacht *Hirondelle*, all books and publications of a scientific nature, as well as certain personal effects, will go to the Oceanographic Institutes at Paris and Monaco, while the Institute of Human Paleontology in Paris is to receive any personal effects relating to the work carried on there. The Paris Academy of Sciences will receive a million francs, the income of which is to provide a prize to be awarded every two years, the nature of the prize to be indicated by the academy, according to the needs of the moment; a like sum is bequeathed to the Academy of Medicine for a similar prize.

PROFESSOR HIRAM BINGHAM has presented to Yale University the anthropological and archeological collections of the Peruvian Expeditions. These collections are to be deposited in the Peabody Museum when the new building is erected.

THE International Congress of Americanists, which met recently at Rio de Janeiro, decided to hold the twenty-first session of the congress in 1924 in Holland. In 1925 the meeting will be held at Gothenburg, and in 1926 in Philadelphia.

AT a recent meeting of the International Commission on Eugenics, held in Bruxelles, and at which there were present representatives from France, Belgium, England, Holland, Denmark, Norway and the United States, it was voted unanimously to invite the German geneticists to send representatives to the commission.

THE first number has appeared of the *Journal of Biochemistry*, published at Tokyo. It contains contributions written in English, French and German. It is published quarterly under the editorship of Samuro Kakiuchi, professor in the Tokyo Imperial University.

IT is reported in the New York *Times* that at a conference in St. Paul, Minn., the Twin City pastors, representing Baptist, Congregational, Presbyterian and Lutheran churches, on October 26 voted to issue a call for a state-wide meeting of protestant ministers next week to oppose the teaching of evolution in the public schools of Minnesota. Condemning evolution as "a program of infidelity masquerading under the name of science," resolutions were adopted urging that "Christians throughout the state appeal to the legislature to eliminate from all tax supported schools this anti-scientific and anti-scriptural theory of the origin of man and the universe." The Reverend W. B. Riley, pastor of the First Baptist Church of Minneapolis, the head of the committee calling the state gathering, said that it would be urged to start an injunction suit to prevent public schools, normal schools and the State University from receiving funds from Christian taxpayers for the teaching of evolution. This decision is reported to be the direct result of an address given on the preceding Sunday in St. Paul by William Jennings Bryan, in which the adherents of evolution were denounced.

A FEDERAL statute discontinued on December 1, 1921, all serial publications issued by executive branches of the government, excepting those especially authorized by law. Accordingly, the latest issue of the *Journal of Agricultural Research* was November 26, 1921. This journal carries reports of original research conducted by investigators of the Department of Agriculture and cooperating state experiment stations. During the last congress, an amendment to the statute was passed providing for the printing of journals or other serial publications under certain limitations, among which was included the approval of the Bureau of the Budget. Under date of October 19, 1922, General H. M. Lord, director of the Bureau of the Budget, has informed the secretary of agriculture that the use of funds from the appropriation for printing and binding of the Department of Agriculture is approved for the printing of the *Journal of Agricultural Research,* to be published weekly in the standard octavo size. Manuscripts which are now on hand will accordingly be forwarded to the Government Printing Office immediately, and it is believed that the first issue of the *Journal* of the forthcoming new volume will appear on January 6, 1923.

IN 1921 Stanford University received a grant of $20,300 from the Commonwealth Fund for a study of gifted children, to be conducted by Professor Lewis M. Terman. During the school year of 1921-1922 approximately 1,000 children of the desired degree of superiority were located and extensive data concerning them were secured. This grant has now been supplemented by a second grant of $14,000 from the same source, on the condition that Stanford University contribute an equal amount, which it has agreed to do. The second grant is chiefly for the purpose of securing medical, anthropological and additional psychological data, but a part of the sum is being devoted to a parallel biographical study of the childhood of men and women of genius. The total cost of the Stanford investigation will be in the neighborhood of $50,000.

MR. SAMUEL G. LANCASTER, of Portland, Oregon, Columbia Highway engineer, has purchased and improved a tract of seventy-three acres, on the Columbia Highway, about forty miles east of Portland, known as Lancaster Camp. The home economics and service in camp is in charge of Reed College, the personnel consisting during the summer months of Reed students. Ten per cent. of the first $1,000 earned from dining service goes to the college for scholarships, with an increase of ten per cent. for each successive $1,000, up to the first $4,000 earned, fifty per cent. of all such earnings thereafter going to the scholarship fund, the remainder to be used in beautifying the grounds, which are to be kept in perpetuity. The scheme was put in operation in the spring of 1922.

AT the recent meeting of the American Electrochemical Society, in Montreal, an advisory committee was appointed to consult with the Bureau of Mines on its electrometallurgical research work and to recommend to the bureau lines of research and investigation. The membership of the committee is made up of the following, who are also members of the Electrothermic Division of the American Electrochemical Society: Robert Turnbull, *chairman,* J. A. Seede, Dorsey A. Lyon, F. W. Brooke, E. L. Crosby, Acheson Smith, Colin G. Fink, C. A. Schluederberg. The bureau will send monthly progress reports of its electrometallurgical work to the members of this committee. Among the suggestions for research work which the committee has already made to Dorsey A.

Lyon, chief metallurgist of the Bureau of Mines, are: specific heats at different temperatures, refractories, expanding of refractories, and spalling of refractories.

AT the annual meeting of the State Federation of Pennsylvania Women on October 12, at which more than 600 women were present, the following resolution, with possibly fifteen or twenty dissenting votes, was adopted:

Whereas, It has been conclusively demonstrated that the health and happiness of hundreds of thousands of animals, and of many millions of human beings, have been promoted and their lives prolonged by the application of knowledge obtained through scientific experiments on animals; and

Whereas, These researches are conferring a wonderful boon upon the starving nations by constantly adding greatly to the food supply of the world; therefore be it

Resolved, That the State Federation of Pennsylvania Women, assembled in annual general convention in the city of Reading, Pennsylvania, on the twelfth day of October, 1922, hereby put on record their gratitude to medical science for past discoveries so profoundly beneficial to human beings and to animals, and we believe that such beneficent researches should be continued and encouraged.

THE State Department has issued invitations to one hundred and fifty countries to take part in an international congress on dairying to be held in this country in October, 1923. The program, in addition to topics of interest to the industry at large, will include recent advances in the sciences related to dairying and particularly the significance of milk and milk products in nutrition. The chairman of the program committee is L. A. Rogers, Dairy Division, United States Department of Agriculture, and the chairmen of the four sub-committees are: C. H. Eckles, University of Minnesota, St. Paul, Minnesota; O. F. Hunziker, Blue Valley Creamery Company, Chicago, Illinois; Fred Rasmussen, secretary of agriculture, Harrisburg, Pa.; H. C. Sherman, Columbia University, New York.

AT the meeting of the League of Nations committee which was held at Geneva, it was decided that arrangements should be made to hold an international congress of the universities of all countries. The subcommittee charged with the arrangement of this congress was instructed to prepare a report on the following topics: The exchange of professors and of students; the equivalent values of university courses and degrees; the institution of international scholarships, of international vacation courses, and of a central office for information on university matters.

UNIVERSITY AND EDUCATIONAL NOTES

FOSTER HALL, the chemical laboratory of the University of Buffalo, designed especially to meet the needs of the electro-chemical, hydro-electric, dye and steel industries on the Niagara frontier, was dedicated on October 27 in connection with the installation of Dr. Samuel P. Capen, of Washington, as chancellor of the university. Dr. Edgar F. Smith, president of the American Chemical Society, and Dr. Edwin E. Slosson, of Science Service, were speakers at the ceremony. The laboratory, erected at a cost of a million dollars, is the gift of O. E. Foster, of Buffalo.

DR. JOHN STEWART, dean of the faculty of medicine of Dalhousie University, Halifax, laid the cornerstone of the new medical science building for Dalhousie University on September 29.

AT the meeting of the Yale Corporation held on October 14, Professor Richard Swann Lull was appointed director of the Peabody Museum of Natural History for a term of five years. Professor William Ebenezer Ford was elected curator of mineralogy in the museum, to succeed Professor Edward Salisbury Dana, who retires from the curatorship after a service of nearly fifty years. The corporation passed a vote in appreciation of Professor Dana's services.

DR. G. R. LYMAN, plant pathologist in charge of the Plant Disease Survey of the U. S. Department of Agriculture, has been appointed dean of the College of Agriculture of West Virginia University, where he will have supervision of the three divisions of agricultural work of that institution, which include the resident instruction in the College of Agriculture, the work of the Agricultural Experiment Station, and of the Extension Service.

Dr. Lyman will enter upon his new duties on January 1.

Professor Leroy Patton, formerly of Muskingum College, Ohio, has been appointed associate geologist of the Bureau of Economic Geology in the University of Texas. Dr. E. H. Sellards, who has been with this bureau several years, has been promoted to be chief geologist, Professor T. L. Bailey, from the University of California, has accepted the position of assistant geologist, vacated by Professor W. S. Adkins a year ago, and Miss Dorothy Shoaf, from the University of Chicago, has been appointed curator of the collections.

Dr. J. L. Shellshear, of Sydney, Australia, has been appointed to the chair of anatomy in the new College of Medicine of Hongkong University.

DISCUSSION AND CORRESPONDENCE

NOTE ON THE DISSOCIATION OF CARBON IN THE INTENSIVE ARC

Some two years ago while experimenting with the extremely powerful arcs used in the Sperry search lights we noted the singular color and peculiar spectrum in the "negative tongue" which appears at currents of 100 amperes and upwards. It develops rather suddenly as a core of the negative flame, suggesting the inner cone of a blast lamp save in color, which is pale purplish.

The spectroscope disclosed a small number of clearly marked lines superimposed on fainter hazy and complex bands, due to the surrounding arc flame. Examining the tongue spectrum of the lines from time to time, we found substantially the same spectrum from various makes of unmineralized carbons, foreign and domestic. Finally, using a five inch achromatic condenser to throw the image of the tongue on a ground glass we examined it in detail with a direct vision spectroscope equipped with a scale, comparison prism and holder for spectrum tubes.

We thus found as characteristic of the tongue spectrum, some fifteen well defined lines. Of these, seven were good coincidences with the most conspicuous of the well known helium lines, and two others with Hα and Hβ.

The He lines were wl: 7066, 6678, 5876, 5048, 5016, 4922, 4388.

Five of these lines belong to the single line, so-called Parhelium series, being the brightest lines of the principal and second subordinate series, and the three of the first subordinate series.

Of the doublet system the chief lines of the sharp and diffuse series respectively appear, not very brilliantly, while we have not yet detected any of the enhanced series. All indications point to the dissociation of a certain proportion of carbon nuclei with the consequent appearance of He due to the immense concentration of energy in this 150 ampere arc. The H lines may be due to water-vapor absorbed by the soft carbon core, or perhaps to further dissociation. We are now setting up a concave grating spectrograph for the closer examination of the tongue spectrum under much higher dispersion, and hence with a less obtrusive background. We hope that the evidently very high ionization power here manifested may lead us to interesting developments with still other elements.

Our thanks are due to the courtesy of Mr. Sperry in extending the great facilities of his laboratory.

Louis Bell
P. R. Bassett

THE DETERMINATION OF FAT IN CREAM

To the Editor of Science: The authors (E. G. Mahin and R. H. Carr) of a paper on "Errors in the Determination of Fat in Cream," read at the Birmingham meeting of the American Chemical Society, have experienced considerable surprise at the tone of a letter by H. W. Gregory, appearing in the issue of Science for September 15, 1922, in which he discusses our work upon this subject. Professor Gregory has based his criticisms upon a mere advance abstract, containing no details of experiment or reasoning, and without adequate knowledge of the real points at issue.

In the original paper by Mahin and Carr (not yet published) we have simply called attention to a hitherto unsuspected error in the almost universally used "glymol" method for making fat readings in the Babcock tests on cream, and we have stated very plainly that there is little or no error if the glymol is added slowly, with the tip of the pipette resting against the neck of the bottle *near the butter fat layer* but (and this is the important point) that by the manner in which the glymol is likely to be added by the average dairy helper there is nearly always an error in the direction of low readings.

That this conclusion was entirely justified will, we believe, be apparent when we state that the results quoted in the original paper were obtained in Professor Gregory's own laboratory, both of the authors watching the tests as they were made in a purely routine manner, by the regular tester and upon creams as they were received in the laboratory. We made no suggestions to the tester, merely asking permission to take readings before and after each addition of glymol. Our observations were confirmed by the tester at the time they were made.

That this is not to be taken as a criticism of the work of the tester, or as a charge of carelessness or wilful negligence, or of lax administration of any laws bearing upon the subject, should be evident when we state that it was only after a considerable amount of subsequent experimentation that we stumbled upon the explanation of the error, which is to be found in the fact that the tester usually follows the very natural method of placing the tip of the pipette just inside the top of the bottle neck, then allowing the oil to flow at the full delivery speed of the pipette into the bottle. This *cause* of error was discovered in March, 1922, and it seems obvious that Professor Gregory's inspectors could not have found and checked the incorrect method for 1,800 or more testers *during the past year,* when neither they nor we nor (so far as is known) any one else knew that the method was incorrect.

We regret very much that our statement regarding the importance of the error in Indiana was interpreted as a charge that Indiana creameries "are beating our producers out of $20,000 worth of cream per year." The case of ten Indiana creameries was cited merely because we happened to have approximate figures on production for 1917 and no charge of this kind was made or even remotely intended. However, because of possible similar misinterpretation by others, we shall gladly delete this paragraph from the paper, as it adds nothing to the scientific value of the latter.

One further misquotation should be noted. In the discussion of the use of various non-miscible oils for this purpose we mentioned the trial of several of these, citing the work of Eckles on fat-saturated amyl alcohol. Of all of the liquids tried, we found that amyl alcohol so prepared was the only one that did not cause a change in readings and we so stated but, far from recommending the use of this liquid, we stated various objections to it and finally concluded that the use of *all* such fluids should be abandoned. Professor Gregory has cited an experiment in which amyl alcohol lowered the fat reading after standing ten minutes but in this experiment, according to his own oral statement, he omitted the very important detail of first saturating the alcohol with butter fat. The conclusion seems fairly obvious. The advance abstract of our paper did not mention this point, but, as already noted, an abstract can not go into experimental details.

We understand that quite lately the laboratory in which our observations were made has begun the use of a much lighter hydrocarbon oil than the one formerly used. We do not know whether this has diminished the error but we think it quite likely. If so, we have here another variable, in the variation in specific gravity and viscosity of the oils in general use for the purpose, where limits are not specified for these properties.

In conclusion, we do not believe that this, or any other scientific question, can be settled by denials or display of feeling, but that the laboratory is the only place where a decision can be reached and we offer, as the simple solution of the matter, that each one who is interested shall try the two methods of adding glymol, making observations for himself. We have no doubt that evidence will be found both for and against our conclusions *because the essential defect of the glymol method lies in its variable possibility of error.* But if our statements are "incorrect truths," polemics will not be required to prove them so. Laboratory experiments are far more reliable.

E. G. Mahin,
R. H. Carr
Purdue University

NOTE ON A DAYLIGHT METEORITE

Thinking that it might be of interest to readers of these columns, the writer calls attention to the following phenomenon observed by him while traveling by canoe on Lake Kipawa, Quebec, on August 31 last.

The day was particularly bright and cloudless, with a southerly wind blowing at about eight miles an hour. The time of the observation was 9:50 a. m., and the course of the canoe was almost directly south. The meteorite was suddenly seen to shoot across the course of the canoe from east to west, about 50° above the horizon, and, as far as could be judged, between 200 and 300 feet above the surface of the lake. Its passage lasted approximately three seconds from the time that it was first noted a little to the left of the bow of the canoe. The general impression received was that of a brilliant Roman candle shooting across the sky, of a vivid copper-green color. The size of the incandescent head of the body appeared to be a trifle larger than a golf ball with a bright incandescent streamer of nearly three feet in length behind it and of a like color. In the wake of the body trailed a curling wreath of white vapor of considerable length which became quickly dissipated.

The passage of the meteorite was accompanied by no detectable noise whatever, so that the other occupant of the canoe, whose gaze was directed elsewhere at the time, failed to see the occurrence. The body suddenly vanished about a hundred yards to the west about the original altitude, leaving a small cloud of white vapor behind that dissolved rapidly away. Although watch was kept on the surface of the lake beyond, no trace of a body falling into the water was noted. It is possible that either it was completely combusted at that moment, or it passed out of sight rapidly along its westerly course.

Norman MacL. Harris
Department of Health of Canada,
Ottawa, Ontario

HOWARD ON CHEMICAL SPELLING

O Leland tell me, tell me true,
The explanation's up to you,
Why did you break the portals down
And jump into the Chemist's town?
But wait a minute: Now I see,
To solve the riddle's up to me;
You still are in your own domain
Where you without a rival reign,
For as the fact appears to me
You're trying to catch that spelling bee.

H. W. Wiley

QUOTATIONS

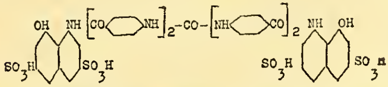
"BAYER 205"

A curious illustration of the German desire, not unnatural in itself, to regain the tropical colonies lost by the folly of the rulers of the German Empire, is afforded by a discussion which took place at a meeting of the German Association of Tropical Medicine at Hamburg. We have not seen a full report of the meeting, but the *Times* correspondent in Hamburg reports that one of the speakers said that "Bayer 205 is the key to tropical Africa, and consequently the key to all the colonies. The German government must, therefore, be required to safeguard this discovery for Germany. Its value is such that any privilege of a share in it granted to other nations must be made conditional upon the restoration to Germany of her colonial empire." Some account of the drug manufactured by the Bayerische Farbwerke and provisionally named "205" was given in our issue of May 20 (p. 807), when we quoted Dr. H. H. Dale's opinion that it was a remarkable curative agent in trypanosome infections. A general account of the probable chemical relationship of "205" is given by Dr. King in the sixth Annual Report of the Society of Chemical Industry (1921).

In 1904 Ehrlich and Shiga discovered the trypanocidal action of trypan red, a compound formed by combining one molecule of tetrazotized benzidine-mono-sulfonic acid with two molecules of sodium naphthylamine disulfonate. In 1906 Mesnil and Nicolle[1] investigated a series of dyes containing amino-naph-

[1] *Ann. Instit. Pasteur*, 417 and 518, xx, 1906.

thalene-sulfonic acid and found that the most active trypanocidal agent was a dye prepared by the Bayer firm. Little notice was taken of this work, and the discovery of salvarsan diverted attention from the trypanocidal dyes to the organic arsenic compounds. The Bayer firm, however, continued to investigate the trypanocidal dyes and discovered that compounds of this type which were not dyes might still be active trypanocidal agents. They took out a large number of patents, and the type of compound to which the firm has paid special attention is represented by the following formula:



A number of substances of this type have been found to be very active trypanocides, and probably Bayer 205 is a derivative of this type. Bayer 205 is a white powder, freely soluble in water, forming a colorless solution, which can be sterilized. Animal experiments[2] have shown that it is an extraordinarily powerful trypanocidal agent, and that a single dose of it will produce immunity to trypanosomes for several weeks or even months. Mayer and Zeiss, for instance, found it cured infection with five different kinds of trypanosomes, that the ratio between the minimal lethal and minimal curative doses was as high as 167 to 1, and that a single dose of 3 mg. rendered a mouse immune to trypanosomes for three months. Recurrences were found to be extremely rare when infected mice were given a single curative dose of the drug.

The various workers have reported curative effects on trypanosomal infections in mice, rats, guinea-pigs, rabbits, dogs and horses. In England Wenyon[3] found that the drug was an extraordinarily effective trypanocidal agent. A brilliant success has been reported in a case of sleeping sickness.[4 5] The case was of a year's standing, and had been treated unsuccessfully with arsenic, antimony and emetine. Four doses of "205," making a total of 3.5 grams, were given. A few hours after the first dose the fever disappeared, and a complete cure appears to have been produced, for four months later there were no signs of recurrence of the disease.

The drug therefore appears to be a trypanocidal remedy of the first importance, and the fact that a single dose confers prolonged immunity to trypanosomes suggests that it will be of the greatest value as a prophylactic. A commission of German doctors is now in Rhodesia testing the drug, and our knowledge as to its action in man will soon be much more extensive. The discovery of "205" promises to mark a great advance in tropical medicine, but it is a remarkable fact that England should be dependent on Germany for this advance in tropical medicine, for at present Germany has not a single colony, while England has the largest tropical empire in the world. It is not a position of which we have any reasou to be proud, but its cause is simple. Germany appreciates the value of pharmacological research and we do not.—*The British Medical Journal.*

SCIENTIFIC BOOKS

Smell, Taste and Allied Senses in the Vertebrates. G. H. PARKER. Philadelphia and London, J. B. Lippincott Co., 1922, 192 pages, $2.50.

This little volume includes chapters on the Nature of Sense Organs, Anatomy of the Olfactory Organ, Physiology of Olfaction, Vomeronasal Organ or Organ of Jacobson, The Common Chemical Sense, Anatomy of the Gustatory Organ, Physiology of Gustation, and Interrelation of the Chemical Senses. In view of the author's long sustained interest in problems of integration of structure and function and his numerous successful experimental

[2] Haendel and Joetten, *Bull. Instit. Pasteur,* 131, 19, 1921; Mayer and Zeiss, *ibid.,* 133, 19, 1921; Walther and Pfeiler, *ibid.,* 380, 19, 1921; Miessner and Berge, *ibid.,* 380, 19, 1921; Mayer, *ibid.,* 248, 20, 1922; Schuckmann, *ibid.,* 247, 20, 1922.

[3] Wenyon, *British Medical Journal,* 1921, ii, 746.

[4] Muhlens and Menk, *Muench. med. Woch.,* 1488, 46, 1921.

[5] Yorke, *Ann. Trop. Med. and Paras.,* 479, 15, 1921.

attacks upon problems of this sort in the field of sense physiology, it is needless to say that his survey of the chemical senses is accurate, authoritative and judicious. So brief a summary naturally can make no claim to completeness, but it is a well balanced selection of topics of significance to students of physiology, psychology and allied sciences.

The more theoretical discussions, especially those centering about the genetic relationships of the receptors, naturally enter debatable territory. In summarizing his well-known observations on the organization of sponges, which "possess muscles but are devoid of nervous tissue," Dr. Parker reiterates (p. 21) his belief that in phylogeny differentiated muscles probably preceded nervous tissue. "So far as can be judged these [nervous] elements originated in connection with the previously differentiated muscle and as a special means of exciting it to contraction." This conclusion seems both unphysiological and unsupported by the facts.

That muscle should be differentiated in advance of the receptive apparatus through which it is activated seems *a priori* as improbable as that receptors should be developed in advance of the appropriate effectors. And Parker's own experiments strongly suggest that the so-called muscles of sponges are really excito-motor organs with lowered excitation threshold and that the excitation mechanism is elaborated within them parallel with the contractile mechanism rather than apart and subsequently. Ordinary protoplasm is, of course, both excitable and contractile, and in some unicellar forms (*e. g.*, Diplodinium, Euplotes, Paramecium and others recently described at the University of California) there are excito-motor masses of protoplasm in which these two functions are both highly developed and in various stages of separation physiologically and structurally. In sponges, as in other lowly multicellular forms, the excitation factor can not be regarded as lagging behind the contractile factor in the differentiation of the process and apparatus of reaction, even though the tissue involved may look more like muscle than like nerve.

In the concluding discussion (chapter 8) all receptors are arranged in three groups: (1) mechanicoreceptors (organs of touch, hearing, equilibration, and probably organs of muscle, tendon and joint sensitivity, lateral line organs of fishes and some others); (2) radioreceptors (organs of vision and temperature); (3) chemoreceptors (organs of smell, taste, general chemical sensitivity, and probably some others). This classification is natural and so far as it goes very satisfactory. But when the author adds (p. 180), "To ascertain into which of these three groups a receptor falls it is necessary to know how it is stimulated after which its classification is simple and immediate," one begins to question how far the simplicity and immediacy of the procedure really takes us.

Rays of the solar spectrum with wave length of say .0008 mm. falling upon the retina and upon the skin produce very different excitations. Both organs are by definition radioreceptors, but just "how it is stimulated" we do not know in either case, nor do we know how it comes about that, if sensation follows the excitation, it is of red in one case and warmth in the other.

Similarly, it has been shown by Parker that ethyl alcohol is an excitant of the organ of smell, the organ of taste and general mucous surfaces and by Carlson of the mucous lining of the stomach also. The threshold is different in each of these cases, the typical reactions are very characteristic in each case, and the sensations (if any) are likewise distinct. Now the fact that these four organs are all chemoreceptors, while important, is less significant biologically than any one of the other three criteria mentioned. In fact, the classification of receptors in terms of the effective stimulus has a very limited range of usefulness and the ultimate goal of our endeavors should be to add to the simple determination of the adequate stimulus of a sense organ the physiologically far more significant knowledge of the real nature of the excitation (that is, of the immediate protoplasmic response to the stimulus) and also a codified statement of the typical or physiologically "normal" more remote effects (reaction, sensation). We are at present very far from the attainment of this ideal, for, as Parker says (p. 180), "The real difficulty lies in the fact that the numerous receptors that we now recognize have undergone varying degrees of differentiation and hence their mutual affinities are extremely diverse."

On the morphological side the difficulties are even greater, and the various attempts which have been made to determine which of the various anatomical patterns of end-organs are more primitive seem rather futile. Protoplasm in general seems to be sensitive to all of the three kinds of stimuli of Parker's classification and morphologically homologous organs seem capable of transgressing our artificial biological laws and "uniformities" in fashion most disquieting to the systematist. This is illustrated by Whitman's description (since confirmed by Hachloy) of the cutaneous sensillæ of leeches, which are tactile in function on the body but in the head become gradually metamorphosed into visual organs, and also by the way in which both olfactory and gustatory organs may serve on occasion as either interoceptors or exteroceptors, with characteristically different central connections and reaction types in the two cases.

No better summary of this phase of the matter can be given than the concluding sentences of Parker's book: "It is because of the repeated differentiations that characterize the evolution not only of the chemoreceptors but of the other groups of like organs that a classification of them or even a simple enumeration proves to be so unsatisfactory. For they are not unitary elements that can be counted like the fingers on the hand nor are they sufficiently co-ordinated to make classifications easy and natural. They are like the whole organism itself in that they exhibit that kind of diversity that characterizes evolutionary flux."

C. Judson Herrick

SPECIAL ARTICLES

PERIGENESIS

I am presenting here a short preliminary account of the results of a study of the division figures in *Tradescantia virginica* L.

With the methods used, the structure of the chromosome is that of an achromatic cylinder of jelly-like consistency as described by Vejdovsky (1912) in which the chromatin, however, is imbedded in the form of chromomeres rather than a spiral. These bodies are so distinct that in any one optical plane, they can be counted.

They are made up of flocculated chromatin particles which associate together in rather dense masses which are arranged inside of the periphery of the linin cylinder in such a manner that there results a central core of achromatic substance.

The relationships of the chromomeres one to the other seem to be somewhat variable although the chromosome often shows a quadripartite cross-section as figured by Merriman (1904), Bonnevie (1908), and by Nawaschin (1910).

The effect of fixing, imbedding, and staining this structure gives appearances which have doubtless led to the interpretation that it is longitudinally split.

The arrangement of the chromatin particles within the achromatic cylinder may be traced back, in the vegetative stages especially, to the earliest prophases and I do not find anywhere, either in the vegetative or reduction divisions, any further evidence of a longitudinal split so that for the reductions, I agree with Meves and others that there is no side by side pairing of the chromosomes in these stages.

I find as did Suessenguth (1921), in spite of the recent evidence in favor of a parallel conjugation, that the continuous prophase spireme is constricted into the chromosomes in end to end relationships.

Muller (1921), in discussing the work of Troland (1917) says, "If he is right, each different portion of the gene structure must—like a crystal—attract to itself from the protoplasm, materials of a similar kind thus moulding next to the original gene another structure of similar parts, identically arranged, which then become bound together to form another gene, a replica of the first."

From the phenomena in all metaphase figures, inasmuch as I find the separation is not by longitudinal division, I would limit the above quoted process to the stages beginning with the close of the telophase and closing with the first tendency towards the formation of the spireme or, in other words, to the so-called resting condition.

E. Haeckel described such a process of growth as the *perigenesis of the plastidules* though perigenesis as described by Haeckel is not referred to by Muller.

The sporophyte cell, from the end of the telophase to the beginning of the next prophase, would therefore become, normally, a tetraploid unit with the chromatic contents merely in need of distribution in the case of the vegetative division or, in the case of the reduction division, of random segregation. Actual return to the gametophytic condition is not accomplished till the second division since dyads are separated on the first or so-called heterotypic spindle.

It is assumed that the genes after the genesis of their like, reassemble in such a fashion that they form a continuous prophase spireme thread. It is during this reassembling of the genes, this reorganization of the nucleus, that the phenomena of crossing over may occur as well as perhaps some mutations not due to such factors as non-disjunction, re-duplication, deficiency, etc.

My material was examined in the living condition, by special staining methods of the living cells in sugar suspensions, by *intravitam* staining, and, as a check, by the standard fixing, hardening, and imbedding methods.

Detailed descriptions, drawings, and photographs will be published in the near future.

Harold C. Sands
Columbia University

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF RUBBER CHEMISTRY

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Committee reports:

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Discusion of "Methods of Research Testing" by committee.

Analytical Standardization: S. Collier, *chairman.*

American conclusions regarding crude rubber: (By title): O. de Vries.

Chemical reactions of sulfur terpenes with rubber. I: John B. Tuttle.

Studies in vulcanization: mechanism of the acceleration of vulcanization of zinc ethyl xanthogenate: H. A. Winkelmann and Harold Gray. The gaseous, liquid and solid decomposition products of zinc ethyl xanthogenate are shown to have no accelerating value. The activity of zinc ethyl xanthogenate as an accelerator is due to the unchanged molecule.

Effect of certain tread pigments on temperature developed in pneumatic tires: D. F. Craver. The paper is a short description of tread compounds used, stress-strain curves of same, theoretical conductivity as calculated by Williams formula, and the actual heating up of tire built with such treads when run on the road, temperatures being taken by means of thermo couple inserted by the awl which was devised by the research department of the New Jersey Zinc Company.

Disubstituted guanidines: Winfield Scott. Disubsubstituted guanidines function as accelerators as amines and belong to the class of hydrosulfide accelerators only. Diphenylguanidine reacts with hydrogen sulfide and carbon bisulfide to form a trithiocarbonate, with aniline and carbon bisulfide to form a dithiocarbamate and with carbodiphenylimide to form tetraphenylbiguanide. The effect of small amounts of zinc oxide and zinc carbonate on the tensile strength of rubber cured with disubstituted guanidines is quite marked. The relative curing powers of di-p-tolylguanidine, di-o-tolylguanidine and diphenylguanidine are in the order named, the first being the most efficient. It requires 25 per cent. more diphenylguanidine than di-o-tolylguanidine to produce the same acceleration.

Studies in hysteresis of rubber compounds: W. W. Vogt.

Thermal changes during vulcanization: Ira Williams and D. J. Beaver. The measurement of the temperature developed in the center of a cylinder of rubber sulfur mixture which is immersed in a constant temperature bath shows that heat is liberated during the first stages of the reaction. An absorption of heat is indicated during the later stages. The extent of these thermal changes has been estimated when stocks of different sulfur and accelerator content were cured at different temperatures. The relationship between the temperature developed and the per cent. combined sulfur is given.

Zinc oxide in a new physical condition—its effect upon rubber compounds: FRANK G. BREYER.

Reactions of accelerators during vulcanization. V. Dithiocarbamates and thiuram disulfides: G. W. BEDFORD and HAROLD GRAY. The metallic dithiocarbamates are true accelerators of vulcanization. Metallic oxides are necessary to prevent the decomposition of the metallic salts by hydrogen sulfide or to reform them after decomposition. Hydrogen sulfide changes thiuram disulfides to dithiocarbamates and decomposes the metallic salts. Ammonia increases the curing power of both thiurams and zinc dithiocarbamates. These views are supported by chemical data obtained in the laboratory in the absence of rubber.

A method for the measurement of resistance to tear in vulcanized rubber: ERLE C. ZIMMERMAN. A method is presented for measuring the resistance to tear of vulcanized rubber in terms of work. In this test a sheet of rubber 0.1 inch thick is supported between hooks on the ordinary tensile testing machine, and an autographic chart is taken as the rubber is torn. Resistance to tear is expressed as inch-pounds per square inch of rubber torn, in the formula,

$$W = \frac{KA - \frac{Fe}{2}}{Lt}$$

in which "K" is a constant, "A" is the work area on chart, "L" is the distance torn, "t" is the thickness, "e" and "F" are the elongation and force in equilibrium at the end of the test. Some data are given of resistance to tear in zinc oxide and pure gum stocks.

The results of variation in the sulfur and hexamethylenetetramine content on some of the properties of compounded rubber: H. A. DEPEW. A non-blooming compound must not contain more than 1 per cent. of free sulfur calculated on the rubber. Using hexamethylenetetramine as an accelerator, the tensile strength, elongation and maximal area under the stress-strain curve increase with a decrease in the amount of sulfur used, and to a lesser extent are increased by using a large amount of accelerator. The shape of the stress-strain curve is not affected by the sulfur and accelerator content. The vulcanization coefficient at the optimum cure depends on the sulfur content.

An abrasion machine by which comparative wear tests can be made on laboratory test pieces or on sections cut from tire treads: H. A. DEPEW. A simple abrasion machine is described, on which laboratory test pieces or sections cut from tire treads can be tested for comparative resistance to the abrading or rasping influence of surfaces of known composition. The test pieces fastened at one end, only, are held against a common, uniformly moving, abrading surface with a definite uniform pressure. The effect of pressure upon the test piece and the effects of speed and composition of the abrading surface are discussed. A comparison of this method of testing with the loose abrasive method is given. Comparisons by service tests (tires and heels) are also made.

The influence of certain compounding ingredients in hard rubber: W. E. GLANCY. Several articles have been published showing the action of compounding ingredients in soft rubber goods. Very little has been published thus far with regard to the principles of hard rubber compounding. Graphs are shown which indicate the mass action effect of sulfur, the curing properties of lime and magnesia and the loading qualities of M. R., tire reclaim and resin in hard rubber mixtures.

A convenient nomograph for rubber chemists: W. R. HICKLER and W. E. GLANCY. Rubber chemists have frequently use for tables which will be available for converting the cure of a rubber stock from a known temperature and time to a different temperature with corresponding time. A formula has been worked out from experimental values and a nomograph constructed whereby it is possible to quickly find the desired cure.

Rubber softeners: P. M. AULTMAN and C. O. NORTH. The action of rubber softeners on rubber itself has received very scant attention from rubber chemists. The writers in an effort to find out this action heated vulcanized rubber in each of a large number of softeners until total disintegration ensued. The comparative rate of disintegration was also observed by means of a test in which the swelling of the rubber in the softeners was measured. This method was checked roughly. Sulfur, accelerators and both together were added successively to the softeners to find out their effect on the action, with the results that in each case there was an increase in the rate of solvation. The state of cure was also found to have an effect on the results, as the rate of solvation was found to be inversely proportional to the cure. Mixtures of softeners were found to have, in many cases, the average properties of their components. From these and compounding results, the writers are of the opinion that a definite relation can be worked out between solvating action and the effects of softeners on the stress-strain curve.

The measurement of temperature in rubber articles by means of thermocouples: Ellwood B. Spear and J. F. Purdy. Measurements of the temperature in rubber articles by thermocouples are all too low where the depth of insertion is not great, 1-3 inches, and where there is at the same time a temperature differential along the buried portion of the thermocouple wires. The correction to be applied depends upon the depth of insertion, the size of the wires constituting the thermocouple, and the temperature differential. A new method is given for measuring the temperature in pneumatic and solid tires. Correction curves are given for use where ordinary thermocouples have been employed.

The limitations of the obscuring power test for compounding materials: Ellwood B. Spear and H. A. Endres. Experimental evidence is presented in this article that the obscuring power test for compounding materials is unreliable and often misleading in the region where the diameter of the particles is in the neighborhood of one fourth the wave length of light, *viz.*, 0.1 mu.

The crystallization of sulfur in rubber and the phenomenon of "blooming." I: Herbert A. Endres. A solution of sulfur in rubber exhibits the same phenomena of diffusion, crystallization and super-saturation as are shown by solutions of sulfur in other solvents. When rubber saturated with sulfur at calendering or vulcanizing temperatures is cooled, the solubility is exceeded and the excess sulfur separates as super-cooled globules, dendrites or stable rhombic crystals, depending upon the rate of cooling. Sulfur bloom is always composed of rhombic sulfur; the stable form at room temperature. It may be caused by crystallization at the surface of the rubber, either directly from solution or by transformation from super-cooled globules or dendrites.

The microscopic examination of rubber compounds containing antimony pigments: A. F. Hardman. To secure a section of a rubber compound sufficiently thin for microscopic examination, some method of hardening must be employed previous to sectioning. Sulfur monochloride has been successfully used for this purpose, but the reagent attacks and destroys the identity of the sulfides of antimony. A bath of molten sulfur may be used to produce the required rigidity without materially altering the appearance of the antimony pigments. Photomicrographs illustrating the new method are shown.

The resilient energy and abrasion resistance of vulcanized rubber: H. W. Greider. A study has been made of the effects of several compounding pigments upon the abrasion resistance of vulcanized rubber. It was found that gas black gives the greatest resistance to abrasion, followed by light magnesium carbonate, china clay, zinc oxide, colloidal barium sulfate and lithopone, in the order named. There is found to be a relationship, but not a direct proportionality, between tensile strength and abrasion resistance for rubber compounded with reinforcing pigments. Resilient energy gives an approximate index of abrasion resistance with gas black, magnesium carbonate, china clay and zinc oxide, but it is not a measure of abrasion resistance with colloidal barium sulfate or lithopone. The data appear to show that hardness (or rigidity) is also a factor in resistance to abrasive wear. The product of resilient energy and hardness is suggested as an index of toughness. Some principles are suggested which may be of value in compounding rubber to obtain high resistance to abrasion, including the use of high-grade accelerated mixings and combinations of reinforcing pigments in such proportions by volume as to give proper rigidity combined with high resilient energy. Combinations of gas black and magnesium carbonate in suitable proportions are found to give high resistance to abrasion, high resilient energy and considerable hardness and rigidity.

Persistence of calender grain after vulcanization. (Lantern): W. B. Wiegand and H. A. Braendle.

A study of the relation of the structure of mercaptobenzothiazole and its derivatives to their value as accelerators of vulcanization. (Lantern): L. B. Sebrell and C. E. Boord. The preparation of mercaptobenzothiazole derivatives by the methods reported in a previous paper has been extended to include several new mercaptothiazoles not previously described. Other compounds having a similar structure have been prepared and their curing power compared with that of mercaptobenzothiazole. In this way the particular grouping responsible for the activity of mercaptobenzothiazole as an accelerator has been identified. The effect of substituents in the benzene nucleus of mercaptobenzothiazole upon its activity as an accelerator has also been studied.

Charles L. Parsons,
Secretary

SCIENCE

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INTERNATIONAL AND INTERSTATE ASPECTS OF THE COLORADO RIVER PROBLEM[1]

THE Colorado River has a drainage basin 244,000 square miles in extent. Parts of seven states and a small section of Mexico are embraced within this watershed. But the amount of water contributed to the discharge of the river by the several states and by Mexico bears no definite relation to the extent of watershed in each. This will be seen from the following figures compiled from records of the United States Geological Survey:

Political Subdivision	Watershed Area sq. miles
Colorado	39,000
Wyoming	19,000
Utah	40,000
Nevada	12,000
New Mexico	23,000
Arizona	103,000
California	6,000
Total United States	242,000
Mexico	2,000
Total	244,000

The mean annual discharge of Colorado River and its tributaries is indicated by the following figures:

Name of Stream	Drainage Area square miles	Discharge acre-feet
Green River	44,000	5,510,000
Grand River (Upper Colorado)	26,000	6,940,000
San Juan River	26,000	2,700,000
Other tributaries, not including the Gila	91,000	1,560,000
Gila River	47,000	1,070,000
Colorado River at Laguna Dam		16,400,000

[1]Symposium on "The Problems of the Colorado River," American Association for the Advancement of Science, Salt Lake City.

Beneficial use of the waters of Colorado River commenced many years ago. No attempt will be made in this sketch to do more than to give the briefest outline of historical facts.

The extent to which the water of Colorado River is being used for irrigation will appear from the following figures compiled by Mr. E. C. LaRue for 1913.

Colorado; area irrigated in 1913 was 440,000 acres.

Wyoming; area irrigated in 1913 was 280,000 acres.

Utah; area irrigated in 1913 was 204,000 acres.

Nevada; area irrigated in 1913 was 5,000 acres.

New Mexico; area irrigated in 1913 was 40,000 acres.

Arizona; area irrigated in 1913 was 315,000 acres.

California; area irrigated in 1913 was 297,000 acres.

Mexico; area irrigated in 1913 was 50,000 acres.

In California the irrigated area now approaches 500,000 acres and in Mexico it is about 190,000 acres. There has, of course, also, been extension of irrigation in the upper states but later figures are not at hand.

No Colorado River water was used for irrigation in Mexico prior to the construction of the Imperial Canal from which water began to be used in 1901. By 1905 there were about 5,000 acres of land in Lower California being irrigated. In 1910 the area was probably about 20,000 acres and in 1920 had reached about 150,000 acres.

The potential use of water from this river and its tributaries can not be stated with any great degree of precision. Some allowances must be made for the fact that just at present each of the several interested states is endeavoring to secure recognition of extreme ultimate possibilities in this connection rather than of early future probabilities. For the purpose of a guide in this discussion the following figures are noted—the endeavor being to include in the areas noted as irrigable only such as would seem to justify construction of works within the next thirty years.

In the Green River Basin the extent of irrigation in 1913 was about 500,000 acres and expansion within thirty years to about 900,000 acres is to be expected; in the Grand River Basin from about 300,000 to about 420,000 acres; on the lower Colorado from about 400,000 acres to 1,500,000 acres; in the Gila River Basin from 280,000 to some uncertain extent possibly 400,000 acres; in the San Juan River Basin from 117,000 to 500,000 acres; in the basins of the lesser tributaries of Colorado River from about 61,000 acres in 1913 to about 160,000 acres, and in Mexico from 50,000 in 1913 and 190,000 in 1921 to 600,000 acres.

After the war between the United States and Mexico the boundary line between the two countries had to be fixed. This was done in a conference resulting in a boundary line treaty consummated in 1848. But it was soon found that portions of the line westerly from the Rio Grande should have been placed further south and negotiations were commenced for a modification of the line. The result of these negotiations (in 1853) was the acquisition of a strip of land, now the south portion of New Mexico and Arizona known as the Gadsden Purchase. There is a story current, though probably impossible of verification and to be considered for the present as without foundation in fact, to the effect that the Commissioners of the United States who made the purchase were given the choice of three locations for a new line. According to this story the line furthest to the south touches the head of the Gulf; but the payments to be made by the United States to Mexico were graded according to the distance that the boundary would be shifted southward and the line requiring the least payment was selected by the United States Commissioners. Whether this story be true or not we can now see how unfortunate it was to have fixed the line in its established position. It should have been as far south as the head of the Gulf of California so that the entire delta of the Colorado River would have been in the United States. The Commissioners accepted a location of the line which may at any time become a source of friction and which has already become a matter of great inconvenience and some embarrassment to the United States. The boundary divides the delta of the river not along a channel, which would be bad enough, but in such a way that most of the delta slope toward the south and some of the slope toward the north remains in Mexico.

The absurdity of the resulting situation is daily becoming more apparent and the interruption of diplomatic relations with Mexico (from 1913 to date) has thus far prevented the taking of steps to ameliorate a situation, involving river work in Mexico for the joint benefit of the two countries, which is fast becoming intolerable. It may be remarked, too, that the seriousness of the situation and the importance of having adequate control of the delta section of the river vested in some agency which can accomplish results is not generally recognized.

Recall for a clearer understanding of this international political matter the essential physical facts:

The Colorado River was found on a course to the Gulf of California 400 years ago by Spanish explorers. These explorers, too, found a dry Salton Basin. As about 50 years were required to evaporate the water from this basin after the river ceased to discharge into it, there is, therefore, positive evidence that for over 450 years and probably for over 500 years the Colorado River has been flowing down the south slope of its delta cone. There is physical evidence, too, easily read, that in recent geological time the river has repeatedly changed its point of outfall from the Gulf to the Basin and back again to the Gulf. The following reference to the Salton Basin is found in the report of G. W. Blake, geologist of the transcontinental railroad survey, 1853:

"The present outflows, though but very slight, are probably similar (referring to Indian traditions of a great flood), and yet it is possible that the interior of the desert might be deluged at the present day, provided no elevation of the land has taken place and the river should remain at a great height for a long time—long enough to cause the excavation of a deep channel for New River."

The Indian tradition relating to the ancient lake is thus given by Dr. Blake:

"The great water (agua Grande) covered the whole valley and was filled with fine fish. There were also plenty of ducks and geese. Their fathers lived in the mountains and used to come down to the lake to fish and hunt. The water gradually subsided "poco poco" (little by little) and their villages were moved down from the mountains into the valley it had left. They also said that the waters once returned very suddenly and overwhelmed many of their people and drove the rest back into the mountains."

This ancient lake had a total length from northwest to southeast of 100 miles. Its northern limit was several miles above Indio and its southern margin was 15 miles south of the international boundary in Mexico. It has a mean width of 20 miles. The evaporation of this great body of water, after inflow ceased, caused the mineral contents of the water to be gradually carried to the lowest portion of the basin, where a crust of salts, mainly common salt, was left in sufficient quantity and of sufficient value to justify the establishment of salt works, which were operated for some years by the New Liverpool Salt Company.

It is within the area once covered by the ancient lake that all of the improved area of Imperial Valley lies. Calexico, at the Mexican boundary, is at sea level. Imperial, 12 miles farther north, is about 60 feet below sea level, and the cultivated lands near Brawley extend from about 100 to 200 feet below sea level.

At the northern end of the basin is Coachella Valley with Indio farthest north, and Mecca 190 feet below sea-level near the shore of the lake, when the lake was at its greatest extent in February, 1907.

And then there was another Indian tradition to the effect that the Colorado River flowed into a hole in the ground. The explanation of this tradition occurred to the author of this paper a few years ago and seems simple enough. When the Salton Sea was full, its surface extent was about 2,000 square miles. From this large area of water the annual evaporation was nearly 8,000,000 acre feet of water. This is one half of the normal annual discharge of Colorado River and more than the river's discharge in a year of light run-off. There were, therefore, probably periods of time sometimes exceeding a year in duration, aside from the filling period, when the Indian saw a river flowing into Salton Basin and saw no water flowing out from this basin. What more natural than that he should assume a hole in the ground through which the river poured its waters into the bowels of the earth?

But of particular interest, because of its bearing upon the present discussion, is the main fact that periodically, say for a period of 500 to 1,000 years, the Colorado River had an outfall into the Salton Basin, that is, down the northern slope of its delta cone and again for a similar period of time the river has discharged into the ocean through the Gulf of California.

With this fact in mind let the boundary line be traced from the south boundary of Arizona following up the Colorado River for some 20 miles to Pilot Knob, and thence a little south of west in a straight line to the Pacific Ocean. This boundary line leaves a part of the Colorado River delta, Yuma Valley, in Arizona. It leaves the head of the Gulf of California and the main south slope of the river's delta cone in Mexico; and it leaves the major portion of the north slope of the delta cone, including what is now known as Imperial Valley and also the Coachella Valley, which was once deep under the waters of the ancient sea, in California.

From the earliest studies made of this region by citizens of the United States it is known that the Colorado River originally flowed from near Yuma to the Gulf of California in a meandering channel, having unstable banks, and inadequate capacity to carry all the water presented at flood stages. The distance in an air line from the head of the river's delta to the Gulf is in round figures 80 miles. In this distance the river falls 100 feet. It is about the same distance from the head of the delta to the lowest portions of Salton Basin but as the lowest part of the basin is over 280 feet below sea-level the fall in this direction is nearly 400 feet. If the river should be permitted to flow into the basin it would take 20 or 30 years to fill it up. There was no immediate danger of the river making a change in its course under the natural conditions that prevailed 50 to 75 years ago because at each flood stage the river banks were overtopped; they were well watered far back from the edge of the stream, and carried a luxuriant growth of trees, brush and grass and they were being constantly warped up by the sediment which the muddy water of the river spread out over the land.

But as soon as human activities modified these natural conditions, as soon as a small dredger cut invited the river down the steep northern delta slope, the river broke from its channel and temporarily abandoned its course to the Gulf. This happened in 1905 and it took a little more than a year to put the river back into its old channel. But while this was being accomplished the delta channels went dry. The vegetation on the parched bank land died out and fire destroyed the plant growth in large part which had, theretofore, protected the area nearest the river against erosion. And so, at the subsequent high stages of the river, there was more overbank flow and greater concentration of water in the swales leading away from the river and therefore increased danger of the river breaking out of its original channel. 1907 and 1908 passed without this happening, but in 1909 the river broke a new channel toward the west following the course of what was known as the Rio Abejas or Bee River. The point where this abandonment of the original river channel occurred was about opposite the south boundary line of Arizona.

The river has ever since, except for a few weeks while checked by a levee, been sending its water southwesterly in a round about way, through Volcano Lake and the Hardy Colorado into the Gulf. But its flow westerly was on or near the crest line of the river's very flat delta cone. Its channel is a broad shallow bed of sand of irregular alignment. At flood stages its water submerges broad stretches of country. Its flood waters would preferably drop off the delta cone to the north but have been prevented from doing this by levees. Herein lies the purpose of this statement of physical facts. The levees along the river and along the crest of its delta were and are required for the protection of property in the United States. All of Imperial Valley and of Coachella Valley are menaced. This does not mean that if a breach in the levees occurred and the river again discharged into Salton Basin that all of these valleys would be flood swept. Not at all. The river would simply flow for a time into Salton Sea doing some damage but it would be turned back again toward the Gulf long before it could make any great headway toward filling the basin.

The interesting fact is that the levees which prevent the river from thus turning to the north and the great undertakings in 1906 and 1907 of turning the river from an erratic course back into its old bed, had to be done in foreign territory, and, moreover, without permission or sanction to do the work by any treaty arrangement. This will be explained by going back a little. When the Colorado River Land and Water Company (after reorganization the California Development Company) determined to put Colorado River water upon California lands it acquired a large tract of land in Lower California just south of and paralleling the boundary line. It organized in Mexico a subsidiary company, the "Compania de Terrenos y Riegos" and through the agency of this company constructed a few miles of canal from the boundary line, near the river, southerly and southwesterly, to a connection with a flood water slough known as Carters, or Salton or Alamo River. Meanwhile a diverting canal was constructed in California tapping Colorado River a few hundred yards north of the boundary line and leading into the upper end of the Mexican Canal. When water was turned into the canal in California it flowed to the Mexican Canal and thence to the Alamo channel and thence back into California. This became the nucleus of the Imperial Canal system. However, after a few years there was trouble at the head of the canal. Its upper section was too flat to pass all the silt entering from the river. And so in 1904 the Mexican Corporation made application to the Mexican Government for a water concession and the right to construct and maintain canals in Mexico. This was granted and provides that water may be diverted from the Colorado River in Mexico or may be brought into Mexico from California and conveyed across Mexican territory back into California, subject, however, to the condition that, to the extent of one half of the water in the canal, the landowners of Mexico shall have the right to use this water for irrigation.

When Imperial Irrigation District was organized and acquired the canal system of the California Development Company, it accepted the same subject to the conditions of the Mexican concession and for the purpose of doing work in Mexico it operates through its subsidiary, the Mexican Corporation.

It will be recalled that in 1909 when the Colorado broke from its channel into Bee River the Congress of the United States appropriated $1,000,000 to be used in protecting the Salton Basin against ultimate submersion. The Colorado River was to be turned back into its old bed and held there. As there was no treaty for the contemplated operations in Mexico, the President designated Mr. J. A. Ockerson to undertake the work. He in turn made the Mexican Corporation his agent and the work went on. It included not only the turning of the river but also the enlargement and extension of the levee north of Volcano Lake which has since become an increasingly important line of defense for the Imperial Valley.

When it is now considered that the control of the floods of the Lower Colorado will benefit about 800,000 acres of delta lands in Mexico and a somewhat larger area in California,—much of this, however, still in wild unimproved condition—the fact will be realized that there should be friendly consultation and cooperation between the United States and Mexico in order that the control of the lower river which must be put in a direct course to the Gulf and which must be kept there, may be placed in the hands of a competent agency, preferably the United States, and that arrangements may be made for reducing the flood menace by storing the waters of the Colorado at some point such as Boulder Canyon.

And then there is needed, too, some understanding between the two countries as to the quantity of water which will be allowed to flow into Mexico. It is probable that under regulation of stream flow by storage there will be enough water for all the lands in the two countries which may reasonably expect it. But practically all of the water which flows in the Colorado River originates in the United States and if the United States should choose to do so and physical conditions permitted, all of the water could be withdrawn from the river for use within the United States. This will never happen, but negotiations in relation to this matter of giving definiteness to what Mexico may expect have already been too long deferred.

Not only is this the situation with reference to the irrigation use of water but immediate action in the matter of flood control is of paramount importance. On this phase of the problem only a word more need be said. Ever since the river changed its course in 1909 it has been depositing its load of silt, about 112,000 acre feet per year, in the Volcano Lake region. Drift and silt have filled depressions and choked old drainage channels. The first effect of the river's change in alignment was to depress the river's flood plane at the head of the Bee River six or seven feet and thence upstream by decreasing amounts to and above Yuma. But as the years rolled by and the warping up of the Volcano Lake regions has continued, the flood plane has been at a mean rate of about one foot per annum. Where no levee was required before 1908, to the north of the site of the lake (the lake itself has already been filled up with silt and obliterated) there is now a levee 14 feet high, with a railroad on top and with its water slope well faced with rock. And yet last year, 1921, the water at some points rose to the top of this levee. Attempt is now being made to coax the river into a more southerly course, but, even if this should succeed, the outfall of the flood waters will then be on a broad flat area which will quickly be filled to delta crest elevation and the same problem as the one of to-day will remain to be solved. The solution of this problem as already stated is comparatively simple when physical elements alone are considered. It is the international aspect which renders it complex. Action, at once, I repeat, by the United States is imperative.

It may be noted in this connection that about 70,000 people live in the area which is to be protected. Property values of $100,000,000 to $200,000,000 are involved. There are several hundred miles of railroads within the area that must be protected against the floods of the Colorado River.

In the matter of developing and putting to beneficial use the water resources of the Colorado River, it seems self-evident that the greatest ultimate good should be the main consideration. State lines cut but little figure in this matter. Opportunity by any state to divert and deprive earlier down-stream users of their water can carry no right to do so unless this be plainly in the public interest and unless it be done with due compensation for property values that are thereby destroyed.

It is wise, therefore, that steps have been taken for discussion of the river's problem as it affects the seven states within which the waters of the river originate. The Colorado River Commission is the medium for bringing these states into conference. What the outcome of this conference will be remains to be seen. Fortunately the production of water in the watershed of the river is so great that, despite all that can be done on its headwaters, to hold back and use the water locally, there will still enough water get by to make the storage on the lower river and the extension of irrigation in Arizona, California and Mexico desirable and economically feasible.

The development on the lower river is an interstate and international matter. It should be undertaken by the United States. The control of such a reservoir as that which is proposed for the Boulder Canyon site, for example, should never be relinquished to private interests whatever the agency by which the project is carried out. Boulder Canyon damsite is located on Colorado River just above the point where the river makes its abrupt turn from a westerly to a southerly course. It is some 60 miles in an air line above the point where California's east boundary line strikes the river and is but a few miles below the mouth of Virgin River. The Colorado River at this point forms the boundary between Nevada on the north and Arizona on the south. The canyon is narrow, being generally reported as about 250 feet in width for a distance of one half mile. The sides of the gorge are steep. The rock is granite. The project for storage at this site as now favored by the United States Reclamation Service involves the construction of a dam that would rise to a height of about

550 feet above the water surface of the river. The storage capacity of the reservoir to be created by such a dam would be in excess of 25,000,000 acre feet. The discharge of Colorado River at this point may be noted, in approximate figures, as ranging from 7,000,000 to 22,000,000 acre feet per year. The mean annual discharge may be about 15,000,000 acre feet. The surface area of the reservoir would reach 125,000 acres.

The feasibility of a dam of the dimensions proposed seems now to be generally accepted by the engineers who have investigated the dam site. A reservoir at Boulder Canyon would control the flow of Colorado River except the contributions by the Gila River, and the storage could be so manipulated that it would eliminate the lower river flood menace to the extent that this menace is due to up river high stages. Such a reservoir would also regulate the flow of the river for irrigation purposes, thereby permitting the extension of the irrigated area, and would generate upward of 600,000 horse power for electrical transmission.

It is not enough to know that this reservoir should be constructed. Equally important is the matter of urgency. And this applies with equal force to the reservoir control of the river and to the placing of the lower river upon a direct course to the Gulf.

C. E. Grunsky

PROGRESS IN POLYNESIAN RESEARCH

In view of the many inquiries regarding the status of the anthropological studies in Polynesia, undertaken by the Bishop Museum, a summary statement of progress and results appears to be appropriate.

Systematic investigations of the origin and culture of the Polynesian peoples have been conducted by the Bayard Dominick Expedition and made possible by a generous gift of Bayard Dominick, Jr., of New York—funds given to Yale University and placed by the university at the disposal of Bishop Museum. During the summer of 1920 four field parties began their work—the first in Tonga, the second in the Marquesas, the third in Rurutu, Raivaivai, Tubuai and Rapa of the Austral Islands, the fourth in selected islands of the Hawaiian group. Through cooperative arrangements with scientists of New Zealand, physical measurements of the Maori and a complete survey of the Maoriori of Chatham Islands forms part of the program. By the end of this year all the field parties will have returned to Honolulu. These surveys supplemented by investigations in Tahiti and adjacent islands organized for 1923, will complete the present plans of the Bayard Dominick Expedition. Contributions to the physical anthropology of Samoa and of Tonga have been published by the museum; other papers are in press or in preparation for publication.

The prosecution of this search for Polynesian origins aims at the solution of two distinct problems: (1) the source of the physical racial characteristics, which have combined to make the Polynesian physical types; and (2) the source of the original elements which formed the basis of the ancient culture of the people. Dependent upon the solution of these is a third problem: the degree in which racial and cultural transplantation and stratification are correlated.

Dr. Louis R. Sullivan, physical anthropologist of the American Museum of Natural History, is devoting himself to the study of the racial data secured by himself and by other members of the expedition. He makes the following tentative classification of the physical characters which go to make up the two basic elements in the Polynesian peoples:

Type 1 is characterized by (1) tall stature, (2) moderately long heads, (3) relatively high, narrow faces, (4) relatively high, narrow noses, (5) straight or wavy black hair of medium texture, (6) well-developed moustache and moderate beard on the chin, (7) moderate amount of hair on the body and limbs, (8) light brown skin, (9) incisor rim present occasionally, (10) femur flattened (platymeric), (11) tibia flattened (platycnemic), (12) ulna flattened (platolenic), (13) lips above average in thickness. Type I is the so-called Caucasoid element in Polynesia; sometimes spoken of as Pseudo-Caucasian or Pseudo-Mediterranean. Macmillan Brown regards it as Nordic. In its characteristics it is intermediate between some

Caucasians and some Mongols. It may eventually prove to be a very primitive Caucasoid type, probably related to primitive inhabitants of Micronesia, Indonesia, and to the Aino and some of the primitive American Indians. It is probably the oldest type in Polynesia (except where it was possibly preceded by the Melanesians), and it occupied all of the Polynesian Islands. At present it seems to be strongest in the southern part of Polynesia.

Type II is characterized by (1) shorter stature, (2) shorter heads, (3) low, broad faces, (4) low, broad noses, (5) wavier hair, (6) undeveloped beard, (7) body hair rare except on the legs, (8) darker brown skin, (9) incisor rim rare, (10), (11), (12) long bones less flattened (data meager, results inferred), (13) lips well above the average in thickness. Type II is the element so often referred to as Malay, and is undoubtedly the one which has been traced to the region of the Celebes by linguists and ethnologists. Malay is not a suitable name for it, since it is usually restricted to groups more definitely Mongoloid. It approaches somewhat closely Giuffrida-Ruggeri's Indonesian type. This element has contributed some of the negroid characteristics (full lips, dark skin, broad flat noses), usually attributed to Melanesian mixture. The type is strongest in northern and central Polynesia.

Edward S. Handy, ethnologist of the Bishop Museum staff, and a member of the Dominick Expedition to Tahiti and the Marquesas in 1920-21, has come to the following conclusions with regard to the general ethnology of Polynesia.

There is a basic Polynesian cultural complex, some of the most important elements in which are: (1) cooking by means of heated stones in ground ovens; (2) the use of stone pestles for pounding food; (3) the use of wood, gourd, and cocoanut shell, rather than pottery, for containers; (4) skillful woodworking and carving; (5) tattooing; (6) the making of tapa, or bark cloth; (7) a characteristic relationship system; (8) the customs of adopting and betrothing children; (9) systematic agriculture and fishing, taro and potato cultures; (10) professional craftsmanship and leadership in industry; (11) tribal government of simple patriarchal communism; (12) preserving heads of enemies as trophies, and cannibalism; (13) ancestor worship, the preservation of genealogies, and the hiding of skeletal remains; (14) inspirational diviners; (15) a speculative creation mythology conceived on the principle of dualism, expressed in terms of male and female agencies. This complex was universally distributed throughout Polynesia; but it is most clearly to be distinguished in the historic cultures of New Zealand and the Marquesas, both of which groups may be characterized as outposts. These elements being universal, and best preserved in the marginal region, may be taken to represent the primitive, in the sense of original, Polynesian culture. This we may call Culture A.

Superimposed on this original culture are certain other elements, some of the most important of which are: (1) organized government; (2) a rigid social classification; (3) complicated systems of land division and ownership; (4) great sacredness of chiefs and elaborate etiquette; (5) organized dancing as a social and religious institution; (6) organized religious ceremonial and priesthood; (7) a generation cult and seasonal rites; (8) haruspication. As compared with Culture A, this culture appears to have been characterized by a higher social and religious, rather than higher technical, development. This group, with other associated elements, too numerous to include here, may be called Culture B.

It is possible that the elements in Culture B may have resulted by a natural evolution from the primitive Culture A. But it is far more probable that they represent the culture of a second immigrating wave of a people, closely related culturally to those of the first wave. Churchill's analysis of the language led him to the conclusion that the dialect spoken by the second wave of migrators to Tonga and Samoa was very closely related to that of the original settlers.

A study of Polynesian ethnology recently completed by Ralph Linton indicates that the material culture of the Marquesans and related groups support entirely the theory of an original culture and later overlay. The more important elements which his study adds to the classification given by Dr. Handy are: to Culture A, (1) a rectangular house with end posts and bed-space; (2) a canoe made of five parts; and (3) the tanged adze; to Culture B, (1) the oval house; and (2) wooden head rests and utensils with legs.

It is interesting to note that the basal Polynesian physical type (Type I), as worked out by Sullivan, is universally distributed, but strongest in the south, and the original culture (Culture A), also universally distributed, is clearest in the south (New Zealand) and east (the Marquesas). Also physical Type II is strongest in north and central Polynesia, the same region in which elements in Culture B are dominant. This demonstrated parallelism of racial types and cultural stratification rests on conclusions arrived at independently by members of the museum staff working in widely separated fields with no opportunity for consultation. It is regarded as a very important contribution to the attack on the Polynesian problem. Another contribution is the definition of characteristics and elements belonging to the respective types and cultures—a prerequisite to comparative studies.

As regards the sources of these racial types and cultural elements and the routes by which they came to Polynesia, the evidence in hand indicates the region of the Malay archipelago (Indonesia) and southeast Asia as that from which the Polynesian ancestors commenced their eastward drift. Whither, beyond that region the search for ultimate origins may lead, can not be foreseen. The writing of the earliest chapters in the history of the Polynesians and of other Pacific races must await the definition of ancient and modern Asiatic types and cultures and the determination of early stages revealed through archeology.

The work of the acheologists of the Bayard Dominick Expeditions revealed no very ancient human habitation in the central and south Pacific. For the Polynesian settlement the evidence serves to substantiate the conclusions of William Churchill, based on linguistic and cultural study. The following dates are considered reasonable estimates: A.D. 0, the first Polynesian migratory movement; A.D. 600, a second migration; and A.D. 1000, a period of great Polynesian expansion. According to S. Percy Smith and other Maori scholars, New Zealand was already in possession of original settlers by the tenth century although the main Maori migration did not occur until the thirteenth and fourteenth centuries. Dr. Handy has concluded that the Marquesas Islands were first settled in the tenth century or slightly earlier, and Fornander presents good reasons for the belief that the original settlers of Hawaii experienced the coming of a migratory wave at the beginning of the eleventh century.

At least three general routes of migration appear to have been used through Indonesia: (1) along the coasts of New Guinea, (2) through Micronesia, (3) through and along the marginal region east of Melanesia.

Two years of organized study has shown that the history of Polynesia is fundamentally a field problem and that progress depends upon the accumulation of facts by trained students.

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SCIENTIFIC EVENTS

A FOREST UNDER THE CITY OF WASHINGTON

EVIDENCE of the existence of an ancient swamp in which great trees flourished in days long past, possibly contemporaneous with earliest man in America, has been discovered in a deep excavation made for the foundation of a hotel under construction in Washington, D. C. At a depth of about twenty-five feet below the street level the excavation disclosed a layer of black swamp muck, containing large quantities of wood, tree trunks and stumps. Some of the stumps are of great size, a few of them reaching a diameter of nine or ten feet. Much of the wood is well preserved, showing clearly the woody structure and the external markings of the bark. A preliminary examination indicates that one of the more common trees of this ancient swamp was cypress.

The story of these trees, however, is only a brief chapter of the whole geologic history shown in the excavation, which has just been examined by Chester K. Wentworth for the

United States Geological Survey. Ages ago this part of the Atlantic Coastal Plain was from time to time covered by the sea, into which streams swept vast quantities of mud, sand and gravel and boulders which formed thick deposits that covered large areas. When the region finally emerged from the sea the Potomac River cut its valley in these deposits, which were carried about here and there also by smaller streams. The larger boulders are derived from the granite on which the gravel lies, but some of the smaller pebbles come from parts of the Potomac basin beyond the Blue Ridge and others from veins of quartz in the granites of the Piedmont Plateau.

Over the layer of plant débris and muck in this old swamp fine clay and pebbles were laid down by streams of water during the glacial epoch, when the northern part of North America, as far south as northern Pennsylvania, was covered with immense sheets of thick ice, showing that the trees lived in the latter part of the Great Ice Age, which is variously estimated to have ended from 20,000 to 30,000 years ago.

OPPOSITION TO EVOLUTION IN MINNESOTA

IT was reported in SCIENCE last week that at a conference in St. Paul, Minn., of pastors representing Baptist, Congregational, Presbyterian and Lutheran churches, it was decided to issue a call for a state-wide meeting of Protestant ministers to oppose the teaching of evolution in the public schools of Minnesota.

At this meeting, which was held on October 26, the following resolutions were passed:

Preamble—As American citizens we believe in the complete separation of church and state, and are opposed to religious teaching in public schools—higher or lower.

As those who wish to teach Christianity must support their private schools, we believe it but just that those who wish to teach anti-Christian theories should be forbidden the use of tax supported schools for propagating their opinions.

Whereas, The evolutionary hypothesis has come to be accepted by many American teachers, and is increasingly taught in the public schools of Minnesota, including high schools, our state normals and state university, and

Whereas, This hypothesis, after sixty-three years of study, remains wholly unproven, and has increasingly shown itself to be a foe to the Christian faith, denying as it does the veracity of the Scriptures,

Therefore be it resolved, That we, citizens of Minnesota, representing thousands of our fellow citizens, hereby utter our protest against this propaganda of infidelity, palmed off in the name of science, and we call upon the trustees of state institutions to demand of teachers a cessation of such teaching and the removal from our schools of such text-books as favorably present the same.

We do this in the interest of true science *vs.* science falsely so-called; and in the interest of fair dealing.

We hold that the first amendment to the constitution of the United States, "Congress shall make no law respecting an establishment of religion," was never intended to be interpreted that the state should become sponsor for irreligion; and that it is manifestly unfair to impose taxes upon Christian taxpayers to inculcate teaching inimical to the Bible and destructive of civilization itself.

We have waited patiently for this hypothesis to either prove a truth or to pass from public instruction. Having now no prospect of either, we demand that the state shall prove its impartiality toward its citizens by dispensing with a subject that is utterly divisive; and is, in the judgment of thousands of its taxpayers, utterly false.

And we declare that if the school authorities prove derelict in the enforcement of the law relating to the teaching of religion or of theories subversive of the Christian faith, we will appeal to the legislature for the enactment of such laws as shall eliminate from our tax-supported school system this antiscientific and antiscriptural theory of the origin of man and the universe.

THE ADMINISTRATION OF THE UNITED STATES GEOLOGIC SURVEY

ON November 15, David White completes ten years service as chief geologist. This contribution to the administration of the survey has been at the expense of his own scientific work, even though he has thereby increased the scientific value of the work of his associates. It seems fair that his oft-repeated request for permission to return to his own geological studies should now be granted, not only to gratify the natural desire of an investigator who has laid aside research problems, one after another, but also to promote the advancement of our science.

Effective November 16, W. C. Mendenhall, for more than ten years the geologist in charge of the Lang Classification Board, will be chief geologist. Mr. Mendenhall's twenty-eight years service in the Survey as assistant geologist and geologist, with field experience extending from the Southern Appalachians to Alaska, is a promise of his broad sympathy with all the problems that will come under his direction, and his notable success in using the data contributed by the field branches in the classification of the public-lands is equally a promise of effective administration.

Mr. Mendenhall will be succeeded as chief of the Land Classification Board by Herman Stabler, his close associate in that branch during the past decade. Mr. Stabler's demonstrated capacity both in research and in administration assures the continuance of the successful application of geologic and engineering facts and principles to public land administration.

The return of Mr. White to productive research suggests anew the sacrifice involved in the administration of scientific work. Administration by scientists is the key-note of the Survey's policy, yet the intellectual cost item involved in this drafting of our best investigators must be kept down to a minimum. Had I been free from other demands on my time this past summer, I should have taken this occasion to start a somewhat radical reorganization of the Geologic Branch, the chief purpose of which would be to reduce its administrative overhead—too many geologists are giving valuable time to work for which they were not trained. Necessarily now, this task of simplifying the organization must be left to the new chief geologist and the acting director, but I ask for them a sympathetic acceptance of the proposal for a less elaborate but more elastic grouping of the activities of the branch. Not machinery but product is the measure of efficiency in a government scientific bureau.

GEO. OTIS SMITH,
Director

THE NEW BUILDING OF THE NATIONAL ACADEMY OF SCIENCES AND THE NATIONAL RESEARCH COUNCIL

ON the afternoon of Monday, October 30, the cornerstone was laid of the new building of the National Academy of Sciences and of the National Research Council at Washington, D. C. This building, construction of which has now been carried above the main floor, occupies a desirable location upon an entire block of land north of the Lincoln Memorial at the western end of the Mall, commanding an excellent and permanent view of the Memorial, the Riverside Park and the bank of the Potomac beyond. The land for this building was purchased through contributions from a group of twenty friends of science.

The building is designed for two main purposes: To house the offices of the two organizations for which it is erected, and to provide space for the exhibition of materials representing certain of the great achievements of science in the past and especially of recent contributions of particular significance in the progress of science. The building presents a façade to the southward 260 feet in length, and will rise to a height of 60 feet above the first floor. In this section there will be three floors for offices, library and special exhibits rooms. Behind this will be a rotunda for general exhibition purposes which will be convertible at need into a lecture room accommodating, with its galleries, over 400 people. The plans permit the addition of other units similar to the southern façade, to complete a quadrangle around the rotunda. The building is being faced with white Dover marble of fine quality and color which makes it in keeping with the other monumental buildings of the city. The cost of the unit at present under construction will be over $1,000,000. The funds for the erection of the building were provided by the Carnegie Corporation of New York.

The laying of the cornerstone was a ceremony of the simplest kind without the presentation of any addresses. It was attended by officers and members of the academy and of the Research Council, among whom was the Honorable Herbert Hoover, secretary of commerce.

The stone, itself, bearing the date "1922" and the initials "N. A. S." and "N. R. C.," occupies a position high in the wall of the first story at the southwestern corner of the building. Within a copper box in the stone were placed significant documents connected with the founding of the National Academy and of the Research Council and lists of the members of both organizations. It is expected that the building will be ready for occupancy in the fall of 1923.

SCIENTIFIC NOTES AND NEWS

The National Academy of Sciences will hold its autumn meeting in New York on Tuesday, Wednesday and Thursday, November 14-16, 1922. The meetings on Tuesday will be at Columbia University, and, so far as possible, papers from the sections of astronomy, chemistry, geology and paleontology will be assigned to this day. On Wednesday the meetings will be at the Rockefeller Institute, with papers from the sections of botany, zoology and animal morphology, physiology and pathology, and anthropology and psychology. On Thursday the meetings will be in the auditorium of the United Engineering Societies Building with papers from the sections of mathematics, physics and engineering. The local committee for the meeting consists of J. F. Kemp, *chairman,* T. H. Morgan, Simon Flexner, J. J. Carty, F. B. Jewett and F. M. Chapman.

The Henry Jacob Bigelow medal of the Boston Surgical Society was presented to Dr. William W. Keen, of Philadelphia "for conspicuous contributions to the advancement of surgery," on the evening of October 25, when Dr. Keen addressed the society on "Sixty years of surgery, 1862-1922."

Members of the faculty and alumni of the University of Chicago recently contributed a fund for a portrait of Professor A. A. Michelson, who for thirty years has been head of the department of physics in the university. The portrait has been completed by Ralph Clarkson.

On the occasion of the celebration of the fiftieth anniversary of the Dutch Zoological Society there were admitted as honorary members: Professor O. Abel, Vienna; Professor M. Caullery, Paris; Professor L. Dollo, Brussels; Professor B. Grassi, Rome; Professor V. Häcker, Halle; Professor S. J. Hickson, Manchester; Professor N. Holmgren, Stockholm; Professor T. H. Morgan, New York; Dr. F. Sarasin, Basle, and Dr. J. Schmidt, Copenhagen.

The British Institution of Mining and Metallurgy has awarded its gold medal to Sir Alfred Keogh, "on the occasion of his retirement from the rectorship of the Imperial College of Science and Technology, in recognition of his great services in the advancement of technological education."

Dr. George Otis Smith has resigned the directorship of the United States Geological Survey, in order that he may qualify legally as a member of the United States Coal Commission. It is understood that the President hopes that Dr. Smith will be willing to resume his work as director of the survey when his service as member of the coal commission comes to an end.

We learn from *Nature* that Mr. E. Leonard Gill has been appointed to fill the vacant assistantship in the Natural History Department of the Royal Scottish Museum, Edinburgh. Mr. Gill has already had museum experience in Leicester and Manchester, and for almost twenty years has been in charge of the Hancock Museum at Newcastle-on-Tyne.

Mr. T. Russell Goddard, assistant curator at the Sunderland Museum, has been appointed curator of the Hancock Museum, Newcastle-upon-Tyne.

Dr. C. R. Orton, plant pathologist at the Pennsylvania State College, has been appointed a member of the division of biology and agriculture of the National Research Council.

The board of managers of the Wistar Institute has elected Dr. J. A. Detlefsen to a professorship for the duration of his sabbatical year as a courtesy and to make possible the continuation of investigations carried on at the College of Agriculture of the University of Illinois.

DR. SELIG HECHT, national research fellow in chemistry, has been appointed research fellow in physical chemistry at the Harvard Medical School, where he will continue his investigations.

PROFESSOR WILLIAM A. RILEY, chief of the division of entomology in the University of Minnesota, returned in September from a three months stay in Porto Rico, where he made an intensive study of the relation of soil conditions to the propagation of parasites.

PROFESSOR ELIAS J. DURAND, of the department of botany of the University of Minnesota, is on leave this year because of ill health.

DR. W. W. STIFLER has accepted an appointment from the China Medical Board of the Rockefeller Foundation and the trustees of Canton Christian College as visiting professor of physics at Canton Christian College for the academic year 1922-1923. Mr. Stifler has been associated with the Peking Union Medical College, since its reorganization in 1917 by the China Medical Board, as head of the physics department and dean of the Premedical School in Peking. After his year in Canton he expects to return to the United States.

DR. ARTHUR BLISS DAYTON, associate in medicine at the Yale School of Medicine, has been given a year's leave of absence to serve as professor of medicine at the Medical School of Yale-in-China. Dr. and Mrs. Dayton are now in Changsha.

DR. G. R. BISBY has returned to the Manitoba Agricultural College, Winnipeg, after a year with the Imperial Bureau of Mycology, Kew Gardens, England.

ISSEI YAMAMOTO, assistant professor in the Kyoto University Observatory, Japan, has recently received appointment as volunteer research assistant in the Yerkes Observatory. He has been sent to the United States by the Japanese government to spend about a year in several of our observatories.

DR. LUDWIK SILBERSTEIN, of the Research Laboratory of the Eastman Kodak Company at Rochester, N. Y., addressed the Franklin Institute of Philadelphia on November 2, on "The spectrum of neutral helium and the behavior of its two electrons."

DR. AUGUST KROGH, professor of physiology at the University of Copenhagen and Silliman lecturer at Yale University, will deliver the second Harvey Society lecture, at the New York Academy of Medicine, on Saturday, November 11, on "Nervous and hormonal control of capillary contractility."

IN continuation of the series of evening lectures given in the spring and fall in the administration building of the Carnegie Institution of Washington, 16th and P Streets, Washington, D. C., a lecture was given on November 7 by Dr. C. G. Abbot, collaborator of the Mount Wilson Observatory and assistant secretary of the Smithsonian Institution, on "The heat of the sun and other stars." On November 21 Dr. Louis A. Bauer, director of the Department of Terrestrial Magnetism, will give a lecture on "The greater problems of the earth's magnetism and electricity, and their bearings in astronomy, geology and physics." Three additional lectures will be given on succeeding Tuesday evenings, announcements of which will appear later.

PROFESSOR Z. B. JEFFERY delivered a lecture on October 9 on Einstein's theory of relativity, at King's College, London, as an introduction to a course of twenty-five lectures to be given at the college on "The Mathematical Theory of Relativity."

As noted in SCIENCE recently the exercises in connection with the dedication of the Sterling Chemistry Laboratory will be held on Wednesday, April 4, 1923. This date is the anniversary of the first lecture in chemistry at Yale by Professor Benjamin Silliman on April 4, 1804.

LADY LOCKYER and Miss Lockyer are preparing a biography of Sir Norman Lockyer, the distinguished astronomer and editor of *Nature*.

THE unveiling of the tablet in memory of the late Professor Sir William Ramsay, K.C.B., F.R.S., in Westminster Abbey by the Prince of Wales, as patron of the Ramsay

Memorial Fund, took place on November 3. Afterwards, in the Jerusalem Chamber, the French ambassador, the Count de Saint-Aulaire, as one of the vice-presidents of the fund, presented to the prince the Ramsay Memorial Gold Medal, which has been executed by the French sculptor, Monsieur Bottee.

Robert Wheeler Willson, professor of astronomy, *emeritus*, at Harvard University, died at his home in Cambridge on November 1, in the seventieth year of his age.

Dr. C. W. Waggoner, head of the department of physics in West Virginia University, has died from the effects of a fall from a horse, at Shreveport, Louisiana.

Frank Sherman Washburn, chairman of the board of directors of the American Cyanamid Company, a leader in American engineering, died at his home in Rye, N. Y., on October 9, aged sixty-two years.

Professor C. Michie Smith, government astronomer of Madras, 1891-1911, and director of the Kodaikanal and Madras Observatories, 1899-1911, died on September 27.

J. K. A. Wertheim Salomonson, professor of neurology and radiology in the University of Amsterdam, has died at the age of fifty-eight years.

The death is announced, as the result of an accident while on holiday in the Alps, of Herr Leo Madrnozka, professor of electrical engineering at the Technical High School, Munich.

The speakers who are expected at the Pasteur celebration of the New York Academy of Medicine are: Professor Russell H. Chittenden, Dr. William H. Welch, Dr. Erwin Smith, Dr. Simon Flexner, Dr. Herman Biggs and Dr. W. W. Keen. The exhibition of books, photographs, medalions, manuscripts, etc., referring to the life work of Pasteur, is to be open to the public at the New York Academy of Medicine, 17 West Forty-third Street, New York, for two weeks, commencing December 27, 1922. The public addresses are to be given at the academy on the evening of January 10, 1923. Any one having souvenirs or memorabilia connected with Pasteur's work is invited to loan them for the academy exhibition, and address, for this purpose, the librarian of the academy, Mr. J. S. Brownne.

The National Committee for Mental Hygiene was engaged during August, September and October in making a mental hygiene survey in North Dakota. This is one of several state surveys being conducted by the national committee. Recommendations are made to the governor and legislature for appropriate action. Those conducting the North Dakota survey were: Dr. Thomas H. Haines, consultant for the National Committee for Mental Hygiene, director; Dr. Ward G. Reeder, assistant professor of school administration in the Ohio State University; C. L. Hultgren, psychologist for the national committee, and Mina A. Sessions and Lucille Martin, psychiatric social workers for the committee.

UNIVERSITY AND EDUCATIONAL NOTES

The departments of civil engineering and electrical engineering of the South Dakota State School of Mines have been transferred to the new building erected for them, for which the legislature made appropriation of $130,000 for building and $15,000 for furnishing. Additional funds were provided for machinery and apparatus.

Mr. and Mrs. Leon E. Schwartz have given $20,000 to the School of Medicine of Tulane University for the establishment of the David Trautman Schwartz Research Fund.

The directors of the University of Cincinnati have received a letter from the chairman of the General Education Board, asking that action taken to name a chair in the College of Medicine after John D. Rockefeller be deferred because of Mr. Rockefeller's objection to such a course. The communication said that "Mr. Rockefeller would prefer to have his name recorded in the hearts and lives of those using the improvements which donations from him have made possible rather than having it carved in stone or officially connected with the building."

Dr. Manfred Call, formerly professor of clinical medicine, has been elected dean of the medical department of the Medical College of Virginia, at Richmond.

Dr. H. M. Jennison, for several years assistant professor of botany at the Montana Agricultural College, Bozeman, has become associate professor of botany in the University of Tennessee.

Andrew Karsten (Ph.D., University of Ohio), has recently entered upon his work as head of the department of chemistry at the South Dakota School of Mines.

Frederick P. Vickery, formerly of Leland Stanford, Jr., University, has been appointed assistant professor of geology and head of the department at the Southern Branch of the University of California, at Los Angeles.

DISCUSSION AND CORRESPONDENCE

STELLAR DIAMETERS

The determination of star diameters has been a matter of considerable interest since the first measures of *Betlegeuse* were published from the Mount Wilson Observatory. Various predictions have been made for the apparent diameter of stars by Eddington, Russell, Wilsing and Hertzsprung, based directly or indirectly upon visual estimates of brightness, color and spectral type. The recent work of Coblentz at the Lowell Observatory has afforded means of determining new curves of spectral intensities giving data for a revised correlation of temperatures and spectral types. Such information, together with the direct thermoelectric measures of stellar radiation made by Coblentz both at the Lick and the Lowell Observatories, affords the basis for the calculation of a star's surface area if its distance is known, or, wanting accurate parallax determinations, the apparent angular diameter can be computed on the grounds of black body radiation. This serves at least as an independent method of checking star diameters, and the results of its application to the three stars whose diameters have thus far been measured by the interferometer method may be of general interest, and are given below:

Star	Diam. from Coblentz' data	Mt. Wilson measures	Predicted diameters Eddington	Predicted diameters Russell
α Orionis (Betlegeuse)	0.045″	0.047″	0.051″	0.031″
α Scorpii (Antares)	0.036″	0.040″	0.043″	0.028″
α Bootis (Arcturus)	0.018″	0.022″	0.020″	0.019″

The agreement between the diameters computed from the galvanometer deflection determined by Coblentz (*Sci. Papers Bureau of Standards,* Nos. 244, 438) and the actual measured diameters is surprisingly good. It is not easy to suppose that a star can radiate as a black body. Since, however, this assumption is fundamental in applying the laws of radiation from which the diameter is computed, it is rather remarkable to find stars radiate as nearly like black bodies as the bit of evidence herein contained would seem to show.

H. T. Stetson
Harvard University,
Astronomical Laboratory

TINGITIDÆ OR TINGIDÆ AGAIN

"To be or not to be"—*Tingitidæ* or *Tingidæ?* Logomachy is a "war about words." It seems that I have involved myself in such a merry war, driven thereto by my desire as a scientific editor to get at the bottom facts as to what is the correct scientific family-name to give to those insignificant, but very interesting and beautiful little creatures, commonly known as "lace-bugs." In a little article published in Science (N. S.), LVI, 1922, pp. 334-335, I found in favor of the family name *Tingitidæ.* Now comes that excellent entomologist, Professor H. M. Parshley, of Smith College, and reminds us that in an article published in *Psyche,* XXIII, 1916, p. 129, he had found in favor of *Tingidæ.* His argument in brief is founded upon the statements:

1. "We can not be sure that Fabricius did in fact adopt the Greek word Τίγγις, the name of a city."

2. "His use of the genitive *Tingis* [in a footnote] shows us that he considered the word his own and indicates what its Latin declension should be."

I regret that I had completely overlooked Professor Parshley's article, and duly apologize for the oversight. I am, however, constrained to state in brief that what he says does not carry conviction to my mind.

As to his first postulate I may indeed say that "we can not be sure" of anything. Fabricius has been dead for over a century, and not even through Sir Oliver Lodge or Conan Doyle can we get into touch with him and ascertain definitely what he was thinking about when he first coined the generic name we still use. But we do know that he had the *habit* of coining generic names from those of ancient towns and cities. The word *Tingis* had been in existence two thousand years before Fabricius was born and in its Greek form Τίγγις and in its Latin forms *Tingi* or *Tinge* could be found in any dictionary Fabricius might have consulted. The word was no more "his own" than hundreds of other words he used in his writings. It is difficult for me to believe that Fabricius out of the depths of his subconscious mind fished up an altogether arbitrary combination of letters, *T-i-n-g-i-s,* making out of them, as Professor Parshley says, "his own word." The nomenclatorists of the time of Fabricius had not yet reached the stage attained at a later date by some of their successors, who took random combinations of letters and then by various transpositions and combinations manufactured words without meaning, which they employed for generic and specific terms. Fabricius was a disciple of the old Linnean school and used the Latin language. I question whether he had a sense of "proprietorship" in words.

The fact that he employs *Tingis* as the genitive only shows that he thought that this was the genitive, after the analogy of some other words in the Latin language, and that he did not take the trouble to ascertain what was the true declension of the noun he was employing. *Humanum est errare.* The genitive of the Latin noun *Tingi* or *Tinge* (the equivalent of the Greek Τίγγις, must have been *Tingitis,* as shown by the adjectival form *tingitanus,* used by Pomponius Mela, Claudius Mamertinus, *et al.* Fabricius simply made a slip in his declension, which it was easy enough to do.

With all due respect to the conclusions of Professor Parshley I contend that we are dealing with an old Latin word (found also in the Greek, where it has an *i-stem*) and that *Tingitidæ* is the correct form of the family name, sanctioned by the use of such eminently capable scholars as Stål (by the way, an excellent linguist), Champion, Oshanin, Horvath, Osborn, Drake and a multitude of others.

W. J. HOLLAND

CARNEGIE MUSEUM,

A MINIATURE PHOTOGRAPHIC DARKROOM

NECESSITY has mothered many an inspiration. This trite exclamation was brought to mind by the sudden need of providing darkroom facilities when our commodious attic quarters were closed in order to lessen fire risk. Two alternatives suggested themselves, either to partition off a corner of a room or to construct a portable light-proof developing box. Past experience with small stuffy darkrooms was recalled, and the writer accordingly undertook to build a dark box as a venture. The convenience of this box, its adaptability to many photographic purposes, and the successful results following its use have led to the publication of this announcement in the hope that others, at present deterred from attempting photography through lack of facilities, may find that the way is easily open.

This miniature darkroom is constructed of pressed wood-pulp board nailed over a light wooden frame. Dimensions of 36 inches for width 24 inches for depth and 20 inches for height have proved to be entirely satisfactory. At the lower part of the front face an opening of about 24 by 10 inches admits the arms and hands of the operator. This opening is rendered light-proof by two thicknesses of close-woven black sateen cloth continuous with two sleeves. By having the cloth considerably larger than the opening and shirring the edges, free movement of the arms is afforded by the bulging central portion. The ends of the sleeves are made close fitting by elastic bands. Black sateen bloomers can be bought ready made and are of the exact pattern and size, with shirring and elastic fittings ready for attachment to the box. Because of looseness of weave, two superposed layers of cloth should be used.

The top of the box has a removable light-tight cover. This is made possible by tacking a tongue of half-inch stripping around the edge of the cover to fit into a trough at the top of the walls. The tongue and trough are painted matt black, a little lampblack in weak alcoholic shellac answering for this purpose. The interior of the box need not be painted, although a white coat affords a better view of manipulations in the interior.

To view what is going on inside the box two small windows are provided at the level of the eye when the box is set on a table. The window in front is of clear ruby photo-safe glass, the one opposite is either of ruby glass or translucent ruby fabric. Behind the rear window is placed an electric bulb operated by a switch inside. Another inside switch controls a socket on one wall which may interchangeably have a low candle-power light for lantern slide making or a high power light for exposing development papers. A shelf located midway across the end is an added convenience. The entire cost for materials is five dollars; a few hours of labor can construct the box.

A secret of continued success in using this small darkroom is to keep hypo away and thus avoid contamination. This is possible by having a tray containing weak acetic acid, about 2 per cent., into which is to be immersed plates, slides, films or prints as fast as they are developed. The acid checks the action of the developer and permits the quick removal of the light-sensitive materials from the developing box to the hypo bath outside without danger of fogging. Developed material can be left in the acid bath until it is convenient to open the box.

The idea of a developing box is not new. There are small developing tanks and boxes on the market for daylight use by the time method of development. Convenient changing bags of cloth have long been employed by the traveler. Developing boxes equipped with sleeves and ruby glass are available with X-ray outfits. Undoubtedly the urgency of the war period for rapid photographic production led to the construction of portable darkrooms. But the simplicity, adaptability and convenience of the above-described miniature darkroom are so great that the writer will be pardoned, even though his discovery is not new, if this announcement will acquaint others with a worthwhile piece of equipment.

A. L. Melander
State College of Washington

THE VALUE OF COST ACCOUNTING IN ANALYTICAL AND CONSULTING LABORATORIES

This subject has had very little, if any, consideration in the past. The probable reason for this neglect appears to be the comparatively small field for analytical and consulting laboratories.

Through the long association with this field the writer has worked out an elaborate system of cost records which have proved most valuable in the determination of a fair price to clients as well as a fair return to the owners. This system produces such information as will show what work is profitable and what kinds of analytical tests are unprofitable; the reasons for the profits or losses are readily revealed after a persistent tabulation of the records.

The latter information serves to permit the preparation of sliding scale prices, *i. e.,* for one test, for two tests, for three tests, etc. It also reveals the comparative fluctuations in the costs on a given test. This variation in costs should always be treated with the utmost care, as when a worker becomes so proficient that he does not require the assistance of any of the usual factors in a laboratory, and finishes the job in record time, the owner as well as the client is entitled to a little of this efficiency in dollars and cents. The owner should weigh the costs in these cases against the reasons why that worker is proficient in making these certain tests and allow himself leeway for either the replacing of that man or the increasing of his salary. An efficient and speedy worker generally secures his knowledge by repetition principally, by use of the owners' books and the supervision and advice of his chiefs. In other words, the speed and efficiency of one worker is not the only basis for costs.

The costs when compiled in a comparative form will readily show the variations, the causes being numerous. Some of them are represented in the unfamiliarity with the methods of analysis, the necessity of preparing the apparatus for the work, the difference in wages and the necessity for accuracy and not speed. The latter case appears when there is a legal matter involved and several repeat tests are made.

The costs are primarily based on the productive amount. Between the period when a worker starts his job and when he finishes it his time is estimated and placed on a card. Each day he completes a Daily Time Report, filling in the laboratory number, work done and the estimated time required. It is impossible to accurately determine the amount of time spent on the job, as from start to finish. The reason for this being the number of jobs a worker can do at one time, namely, start one and get that job in a condition where it will work while he is away from it, in the meantime, start another, watching both at the same time.

After the worker fills in his card it is approved by the man in charge and sent to the accounting department daily. The department chiefs and assistants are given cards which permit them to record their time from start to finish. The nature of their work, which consists mainly in consultation work, permits a recording of their time accurately.

The time cards of both the workers and chiefs are then summarized by the addition of the per hour rate, and the amounts chargeable to any particular job are entered on a cost-ledger card.

The productive amount as shown on the cost ledger card is increased by its proportionate share of the overhead as determined by the distribution of overhead. Materials used are so small in comparison with the other factors that to determine the amount used on each job would cost more than the results would warrant. The total amount of materials used, as determined by a check against the inventory on the yearly basis, is charged directly into the overhead.

In the beginning it is necessary to appraise the inventory as accurately as possible, also the location of the various items as to departments. The space occupied by each department must be known so as to properly distribute the rent charges. The question of insurance can be distributed according to its risk, *i. e.*, fire—on the basis of the inventory.

The value of this work is evidenced in more than one direction. It presents a basis for setting a figure for a fair price for analytical and consulting work, a check on the comparison of costs so as to quote on large amounts of tests (*viz.*, more than one at a time), keep a close watch on the speed and efficiency of the various workers, determine the value of unfinished work, have a complete record at all times of the costs of promotion of prospectives, a perpetual record of the costs on contracts, and the value of the various kinds of income and their cost.

The difference in keeping these costs in a laboratory is apparent within two to three months after the installation. The operation of these records does not require any large force to keep it running and the time in preparing the cards by the employes does not in any way interfere with their regular work.

FRED W. FEUERBACHER

QUOTATIONS

PROTECTING SCIENTIFIC RESEARCH AT THE POLLS

AT the polls in November, in California, Colorado and Washington, scientific medicine will be tried at the bar of public opinion. The verdict will depend in part on public knowledge of the attainments and conduct of physicians in the past. The true physician, as attorney for the defense, will be actively campaigning against the antis of all kinds, and he will be especially active on election day, when the case goes to the jury.

In Colorado and in California, the people will decide by popular vote whether medical research involving the use of living animals shall be prevented. The antivivisectionists in these states, mistrusting or despising their legislatures, are seeking, through the initiative, to bring about the enactment of such measures by playing on the ignorance and the emotions of the people. No properly informed person can vote in favor of the antivivisectionist measures proposed.

In Washington, the contest is being fought under the referendum to restrict the activities of the health authorities with respect to the sanitary and hygienic control of the public schools. The foes of scientific medicine, among them those who even deny the existence of disease, procured the passage of an act in 1921 granting to parents the privilege of forbidding examination of their children in school by the health authorities. The public health forces of the state, recognizing the danger to public health inherent in this measure, have procured its submission to the people, and it will be voted on, November 7. The demand for this uncivilized legislation was presumably due to recognition, by the enemies of medical science, that medical mysticism and quackery can not thrive in a community enlightened with respect to modern medicine, and that the public schools constitute the great channel through which the people can be enlightened and future generations gain from the past. In fact, opposition to the rejection of this measure is an attempt to destroy one of the most effective methods of teaching facts concerning disease, namely, by their active application in school administration.

In California, members of two of the cults that now infest the medical underworld are fighting through the initiative to free themselves from control. The liberal and fair-minded provisions for licensing their practitioners do not satisfy them. Chiropractors have been defying the law, and, when convicted and sentenced, have gone to jail rather than pay fines, thus posing as martyrs. Apparently neither cult will be satisfied by any measure that does not allow it to pursue its own course at its own sweet will.

The medical profession must see that no ground is lost to the enemies of scientific medicine and particularly of preventive medicine. The debt of the physician to his patient and his community can not be discharged by proxy. Personal service, intelligently, energetically and loyally rendered, is absolutely essential to success, if the results of the contest are to be certain and complete. Every physician in each of the communities now laboring under the threat of this dangerous legislation should devote an hour or two each day between now and election to enlightening his patients and friends, to informing them as to what is right and to urging them to act on behalf of the right. Thus he will not only be doing his proper part as a true physician but also as a good citizen.—*Journal of the American Medical Association.*

SCIENTIFIC BOOKS

Applied Colloid Chemistry: General Theory. By Wilder D. Bancroft, professor of physical chemistry at Cornell University. First edition (1921), International Chemical Series. H. P. Talbot, consulting editor. McGraw-Hill Book Company, Inc., New York.

In this volume Professor Bancroft professes to deal with the general theory of colloidal solutions in a new way; he says, "I have written this book deductively." By this one is led to understand that the author sets out to deal with general principles which later may be applied to the particular case involved in the study of colloidal solutions. One should not, then, object that colloidal solution is hardly mentioned in the first third of the book.

In carrying out his plan, the author devotes the first three chapters—or considerably more than one third of the book—to the treatment of the phenomena of absorption in all its phases. This subject is dealt with in the encyclopedic manner so frequently found in German texts, but the style is illuminated and made interesting by that piquancy of suggestion and comment which makes Professor Bancroft's lectures and papers especially attractive. Undoubtedly there is here a valuable summary of the present state of our knowledge of absorption; if any criticism is to be offered, it is that some of the matters dealt with, while important from the point of view of general absorption phenomena, seem to have very little application to the study of colloidal solutions: as, for example, the outlines of various commercial chemical operations at the end of the first chapter.

The fourth chapter is devoted to surface tension and the Brownian movement. After the minute attention devoted to absorption it is a disappointment that such a meagre treatment is given of the general relations involved under the head of surface tension. This treatment is confined practically to dealing with the application of the Willard Gibbs surface concentration law to colloidal particles. One wonders why the Brownian movement phenomenon is attached to this chapter as there is given merely a sketchy account which would fit in better under the chapter dealing with "properties of colloidal solutions."

The remaining chapter (V) of the general theory is on "coalescence." This chapter appeals to one as ideal in its scope in that it fulfils the aim laid down by the author in his preface. General phenomena are adequately treated and the application to colloidal work is admirably clinched at its close.

Thus slightly more than one half of the book is devoted to a more or less general treatment of absorption, surface tension, Brownian movement and coalescence. The remainder deals with the preparation and peculiar properties of the following classes of colloidal solutions: (1) suspensoids (Ch. VI and VII); (2) emulsoids (Ch. VIII and IX); (3) non-aqueous colloidal solutions (Ch. X); (4) fog and smoke (Ch. XI); and (5) solid colloidal solutions (Ch. XII). The last chapter (XIII) contains a card catalog account of the thickness of films.

The chapter on the properties of colloidal solutions seems to be quite inadequate for a volume which professes to be a complete treatment of the general theory. While many interesting facts regarding these solutions are given, there is a lack of logical method and perspective in their arrangement. For example, a rather long and intrinsically interesting section is devoted to color phenomena; but the colloidal chemist will hardly admit that this particular property is as important as the electrical properties of these solutions or as the phenomenon of coagulation by electrolytes, each of which is given rather less space.

Perusal of the chapter on gelatinous precipitates and jellies justifies the author's statement in the preface that there is not much known about these materials. What is known is given in a very readable shape. More might have been given regarding the evidences of the existence of a structure in protein solutions as outlined by Professor Brailsford Robertson. It is interesting to have the criticism of a physical chemist on the recent work of Loeb, as given in this chapter.

The remainder of the book consists in general of an encyclopedic account of experimental facts regarding emulsions, foams, fog and smoke: regarding this phase of colloidal work there is known very little more than a series of interesting, but more or less detached, experiments, coupled with some very important commercial applications such as ore flotation and the Cottrell process. It is sometimes annoying to find the practical application of experimental facts so far in advance of our theoretical knowledge of their causes.

The book can be recommended as a mine of information on most of the subjects dealt with. However, from the point of view of an attempt to give a final treatment of the general theory of colloidal solutions it is rather disappointing. Such a general treatise demands not only the excellent treatment here given of absorption phenomena but just as ample treatment of such questions as (1) the relation of surface tension phenomena to small divisions of matter, (2) the Brownian movement of small particles, (3) the electrical charges of small suspended particles, electro-endosmose phenomena, and coagulation of electrolytes, and, say, (4) the physical properties of jellies. One would be justified in expecting in addition an attempt to account for the limiting size attained by these particles in suspension in any given case. In fact one can hardly say "the general theory of the subject once cleared up" with the conviction that such a desirable state of affairs is yet accomplished.

As is true with all the volumes of this series (International Chemical Series), the workmanship is excellent, the references very ample, and the appearance of the whole very attractive indeed. This particular volume will be read with interest and pleasure.

E. F. Burton

University of Toronto,
Canada,
October 14, 1922

SPECIAL ARTICLES

THE ORDER OF SCIENTIFIC MERIT

IN selecting groups of one thousand American men of science for statistical study in 1903 and 1909, the workers in each of twelve sciences were arranged in the order of merit for their work by ten of their leading colleagues.[1] The average positions gave the order, and, as there were ten observations of the position of each individual, its probable error could be calculated.

As the writer of this paper is a psychologist and the ultimate object of the work is the study of behavior with a view to advancing scientific research, the psychologists may be used for illustrations of method. William James was placed first in 1903 by the independent judgment of each of the ten observers. The psychologist who stood second had an average position of 3.7 with a probable error of 0.5; the chances are even that his position was between 3.2 and 4.2. The psychologists who stood third, fourth and fifth were assigned, respectively, positions of 4.0, 4.4 and 7.5, with probable errors of 0.5, 0.6 and 1.0. It follows that the relative order of Nos. II, III and IV is not determined definitely, whereas the chances are some 10,000 to 1 that each of these stood below No. I and above No. V. The probable errors increase in size as the work of the men becomes less significant; it is on the average 0.65 places for the first ten of the fifty psychologists and 10.7 places for the last ten. Consequently No. XL on the list would have about one chance in four of falling out of the group of fifty, if the number participating in the arrangement had been very large.

The figures determine not only the validity of the positions, but also the differences in scientific merit among the psychologists, these varying inversely as the probable errors. As men who are about 6 ft. 2 in. tall are likely to differ from each other about ten times as much as men who are about 5 ft. 8 in. tall, so the more distinguished scientific men at the top of the list differ from each other about ten times as much as those toward the bottom, and a unit can be adopted for measuring the differences. This method for converting relative positions into degrees of quantitative differences, which was first used by the writer[2] to measure subjective differences in the intensity of lights has proved to be of wide application.

For a third selection of our thousand leading men of science it seemed desirable, in order to avoid the inbreeding that might occur through selection by a limited group, to obtain a general vote from those competent, and, as before, the new methodological problems have proved to be of interest. The validity of votes appears not to have been considered, yet the problem is wide-reaching and is closely related to the drawing of balls from an urn, which has largely occupied students of the theory of probabilities.

If, for example, the council of the American Psychological Association, which consists of eight members, decides without consultation in favor of a given measure by a vote of 6 to 2, how likely is this to represent the majority opinion of the 432 members? We do not know the distribution of this "population," but if from an urn containing 216 white and 216 black balls, 8 are drawn, the chances are about one in nine that 6 will be white and about one in seven that 6 or more will be white. These may be regarded as approximately the chances that when the membership is about evenly divided a vote of that character will be obtained from the council; and on this basis the desirability of a plebiscite vote may be decided.

In 1916 Mr. Wilson was elected president by the vote in California, which was in his favor by 466,300 to 462,394, giving him a majority of 3,906. It might be supposed that this small majority would readily have been reversed by an indefinitely large electorate, but if the population were equally divided this would probably occur only once if an election were held every day for a hundred years.

If the members of a jury reached their deci-

[1] SCIENCE, November 23, November 30 and December 6, 1906, "American Men of Science," The Science Press, 1910.

[2] *Philosophische Studien*, 1902. See also "Studies by the Method of Relative Position," H. L. Hollingworth, in "The Psychological Researches of James McKeen Cattell," a review by some of his pupils, on the occasion of the twenty-fifth anniversary of his professorship. New York, 1914.

sion without consultation and stood eleven to one for conviction, many would conclude that the chances are eleven to one that the defendant is guilty. As a matter of fact if the total population is divided in the same ratio and the legal fiction is followed that a man is proved guilty or innocent only by unanimous vote of twelve peers, the chance of obtaining a jury which without consultation will be unanimous for conviction are about one in three, of obtaining a jury unanimous for acquittal, only one in many billions. The practise of the courts must ultimately adjust itself to such conditions, and learn whether the unanimous vote of three or five jurymen without consultation is more or less valid than the unanimous vote of twelve after consultation. It must be decided on what probabilities a man shall be convicted and to what extent the chances of innocence shall be considered in imposing sentence.

When our rulers are selected and their legislation is determined by votes, it seems strange that knowledge concerning the variable and constant errors is so completely lacking. A decision of the supreme court, which may involve the welfare of hundreds of thousands of children or taxation amounting to billions of dollars, is equally binding whether the vote is unanimous or by a majority of one. It would apparently be as reasonable to require a three fourths vote of the supreme court to invalidate a law passed by both houses of the congress and signed by the president, as to require a unanimous vote of a jury to award petty damages.

The method of voting used to select scientific men might have useful applications in industry. For example, if a bank employs 100 clerks, some of whom will be promoted from time to time, all of them might be asked to check the fifty per cent. and the five per cent. most deserving of promotion. From the records an order of merit for promotion would be obtained, together with the relative value of the men to the bank and the salaries deserved. The data would also throw light on those voting, for the value of the judgment of each is measured by its departure from the average; if any were prejudiced or unfair in their treatment of friends or rivals this would be discovered. The combined judgment of associates is probably a more valid method of selection than the choice of a superior and would presumably lead to better service.

In like manner a group of factory workers or of laboring men might select a boss or leader by vote. If the employer would agree to take one of the five men receiving the most votes, the employees would understand and probably approve the method. Not only would a good selection free from favoritism be made, but the men would share in the control of their work and would be more loyal and more efficient.

The writer has proposed a compromise between the competitive and the semi-communistic systems for payment of the salaries of university professors, according to which, say, five super-professorships with relatively large salaries and large freedom should be established. The difficulty under our present method is that the appointments would be by favor of the administration. If, however, a vote of the teachers in the university, and perhaps of the students, were taken on the basis of desert for research, teaching and service, a method of selection would be used probably more accurate than the choice of the president and at the same time more conducive to cooperation and goodwill.

In the selection by votes of one thousand scientific men the same number for each of the twelve sciences was retained as in the two previous studies, this being nearly proportional to the total number of workers in each science. In the first edition of "American Men of Science" there were listed about 4,000 scientific men, in the second edition about 5,500, and in the present edition, published some fifteen years after the first, the number is about 9,600. The present writer was in 1888 the only professor of psychology in the world. The number of members of the American Psychological Association, which has a professional qualification, increased from 127 in 1903, when the first selection was made, to 432 in 1920. The average number of doctorates conferred in psychology during the five years prior to 1903 was 12.6; it was 40 in 1920. Competition for inclusion among our fifty leading psycholo-

THE DISTRIBUTION OF VOTES FOR ONE HUNDRED PSYCHOLOGISTS

gists or among our thousand leading men of science is thus much more severe at present than was the case when the selections were first made. There are now about 500 working psychologists and about 10,000 scientific men in the United States; the present selection consists approximately of those who form in each science the upper tenth in merit of their work.

In the case of the psychologists, here used as an example, those in the two earlier groups of fifty (except five no longer occupied with psychology or no longer residents of the United States), numbering 48, were asked to send the names of 10 or a smaller number of others whose work warranted their inclusion in such a group. Then those who received two or more nominations were in like manner asked to propose 10 or fewer names. The 52 who received the most votes were added to the original 48 to form a group of 100. These names were placed in alphabetical order on a list, which was sent to them all, with the request to "check (√) about 50 (namely, about one half) of the names to indicate those who have done the best work in psychology, placing a double check (√√) before about five of those whose work has been the most important." Eighty-three (besides one who replied too late) of the 100 returned the blank and, as each was asked not to consider himself, there were 82 votes. When more than five double checks were assigned they were weighted inversely as the number. The result of the votes can be conveniently shown by curves such as are here reproduced. The middle curve gives the distribution of the 82 votes for the 100 psychologists, the vertical ordinates representing the number of votes, while the individuals are ranged serially along the horizontal axis. The bottom curve shows the number of double checks for each individual, namely, the opinion that he is one of the five psychologists whose work is the most important. The top curve represents the sum of two votes, and the individuals are arranged in order in accordance with this vote.[3]

[3] Similar results have been obtained in each of the twelve sciences, the number of scientific men

As indicated on the curve and shown on the tables (which it seems unnecessary in this place to print) two and only two psychologists were included among the fifty leading psychologists by unanimous vote of their eighty-two colleagues. The psychologist at the bottom of the fifty received 35 votes; three were given for the psychologist who stands last in the hundred. Sixty-two of the 82 voting include among the five whose work has been most important the two psychologists who received a unanimous vote for inclusion among the fifty and 20 do not. Such differences in judgment are legitimate and significant. Thus the psychologist placed eleventh is held by 22 of his colleagues to belong to the first five and by 21 not to belong to the group of 50, and similar conditions obtained for the one placed twentieth. The names could be guessed by one familiar with the situation. They are men of distinction whose more important work is by some judged not to fall within the field of psychology.

The attitude of those voting is of scientific significance, for it measures the validity of judgments. If we assume the average judgment of the 82 psychologists to be nearly correct, the departure from this average measures the competence of the individuals to form such judgments. There do not appear to be group differences dependent on distinction or age, but individuals, as shown in the previous study, differ in the ratio of about two to one. There will be an extraordinary change in our attitude toward political, social and business problems when we learn to look upon our observations, recollections, beliefs and judgments objectively, measuring the probability of their correctness and assigning probable errors to them.

The top curve represents the sum of the two votes and the order there given is the one used. A different weighting of the two votes would not considerably affect the order. The vote for the five leading psychologists in the main discriminates only the positions of the men in the upper quartile. In place of the double vote for the five and the fifty per cent. of the 100 psychologists whose work has the most merit, a satisfactory distribution might be obtained by a vote for 25, or one fourth of the whole number. In view of the constant use of votes for elections and decisions, the problems involved deserve more complete investigation.

A probable error can be found for the positions of the individuals by a method that was apparently first used by the present writer. When eighty of those voting are divided into ten groups of eight each, we have the separate votes of each of these groups and from their variation the probable error of the average vote can be calculated. Thus the psychologist No. L, in the ten groups of eight votes each received, respectively, 4, 4, 2, 1, 4, 7, 4, 3, 2, and 2 votes. The probable error is 0.363, and for the group of eighty votes it is 3.63. The position on the curve assigned by each of the small groups can also be found and a probable error calculated from these ten positions.

The probable errors based on 80 votes (as a rule for each fifth individual) are indicated by the broken vertical line on the curve and when referred to the order of merit by the broken horizontal lines. The probable errors of the votes of the five psychologists last in the fifty are, respectively, 3.4, 2.8, 2.8, 3.1 and 3.6, an average of 3.14. The curve from No. X to No. C is nearly a straight line, the vote decreasing from 79 for No. X to 3 for No. C. Consequently the probable error of the vote when referred to the order is increased by

ranging from 175 chemists to 20 anthropologists. The returns, however, were most complete for psychology, the writer being personally acquainted with nearly all psychologists and a second request having been sent to those who did not reply to the first. There were in all some 130,000 votes to be collected, counted and tabulated. For the treatment of this material I am mainly indebted to my daughter, Miss Psyche Cattell. Dr. Dean R. Brimhall and Dr. Alexander Weinstein have also assisted in the revision of the material and in the computations.

I am under very great obligations to Professor Raymond L. Pearl, of the Johns Hopkins University, and to Professor H. L. Rietz, of the State University of Iowa, for their kindness in reading the manuscript of the paper and for the useful suggestions that they have made. This acknowledgment should not, of course, be construed as involving responsibility on their part.

about one sixth. The probable error of position at the bottom of the group of fifty is 3.6; there are thus only three or four for whom there would be as much as one chance in four of being dropped from the list if the arrangement were made by an indefinitely large electorate of the same character.

In the first study of the psychologists, the probable error at the lower end of the fifty was 10.7, that is, there were 10 or 11 for whom there was one chance in four that they should not be included on the list. There were then ten arrangements in order of merit; now there are eighty votes. The probable error decreases as the square root of the number of observations, and the probable errors in the two cases, other things being equal, should be about as 3 : 1, which is in fact almost exactly the case. The probable error of a single vote for the psychologists low in the group of fifty at the present time is thus the same as by order of merit in the group of 1903.

In the first study, however, we were concerned with the upper quartile, and we are now concerned with the upper decile of the group of American psychologists. If we assume distributions in accordance with the curve of error, the men who now stand at the bottom of the fifty in the present selection will be as able as those who stood about twenty in the first arrangement. An examination of the relative positions of the individuals who are in each of the two arrangements indicates that this tends to be the case. The probable error at the bottom of the fifty selected by votes should be in the neighborhood of those who stood about twenty in the first arrangements. This would make a single vote one half as valid (the ratio of the probable errors in the first arrangement for those near the bottom of the fourth hundred and in the tenth hundred of the thousand being 64 : 125) as a single judgment of order of merit. The figures given should, however, be regarded as indications of method rather than as exact determinations, for they are subject to various errors.

The average position of the survivors of the first group of psychologists in the arrangement of 1903 was (after deaths have been eliminated) 4; it is now for the same individuals 14.8. Those in the four following groups of ten have dropped, respectively, from 11.5 to 18.1; 20 to 27.4; 29.5 to 59.2, and 39.5 to 64.9. This drop in position is on the average less than would be expected if the 10,000 scientific men of to-day are as able and have as good opportunity as the 4,000 scientific men of 1903. The inference is that as the total number increases the proportion of men of distinction decreases. This may be due to the fact that men of special ability find their level apart from the size of the group or because the scientific career attracts less able men or gives them less opportunity than formerly. Both factors are probably present; it is apparent that the situation deserves further investigation. In the previous study it was shown that in the increased competition of a five-year period, those between 40 and 44 years of age remained on the average about stationary; those below 40 gained; those above 44 lost, the loss being in direct proportion to the age.

As the work of the men becomes more important, the differences between the individuals as measured by the probable error of position become greater, the distribution corresponding in a general way to the upper end of the curve of error. In the case of the votes there are complications, for the votes for different men do not have the same weight. The ten who receive the most votes receive nearly all the votes, and in the cases of the few who do not vote for them poor judgment or an error in checking is indicated. Some votes mean that a psychologist stands first or near the top of the list, whereas others mean that he is barely included. Consequently the order and the probable errors in the case of such a vote for one half of the group do not have great validity for the upper part of the distribution. The order is obtained in a satisfactory manner by the double vote, but this introduces further complications in the probable error. In all cases of votes, we have asymmetrical distributions and skew curves. The quantitative relations should be worked out in the first instance for less complicated material than that with which we are here concerned.

In nearly all cases in which probable errors have been applied to psychological data, the determinations are more exact than common sense would presuppose. Thus the writer found[4] that in grading traits of character by ten individuals on a scale of 100, a position was assigned with probable errors varying from 4.6 for physical health and cheerfulness to 3 for originality and efficiency. All other traits, such as energy, courage, judgment and integrity, were assigned positions with intermediate probable errors, the average being 4, which is nearly the same as the probable error of position as determined by 80 votes of the psychologists near the middle of the 100 in order of merit.

The comparatively small probable errors appear to be due to the fact that there are constant errors which affect the whole group. The psychologists who vote are subject to the same kind of influences, not making in fact independent judgments, but being influenced as a group by the knowledge of what others think and by all sorts of conditions, conventions and restrictions. If a similar vote were taken ten years hence the work of the same psychologists would be viewed from new standpoints and the positions would change to a much greater degree than the probable errors warrant. "Constant" errors are in fact more inconstant and variable than "variable" errors.

In the case of a vote (as in any series of measurements) there are two factors entering into the probable error, one dependent on the quantitative conditions prescribed in advance, the other on the behavior of the individuals. The former may be called the deductive probable error and when the latter is determined by experiment and added to it the whole is the inductive or actual probable error. Thus, if from an indefinitely large number of balls equally distributed between black and white, some are drawn, the most frequent distribution will be an equal number of black and white, but the average departure from equality will increase as the square root of the number drawn and the ratio of departure from equality will decrease as the square root of the number.

If large numbers of white and black balls are distributed in the ratio of 33 white to 47 black, and we draw 80 balls, the most probable number of white balls will be 33. The standard deviation from 33 in a large number of draws will be 4.40, and the quartile deviation or probable error will be 2.97; that is, in one case out of four there will be more than three white balls. The psychologist at the bottom of the fifty received 33 votes out of a possible 80. If an indefinitely large number of psychologists were distributed in this ratio the deductive probable error or error of sampling would be 2.97. The actual probable error, namely, 3.63, is composed of (the square root of the sum of the squares of the two) this deductive probable error and an error or deviation due to the groupings of the psychologists into different "species" with different points of view. The psychologist who stood XIL had a probable error of 3.1. The deductive probable errors are approximately the same for the two individuals, but it is more difficult to form a judgment regarding No. L than regarding No. XIL.[5]

The situation may be illustrated by an instance of general importance. Death rates, birth rates and marriage rates are continually used, but always without probable errors. Thus, for example, the Bureau of the Census issues weekly a bulletin that contains the death rates of the leading cities of the United States, but the figures have no meaning because one does not know whether the different rates are due to chance fluctuations with a limited population or to causes such as a large proportion of infants or an epidemic of influenza.[6] If the

[4] Address of the president of the American Society of Naturalists, SCIENCE, April 10, 1903.

[5] In these cases the actual and the deductive probable errors have probable errors of the order of magnitude of the differences between them, and these differences have only moderate validity. The writer has purposely "not minded his p's and his q's," for it seems that equations are not becoming to one who is not a mathematician.

[6] In the last report received (for the week ending September 2, 1922) the death rate of New Haven is given as 5.8 and of Houston as 13.9. In the same week a year ago the death rate of New Haven was 10 and of Houston 7.6. Without probable errors these figures give no useful information in regard to the conditions in the two cities.

average death rate is 12 per thousand, in a city of 100,000 population there will be about 23 deaths in a week. If black and white balls in indefinitely large numbers are distributed in the ratio of 23 black to 99,977 white and 100,000 are drawn, the most probable number of black balls is 23, but one time in four there will be more than 27. Thus the recorded death rate for a week for a city of 100,000 will normally fluctuate. If it is on the average 12, it will in half the weeks be approximately either as large as 15 or as small as 9.

If the death rate exceeds 15 in two consecutive weeks then the chances are fifteen out of sixteen that it is due to some cause such as an epidemic. The conditions are obviously of practical importance for physicians and health officers. The situation for death rates is nicely illustrated by the illustration that has been used of the distribution of black and white balls in an urn. If the population of the country were 100,000,000 and the death rate were 12 (as it should be, but is not), then 1,200,000 people would die during a year. Among 100,000,000 black and white balls there are 1,200,000 black. But if we draw 100,000 (*i. e.,* take a town of that population) there will be a chance fluctuation as described above. It is also the case that the balls are not completely mixed, there being more black balls in some part of the urn than others. In some places we shall draw a larger proportion of black balls. When there is a negro population or a tenement house population or a large population of very young or very old people, there are relatively more black balls. There are temporarily more black balls in one place when there is an epidemic or the like. In that case we have the analogy of the black balls attracting one another.

This paper has been written to explain the methods used to select the thousand leading American men of science by votes. The psychologists have been taken as an example; if space and time permitted tables and curves might be given for the other sciences and a study of the data might yield results of interest. Such treatment must, however, be postponed or left to others. The object of the present paper will be accomplished if it makes clear that the scientific men have been selected and placed in the order of merit for their work by valid objective methods and that the methods used have wide application. In a subsequent paper the distribution of the scientific men will be considered with special reference to the changes that have occurred in the course of ten years.

J. McKeen Cattell
The Psychological Corporation,
August 1, 1922

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF LEATHER CHEMISTRY
John Arthur Wilson, *chairman*
Arthur W. Thomas, *secretary*

The mechanism of unhairing: John Arthur Wilson and Guido Daub. A series of detailed studies was made of the mechanism of the unhairing of skins by means of the sweating process, lime liquors and caustic sulfide liquors. Sections of skin were examined under the microscope at different stages. In liming and in sweating, the first action on the skin itself is the hydrolysis of the epithelial cells of the Malpighian layer of the epidermis, once the cells are destroyed, the remainder of the epidermis, the hair and the sebaceous and sudoriferous glands are completely separated from the derma and can then be removed mechanically. In the sulfide method, the alkali destroys the corneous layer of the epidermis and the skin appears to be freed from epidermal matters on its surface long before the alkali has penetrated to the depth of the hair bulbs. Where this method has been employed, the hair bulbs are usually found intact in the finished leather. The paper is illustrated with photomicrographs.

Pancreatin as an unhairing agent: John Arthur Wilson and Albert F. Gallun, Jr. When calf skin is swollen in dilute caustic soda, neutralized with sodium bicarbonate, and then put into a suitable solution of pancreatin at 25° C. exposed to air, the hair is completely loosened in 24 hours, but the action is not due to the enzyme, since it is checked by covering the solutions with a layer of toluene. At 40° a solution of pancreatin fails to cause a loosening of the hair of fresh skin because the corneous layer of the epidermis is impermeable to the enzyme and thus prevents it from attacking the soft Malpighian layer below. When a skin has previously been swollen by acid or alkali, and the corneous layer rendered softer and more permeable, a solution of pancreatin at 40°, even under toluene, will not only destroy the Malpighian layer of the epidermis and loosen the hair, but it will also dissolve the elastin fibers of the skin, thus effecting both unhairing and bating in a single bath.

A study of the strength of proteolytic enzymes in the process of bating: Charles S. Hollander. During comparative tests of bating with dung bates and with pure enzymes, tests were made at intervals of the strength of enzyme in the liquors, by the casein method. The concentration varied considerably with time in the case of the dung but remained practically constant when pure enzyme preparations were used.

The hydrolysis of collagen by trypsin: Arthur W. Thomas and Frank L. Seymour-Jones. It is shown that collagen is readily digested by trypsin under proper conditions, and that it is unnecessary to subject collagen to chemical or pepsin pretreatment in order to render it vulnerable to tryptic action. This refutes the generally accepted belief based on the statement of Kuehne (1887) that trypsin can not hydrolyze collagen.

The points of minimum plumping of calf skin: John Arthur Wilson and Albert F. Gallun, Jr. A study was made of the change in degree of plumping of calf skin at different acidities and alkalinities. There are two points of minimum plumping, one occurring at a value of 5.1 and the other at 7.6 on the p_H scale. Available data seem to indicate that these two points of minimum represent two different forms of skin protein, one stable only in acid solution and the other in alkaline solution.

Direct determination of plumping power of tan liquors: John Arthur Wilson and Albert F. Gallun, Jr. The degree of plumping of skin in a given tan liquor is measured by the ratio of its resistance to compression when taken from the tan liquor to its resistance to compression under standard conditions. The method can be conducted with extreme sensitivity and is capable of making the measurement in actual tannery practice.

Effect of hydrogen-ion concentration upon the analysis of vegetable tanning materials: John Arthur Wilson and Erwin J. Kern. The per cent. of tannin found by the A. L. C. A. official method increases with p_H value to a maximum at 8 and then decreases rapidly towards zero. On the other hand, p_H value appears to have no effect upon the determination by the Wilson-Kern method over the range 3.6 to 7.3, but the rate of tanning of hide powder decreases rapidly with increasing p_H value above 7. The rate of filtration of tan liquors is markedly affected by change of p_H value, which may be attributed to changing degrees of dispersion of some of the solid matter. The addition of lime to tan liquors causes a precipitation of tannin, but only at p_H values above 7.2.

Stability of the hide-tannin compound at different p_H values: John Arthur Wilson and Erwin J. Kern. Leather is resistant to washing in neutral or acid solutions, but is broken up into protein and tannin by alkaline solutions. The decomposition begins at $p_H = 7.7$ and proceeds at an increasing rate as the p_H value is raised above this value.

The concentration factor in the fixation of tannins by hide substance: Margaret W. Kelly. The relationship between degree of fixation of tannin by hide substance and the concentration of the vegetable tanning liquors has been worked out for a number of important extracts. All show a steady increase in tannin fixed, as concentration increases, up to a maximum tannage followed by a sharp drop in more concentrated liquors.

The hydrogen-ion and time factors in the fixation of tannins by hide substance: Margaret W. Kelly. The combination of vegetable tannins with hide substance is shown to depend upon the hydrogen-ion concentration of the liquor to a most pronounced degree. Over a broad range of hydrogen-ion concentration, an M-shaped tannage curve is obtained. In acid solutions the greatest fixation is obtained at $p_{H^+} = 2$ to 3, falling off at greater acidities. On the less acid side of $p_{H^+} = 2$ to 3, the fixation decreases to a minimum at $p_{H^+} = 5$, the isoelectric point of collagen, then increases to a second maximum at $p_{H^+} = 8$, and at greater alkalinities falls off approaching zero. The second maximum at $p_{H^+} = 8$ is much lower than the principal maximum fixation at $p_{H^+} = 2$ to 3. Explanation for this behavior is submitted in the original paper.

The influence of neutral salts upon the fixation of tannins by hide substance: Arthur W. Thomas and Margaret W. Kelly. Both sodium chloride and sodium sulfate decrease the fixation of vegetable tannins by hide substance at $p_{H^+} = 3$; sodium sulfate to a greater extent than sodium chloride. At $p_{H^+} = 5$, sodium chloride in low concentrations promotes the fixation; at higher concentrations it inhibits fixation, as sodium sulfate does at all concentrations. At $p_H+ = 8$, both salts decrease the fixation, but not to the same extent. Explanations for the differences in behavior are given based on the Donnan effect on the collagen and the action of the salts in altering the degree of dispersion and diffusibility of the tannin particles.

The difference in kind or degree of tannin fixation as a function of the hydrogen-ion concentration: Arthur W. Thomas and Margaret W. Kelly. It has been shown that after removing all water soluble substances from freshly prepared leather, treatment with alcohol will extract varying amounts of tannin depending upon the hydrogen-ion concentration at which the leather was tanned. For example, hemlock and gambier leathers tanned at $p_H+ = 3$ will yield about 25 per cent. of their fixed tannins to alcohol extraction, a smaller amount when tanned at $p_H+ = 5$, and practically none when tanned on the alkaline side of $p_H+ = 5$. If the leathers are drastically dried before alcohol extraction, very little alcohol soluble matter is found. These preliminary experiments are to be continued with the view of throwing more light upon the differences in kind or degree of tannage at differing hydrogen-ion concentrations.

The tannin-gelatin reaction: Arthur W. Thomas and Alexander Frieden. The mutual precipitation of tannin and gelatin depends to a very large degree upon the hydrogen-ion concentration of the solution. It has been shown that the gelatin-salt test for tannin is sensitive to one part of tannin in 110,000 to 200,000 parts of water, depending upon the source of the tannin, and provided the hydrogen-ion concentration of the solution is adjusted to its optimum. This optimum varies with different extracts, ranging from $p_H+ = 3.5$ to 4.5. The details are given in the original paper. It is also shown that it is unnecessary to prepare the gelatin-salt test reagent daily. This reagent kept for two months at summer temperature when covered with a layer of toluene and its delicacy was not impaired in that time. How much longer it would keep is unknown.

Are vegetable tannins amphoteric? Arthur W. Thomas and Stuart B. Foster. Six common vegetable tanning materials were investigated by the electrophoresis method indicating that all are amphoteric, *i. e.*, changing from anodic migrating to cathodic in the p_H+ range of 2.5 to 2.0. Hydrogen-ion concentration precipitation curves are also given for the extracts studied.

The practical color measurement of vegetable tan liquors: R. O. Phillips and L. R. Brown. It is suggested that color measurements are best made by tanning pieces of skin under standard conditions.

The acidity of synthetic tans: S. Kohn, J. Breedis and E. Crede. The active principles of most synthetic tans are sulfonic acids in the preparation of which an excess of sulfuric acid is used. It is relatively easy to find out whether or not sufficient alkali has been added to neutralize this excess. But sulfuric acid being neither the sole nor the worst of the undesirable ingredients occurring in some syntans, it is important to devise methods by which preparations containing undesirable ingredients can be detected. To the methods suggested previously a new one is added which is based upon comparative observations of the part played by the acidity of syntans in the precipitation of gelatin.

The colloid chemistry of basic chromic solutions: Frank L. Seymour-Jones. A review of the literature upon the nature of chromic solutions showing their very complex and as yet unsettled condition of solution. Ultrafiltration experiments failed to show the presence of any colloidally dispersed chromium compound in the ordinary single bath chrome liquor. The experiments are preliminary in nature and further investigation is contemplated.

The electrophoresis of chromic solutions: Frank L. Seymour-Jones. The Thompson-Atkin theory of chrome tanning, which postulates a negatively charged chromium complex as the tanning agent, is criticized and shown not to be of general application, if at all, since chromic solutions which did not show any evidence of negatively charged chromium complexes tanned hide powder. It is true, however, that in certain basic solutions of chromic sulfate, part of the chromium exists in a negatively charged complex, while this does not occur in the basic chloride nor yet chrome alum.

The interpretation of the influence of acid on the osmotic pressure of protein solutions: Jacques Loeb. When osmotic equilibrium is established between a solution of casein and hydrochloric acid enclosed in a collodion bag and an outside aqueous solution free from protein, the hydrogen-ion concentration is always greater in the outside solution than in the casein solution. The observed osmotic pressure is accounted for quantitatively by the difference in concentration of hydrochloric acid in the two solutions, without taking into consideration any possible osmotic pressure of the casein itself. The observed potential difference between the two solutions in millivolts always has the numerical value equal to 59 times the difference in p_H value between the two solutions at 24°, proving that the inequality in p_H value is determined by Donnan's equation for membrane equilibria.

A preliminary study of a plunger type of jelly strength tester: S. E. Sheppard and S. S. Sweet. In previous papers the authors have described an instrument for measuring in absolute units the rigidity of gelatin jellies. They have used the results to check the performance of plunger types of jelly strength testers. In these instruments a plunger resting on the jelly is loaded to produce a fixed arbitrary depression or distortion. The authors have devised an instrument with a balanced beam, and continuous chainomatic loading. Hence the load : deflection, or stress : strain curves can be plotted for constant rate of loading. The points investigated were: (1) Effect of shape of plunger. It is found that with plungers having a rounded base the area of contact varies with the load, and unreliable load : deflection curves are produced. The most satisfactory plunger is a frustum of a cone, with the larger base resting on the jelly surface. Families of straight lines passing through the origin are obtained in good agreement with Hooke's law. (2) Ratio of diameter of plunger to diameter of vessel. Using plunger heads of above shape, this ratio should be less than a certain value, or spurious rigidity; hence spurious jelly strength will be obtained. This is a function of the absolute jelly strength (rigidity) so that comparisons for grading may be vitiated. (3) Ratio of depression to height of jelly. Similarly the depth of jelly must be large compared with the depression, using the same plunger diameter. These results are discussed in connection with recent work on the structure of jellies.

On the non-isotropic swelling of thin sheets of gelatin: S. E. Sheppard and S. S. Sweet. By coating definite amounts of gelatin solution of various concentrations, etc., on suitably prepared glass plates, after drying flat sheets of definite thickness and area can be stripped off. The swelling of these in water and aqueous solution is not isotropic, *i. e.*, not uniform in all directions, but greatest for the thickness. It is found that the *ratio* of volume increase to area increase differs for different gelatins, and also depends upon the treatment, becoming lower, for example, on hardening with formaldehyde.

The preparation of gelatin free from ash and hydrolytic decomposition products: S. E. Sheppard, Felix A. Elliott and Miss A. J. Benedict. A 5 per cent. solution of commercial gelatin is electrolyzed in a cell of electrofiltros for three to four weeks, the salts passing through the cell into the electrode chambers. This reduces the ash to ca. 0.10 per cent. This deashed solution is then precipitated with acetone, thus removing hydrolytic decomposition products and further reducing the ash to ca. 0.01 per cent. This gelatin is then redissolved in conductivity water, chilled in sheets and dried. The reaction of a solution of such gelatin in solution is about 4.8 H-ion. This gelatin is useful for all research work on gelatin as well as providing a definite material for culture media which can be brought to any particular reaction with complete knowledge of salts present.

The hygroscopicity of hide glues and the relation of tensile strength of glue to its moisture content: E. Bateman and G. G. Town.

The two forms of gelatin and their isoelectric points: John Arthur Wilson and Erwin J. Kern. In a tenth-molar phosphate solution of increasing p_H value, gelatin shows two points of minimum swelling, one at 4.7 and the other at 7.7. It is suggested that the two points of minimum represent the isoelectric points of the gel and sol forms of gelatine, respectively.

Some modern problems in leather chemistry: Edmund Stiasny. The striking feature of modern research in leather chemistry is the entirely different point of view in the choice and treatment of problems as compared with the period previous to ten years ago. The older experimentation was entirely from the standpoint of direct practical investigation, while in pure research for the purpose of deep understanding of the processes, entirely unfettered by any thought of immediate practical utility, in which the entire structure of modern science is employed, activity has become evident only within the past decade. Professor Procter is the connecting link between these two eras and the example set by him in his scientific attitude is especially evident in the United States. A few of the problems of timely interest are the chemical nature of collagen, the mechanism of bating and what is called the astringency of vegetable tannins. (The author reviews the results of his experimentation upon these problems which will be published in full later). The ultimate aim of all research in leather chemistry is the widening and deepening of our fundamental knowledge of this as yet very undeveloped field.

DIVISION OF GAS AND FUEL CHEMISTRY

A. C. Fieldner, *chairman*

R. S. McBride, *secretary*

Chemistry of combustion: W. K. LEWIS. The present state of knowledge of combustion is reviewed, the field being divided into, first, combustion within the fuel bed; second, distillation of the volatile matter in the fuel; and, third, the burning of the combustible gases over the fuel bed. The composition of the gases within the fuel bed is discussed and the effect of increased rate of combustion shown. The velocity of the reaction of C plus O_2 equals CO_2 is shown to be dependent on the speed of diffusion and not on the specific reaction rate. The modern concepts of the combustion of hydrocarbons are also discussed.

Combustion of powdered coal: HENRY KREISINGER and JOHN BLIZARD. This paper considers essential factors in burning powdered coal, and gives a review of some tests carried out by the U. S. Bureau of Mines and the Combustion Engineering Corporation. The size of the particles, their motion relative to the surrounding air and methods of bringing them into contact with fresh supplies of air as they burn are discussed. A furnace and burner designed for burning powdered coal are shown and the principles of the design explained. The principal results of tests carried out on a large boiler are shown graphically.

Simultaneous combustion of CO and hydrogen: R. T. HASLAM. A review of the literature shows that doubt exists whether the combustion of hydrogen and carbon monoxide is of the second or third order. Experimental evidence is offered to show that when carbon monoxide and hydrogen burn simultaneously with oxygen in free space the combustion reactions are both trimolecular and that the ratio of the reaction velocity constants in the equation $\frac{d}{dt}(CO) = K_1(CO)^2(O_2)$ and $\frac{d}{dt}(H_2) = K_2(H_2)^2(O_2)$ is $\frac{k_1}{K_2} = 0.35$.

Some aspects of combustion of gases: HENRY L. READ.

A study of the water gas reactions: R. T. HASLAM, F. L. HITCHCOCK and E. W. RUDOW. The action of steam on carbon through the temperature range of 650 degrees centigrade to 1200 degrees centigrade was studied by means of varying the pressure of the steam and results indicated: First, that below 900 degrees the major reactions are (B) C plus $2H_2O$ equals CO_2 plus $2H_2$; (D) C plus CO_2 equals 2CO; whereas above 900 degrees the reactions are (A) C plus H_2O equals CO plus H_2; (B) C plus $2H_2O$ equals CO_2 plus $2H_2$; (D) C plus CO_2 equals 2CO; second, that the undecomposed steam is shown to be the controlling factor in the CO and CO_2 ratio rather than the temperature at which reactions take place; third, equations are given showing the per cent. of CO_2 as a function of the undecomposed water; fourth, considering the rate of reaction (B) as unity it was found that (A) at temperature below 900 degrees centigrade reaction (A) is practically non-existent and that the velocity constant of reaction (B) is 2.0; (B) at temperature above 900 degrees the velocity constant of reaction (A) is 1.0 and that of (D) is 2.18.

Producer gas reactions: W. K. LEWIS. Application of equations in previous article (water gas reactions—Haslam, Hitchcock and Rudow) showing effect of temperature, steam-air ratio and time of contact on composition of producer gas.

The combustion of gaseous fuels: GEORGE F. MOULTON. Gas fuels commonly distributed for domestic and industrial purposes by gas companies vary in heating value from 450 to 1,100 B.T.U. per cubic foot. These gases vary in specific gravity from 0.35 to 0.70, and the pressures at which they are delivered to the consumer's appliance vary from 2 to 12 inches of water. The result of these large variations in heating value, specific gravity and pressure is that the manufacture of efficient gas appliances has been greatly retarded; the knowledge of correct adjustment of appliances is very vague, and modification of existing standards of quality has been made difficult because the effect of these changes on quality of service, efficiency of utilization and safety of operation has been difficult to determine. The range of operation of burners as well as the efficiency that can be secured will depend primarily on the characteristics of the flame. This paper shows how these flame characteristics are modified by a change of injection of primary air which may be caused by variations in gas rate, pressure, composition of gas, etc.

Combustion in engine cylinders: H. C. DICKINSON. The process of combustion in engine cylinders presents some very interesting problems which demand a radical departure from the usual methods of reasoning and experiment. When a combustible mixture of gases burns at constant volume no two successive portions of it are burned at the same pressure or the same temperature or at the same time. The reactions do not take place simultaneously throughout the mass and the law of mass action does not apply, except to infinitesimal elements of the charge. The times involved are excessively short and it is doubtful if chemical equilibrium is ever attained at any point until the important phases of the process are passed. The importance of the internal combustion engine in the present scheme of things demands much more precise knowledge of the chemistry involved in its operation.

Factors governing the selection and use of fuel for industrial heating operations: J. A. DOYLE. This paper deals with factors governing the selection and use of fuels in the production of chemical products subjected to the action of heat in the process of manufacture. The necessity for considering the physical form and chemical association of a given form of fuel, in addition to the heating value of that fuel and the mechanical characteristics of the appliance for generating, applying and utilizing heat in the product is stressed. The influence of excess air upon the heating value of the different fuels, the composition of the atmosphere surrounding the material to be heated, the changes in composition of the combustible mixtures and the products of combustion of the different fuels with varying amounts of air are shown. The influence of process requirements and plant conditions upon the choice of fuel is outlined. The above points are illustrated by graphic charts showing the relation of the various factors and their influence upon the final result. The paper is in substance a plea for a broader consideration of the problem of fuel utilization from the standpoint of the quality and cost of the finished product, and the necessity for developing a better understanding on the part of those concerned with industrial heating operations of the influence of the conditions governing combustion upon the use of fuel and the utilization of heat.

Methods of utilizing the coke produced by low temperature carbonization of coal: HARRY A. CURTIS. The coke obtained by low temperature carbonization of coal is soft, light and quite unsuited for general use as a smokeless fuel. Attempts have been made to increase the density of the coke by compressing the coking coal mass in the retort, but these methods have not attained commercial success. By pulverizing the soft coke it can be burned efficiently in powdered fuel equipment, but preliminary tests of the fuel on a Coxe stoker gave unsatisfactory results. By grinding the coke, briquetting it and carbonizing the briquets a very high grade smokeless fuel is obtained, but the cost of these operations is high.

The forms of sulfur in coke—a physico-chemical study of the sulfur held by carbon at high temperatures: ALFRED R. POWELL. A phase rule study of the system, carbon-sulfur, at high temperatures showed that the sulfur exists in two distinctive forms: (1) a very stable form which exhibits all the properties of a solid solution, and (2) free sulfur physically absorbed by the carbon. Coke may contain both of these forms in addition to some sulfur combined with iron as ferrous sulfide. At temperatures in the neighborhood of 500° C. the ferrous sulfide of coke oxidizes very readily in the presence of air to ferric oxide and free sulfur. This reaction seems to occur during the quenching of coke and explains the disappearance of ferrous sulfide from coke rather than any reaction which occurs during the coking process.

A specific apparatus for gases: T. R. WEYMOUTH, R. P. ANDERSON and J. R. FAY. This new device consists of a thin orifice and a small capillary tube in series and makes use of the fact that the differential pressure resulting from the steam-line flow of gas through a capillary tube is independent of the specific gravity of the gas while the differential pressure resulting from the flow of gas through a thin orifice varies directly with the specific gravity of the gas. The flow of gas through the orifice is kept constant by holding a certain differential pressure on the capillary tube and the differential pressure on the orifice is calibrated to read specific gravity of the gas.

The examination of low-temperature coal tars: JEROME J. MORGAN and ROLAND P. SOULE. A critical review of the adaptability and limitations of procedures available for examination of low-temperature tars. The lower boiling phenols are determined by Raschig's nitration method together with methods based upon freezing point and densities of binary and ternary mixtures. Paraffins and naphthenes are freed from unsaturates and aromatics by 98 per cent. sulfuric acid. The proportions of paraffins and naphthenes in their mixture are found from density-boiling point curves. For qualitative examination non-saturated hydrocarbons are separated by liquid sulfur dioxide. No method is known for estimation of unsaturates in presence of aromatics.

The Becker combination coke oven: HAROLD J. ROSE. The latest advance in by-product coke oven design is represented by the Becker combination oven, a modification of the Koppers oven. Greater heating efficiency, better coke quality and increased strength of construction are obtained by a novel design which provides for the heating and regeneration of the coke and pusher ends of each oven as separate units. In this construction, gases of combustion pass over the top of each oven and down through the opposite flues of the same end, instead of passing longitudinally to the end of the same line of flues. Details of design will be fully illustrated by means of lantern slides.

Methods for studying the macrostructure of coke: Harold J. Rose. The study of the structure of coke has been greatly neglected, due largely to the difficulties involved in preparing specimens, and in satisfactorily reproducing the structure photographically. This paper opens the way to the comprehensive study of coke macrostructure, by the use of novel methods. After sectioning the coke, the author impregnates the cut surface with a white hydraulically hardening compound, after which it may be polished to any desired degree. The excellent contrast of black coke with white impregnating compound makes detailed study and reproduction an easy method. Another novel method is the direct reproduction of the coke surface as obtained by inking the polished coke surface and printing with it on enameled paper. The article is copiously illustrated with macrophotographs.

A new electric furnace for the determination of the by-product yields of coal: Harold J. Rose. The by-product yields obtainable from coal when coked in a by-product coke oven may be determined by laboratory distillation tests. Since the yield of by-products is seriously affected by small variations in distillation conditions, the laboratory determination requires the most rigidly controlled testing conditions. For this purpose a furnace, consisting of a deep trough formed from a number of U-shaped electrical heating units with individual control, has been developed, and is in regular use for research and testing purposes. Typical results are given to show the agreement of duplicate determinations made with this apparatus. The furnace is described and fully illustrated.

The combustion of coal which has been a long time in storage: S. W. Parr and T. E. Layng. It has been fairly well demonstrated that coal in storage does not lose any appreciable number of heat units. Previous investigations show the seeming loss in B.T.U. to be due to a corresponding increase of weight resulting from absorbed oxygen. However, when coal, especially fine material which has been long in storage, is burned, the result is very likely to show a low efficiency and indeed such coal sometimes seems to be unwilling to burn at all. The results noted in this paper account for the behavior of such coal to be due to the fact that coal in the finer sizes, especially coal of the mid-continental type, has a very large absorptive capacity for oxygen, that, because of the colloidal character of the coal substance such absorbed or adsorbed oxygen is held so tenaciously that when discharged by heat it has reached the combining stage and goes off as CO_2. The blanketing effect of this gas over the fuel bed results in a deadening of the fire and a loss of efficiency.

A study of solvents for the separation of coal into its type constituents: R. S. Fisher with S. W. Parr. The greatest advance in coal studies during recent years has resulted from the use of solvents which separate the coal into its type constituents without decomposition of their chemical structure. British and continental investigators have made much use of pyridine, which, however, seems to lack this prime requirement of a true solvent in that it enters into chemical reaction with certain of the coal constituents. The work here described gives data in the use of benzene, toluene and xylene, with methods for the use of the latter solvent which excels all others in the amount and completeness of removal of the soluble material. This is a preliminary report only as the work is being actively followed up because of the promise of larger yields more easily recovered than by methods in vogue heretofore.

The softening point of coal—its determination and significance: T. E. Layng, W. S. Hawthorne and A. W. Coffman, with S. W. Parr. References to the softening point of coal are frequent in fuel literature. The term heretofore has had a very vague meaning. This paper describes a method for its determination at once simple and accurate. The interesting fact has been developed that under uniform conditions the softening point repeats itself with marked constancy. Moreover, it is evidently a characteristic factor for varying types of coal as also for coal which has been for different lengths of time in storage. That is to say, it is a value which runs parallel with the oxygen content. No less striking is the solidifying temperatures, which result in a curve symmetrical with the range exhibited for the softening-temperatures. Description of the apparatus with results on numerous coals are given. The results are exceedingly interesting and may answer such questions as: What is the type of coal? What would be its behavior in storage? What kind of coke would it make and what modification of existing methods would improve its coking qualities? The report is preliminary only and further experiments are in progress.

The fractional decomposition of coal and coal components: S. W. Parr and T. E. Layng. Next to the fractionation of coal by solvents the fractional decomposition of coal in its combined form and also of its separate type constituents has furnished the most valuable data concerning the character of different types of coal and their behavior in the process of decomposition. Investigators in this field heretofore have failed to appreciate the significance of oxygen either combined or absorbed, but especially the rôle of the oxygen held in some form of absorption. The results as interpreted from the standpoint of this investigation have an entirely new meaning and are of fundamental importance in connection with studies along the line of coal carbonization.

A proposed theory of coal carbonization: S. W. Parr and T. E. Layng. This paper presents the summarized results of the several contributory lines of investigation on topics directly related to the carbonization of coal. The evidence seems to be conclusive that a correct theory for coal carbonization has yet to be written. It is not to be inferred that its final formulation is attempted in this paper. However, the results now in hand point out the general outline. The basic principle seems to be that the bonding effect which results in the production of a coherent mass is due not only to the presence of bituminic material, but to the absence or control of deleterious products of decomposition from the cellulosic substance, which under certain conditions may weaken or completely nullify the bonding property of the bituminic bodies. The production of coke is therefore not a simple matter of destructive decomposition of organic matter, but a destructive decomposition accompanied by cross reactions which may, under varying circumstances, produce an altogether different result as to the physical character of the final product. The paper is a preliminary report only.

Utilization of gas at low pressures: Anna P. Warren. So much has been said about the use of gas and so little information of practical value to the domestic consumer is available that experiments under actual home conditions are in progress to determine the conditions necessary for maximum thermal as well as practical efficiency at the minimum pressure and rate of consumption of gases varying in heating value from 1,150 B.T.U. to 500 B.T.U. per cubic foot. Up to the present time, under standard conditions, natural gas is the only commercial gaseous fuel that will give relative high thermal as well as practical efficiency under one ounce pressure.

Available hydrogen in coal and a direct method for its estimation: Joseph D. Davis. Available hydrogen, called "disponsible" hydrogen by German writers, is hydrogen contained in coal in excess of that required to satisfy the total oxygen calculated to water. It is customary to calculate the available hydrogen of a coal from its ultimate analysis. The method described in the paper is volumetric. It is similar to that used for the analysis of combustible gases wherein the slow combustion pipette is used. The coal is burned in a known volume of oxygen and the volume contraction observed after the combustion has taken place is due to oxygen consumed in burning the available hydrogen to water.

Thermal operation of modern regenerator coke ovens: D. W. Wilson, H. O. Forrest and C. H. Herty, Jr. Briefly stated, there have been included in this report: first, discussion of data needed to show completely the thermal operation of a modern regenerator coke oven battery; second, description of the experimental methods employed to obtain the needed data together with a table giving experimental figures obtained; third, a table balancing total heat input against total heat output is given, with a discussion of this and a calculation of the efficiency of the ovens; fourth, a so-called sensible heat balance is tabulated, the net heat effect of the coking process is discussed and the relation between the sensible heat balance and the exothermicity of the conversion from coal to coke is indicated.

Producer gas from powdered coal: R. T. Haslam and L. Harris. Aside from the possibility of using a low grade fuel, the use of powdered coal for the manufacture of producer gas would give a constant composition gas free from tar, thus being easily cleaned, and the producer would be flexible, rapidly handling changes in load up to full capacity. As a result of experimental work not yet completed a gas of 12.0 per cent. CO and 7.0 per cent. CO_2 has been generated. Theoretical and experimental considerations show that the main factors are, first, high temperature in the combustion chamber (1,100-1,300° C.); second, air for combustion highly pre-heated (900-1,000° C.); third, coal finely pulverized, and fourth, air and coal well mixed together and so maintained until the end of the reaction.

Charles L. Parsons,
Secretary

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CHANGES OF LATITUDE

In this era of changes of every description, the question of changes of position of our astronomical observing stations on the surface of the earth has recently become a live issue. The question is still an open one, and its ultimate decision may rest upon a comparison of the precision of the results of observation with the size of the changes predicted or adopted by geologists.

California has undergone some severe earthquake shocks, of which we commonly talk but little and endeavor to think not at all. Of the modern disturbances, that of 1906 was clearly due to a slip at the surface of the earth along a geological fault line. At the location of this fault the relative slip of the two opposite sides was as much as twenty feet in some places. There is no such evidence available for any other earthquake, but it may be assumed that other shocks in this coastal region were of similar nature.

In Japan, where some five hundred earthquakes of sensible character have been recorded in twenty years, the shocks are presumably not due to slips at the surface along geological faults.

The only extensive results of astronomical observations in this region are those at the Lick Observatory, where meridian circle work has been prosecuted for nearly thirty years, and at Ukiah, about a hundred and fifty miles northwest of us, where zenith telescope work has been carried on continuously for twenty years. There have been isolated zenith telescope determinations of latitude, but they would contribute little of importance to the discussion of progressive or abrupt changes, owing to the uncertain errors of the star declinations adopted.

For instance, the latitude of our instrument, as furnished by the U. S. Coast and Geodetic Survey in the early days, was 37° 20′ 24.48″.

This value is more than a second of arc smaller than the one derived from our meridian circle observations, beginning in 1893. Errors of the old observations, including those of the star declinations, the lack of corrections for latitude variations, and the errors of the geodetic triangulation probably account fully for this difference. It appears not to have been quoted as an illustration of geological change. Possibly it is so large as to be out of bounds. The range of movements under discussion at present is usually from one to five feet. There was a notable earthquake in 1868, possibly due to a fault slip. It would, however, be difficult to assign the proper proportions of a difference of a second of arc to the errors of observation and to the slipping, if the 1868 shock is to be made responsible for its part.

The meridian circle results include the epochs of the earthquakes of 1895, 1903, 1906 and 1911. The first one of these was less intense than the others. The observations at Ukiah include the epochs of the last three.

On request for our data, the results given in the column Observed φ_0 below were originally compiled in quarterly values, the observations of each month having been combined into means of the values of two or three months. The table gives the number of successive quarterly values that make up the respective annual values of φ_0. In the annual φ_0 some of the periodic errors due to declination have been eliminated. There are some gaps in the sequence of observations, one from 1908 to 1912 due to my absence at San Luis, Argentina, for the work of the Carnegie Southern Observatory.

The system of standard stars in use varied from time to time, for special reasons of program and international projects of observation, and in the column of Corrected φ_0 the systematic corrections derived from the varions authorities have been applied as far as is possible. The reduction has thus been made to the system of auwers, for which a correction of approximately +0.1″ may still be required, to give us the true astronomical latitude of our instrument. The average residual of the last column is two thirds the size of that of the column preceding.

There are more stars in the catalog of Newcomb, and rigorous systematic corrections can not be derived for the extra stars. The latitude results during the use of his system, in the years 1901 to 1904, are nearly 0.1″ higher than those of the remaining years. Some additional results are included in the last column.

Treated as a consecutive series, from 1893 to 1921, there is no sensible continuous progressive change of latitude from the mean, 37° 20′ 25.6″. To illustrate the effect of abrupt changes at the epochs of earthquakes, the yearly results have been combined in groups, corresponding to each of three shocks. The small differences thus exhibited are such as would be expected, from the accidental errors of the yearly means. The influence of the high point in the series, where the declinations of Newcomb were employed, is felt in the combinations. There will be an apparent progressive rate up to that point and a drop thereafter which are probably fictitious. The mean values of φ_0 preceding 1901 and following 1904 have excluded the effect of the systematic difference due to Newcomb.

The errors in determining the declinations of stars are smaller than those involved in latitudes, since some of the important systematic errors can be eliminated. The probable error of the annual φ_0 is evidently too large to permit the detection of real changes that do not exceed 0.05″. Differences of 0.1″ would be anticipated for half the comparisons between separate yearly means, according to the law of distribution of errors, and three differences as large as 0.2″ might occur in a run of 18 differences.

The following computed latitudes for Ukiah differ from the true values by a systematic constant. The effect of the fourteen month term is eliminated in the mean of any fourteen consecutive monthly values. The effect of the annual term is eliminated in twelve. By taking means of fourteen consecutive values, beginning each series with the first month of a year, each mean below is subject to a correction for two extra months of the annual term—a small constant for all of them. No corrections need be compnted for either term in this method, and no assumption need be made as to the invariability of the coefficients of either term. The means are thus well adapted to show progressive or abrupt changes in latitude. The annual rate is quite precisely the mean rate for all the international zenith telescope stations, +0.005″ per year. A systematic correction to the proper motions, as originally computed for their star list, would account for this common rate. Its application gives the last column of the Ukiah results, and its effect is to diminish the average residual from 0.034″ to 0.027″.

LICK OBSERVATORY LATITUDE

MERIDIAN CIRCLE

Epoch	No.	Obs. φ_0	Corr. φ_0
1894.2	4	25.52″	25.52″
5.2	4	53	53
6.1	3	70	70
7.0	4	46	58
8.0	4	72	57
9.2	4	76	59
1901.1	4	83	74
2.3	4	81	74
3.2	4	74	67
4.1	3	50	47
6.0	4	47	47
7.3	3	....	61
8.0	2	37	42
12.6	4	64	64
13.3	2	50	50
14.5	4	61	61
16.7	4	....	56
17.6	5	50	55
21.6	3	....	77
Mean		25.60	25.59
Av. residual		±0.12	±0.08
Preceding 1903			25.62
Following 1903			.56
Preceding 1906			25.61
Following 1906			.58
Preceding 1911			25.59
Following 1911			.60
Newcomb, 1901 to 1904			25.65
Preceding 1901			25.58
Following 1904			.57

UKIAH, ZENITH TELESCOPE

FOURTEEN MONTH MEANS

Epoch	(φ_0)	Rate
1902.6	12.08″	12.12″
3.6	12	16
4.6	12	15
5.6	11	14
6.6	11	13
7.6	11	13
8.6	09	10
9.6	15	16
10.6	16	16
11.6	16	16
12.6	14	13
13.6	13	12
14.6	19	17
15.6	24	22
16.6	21	18
19.6	16	12
20.6	10	05
Mean	25.14	12.14
Av. residual	± 0.034	±0.027
Preceding 1906	14.107	14.142
Following 1906	153	142
Preceding 1911	14.117	14.139
Following 1911	167	141

Rate +0.005″ per year.

The probable error of a yearly zenith telescope latitude is evidently about one third that of the meridian circle results. There are approximately 3,000 observations per year in the former, and 800 in the latter. Both classes of observations are subject to systematic errors that produce larger errors in the mean results than would be due to accidental errors of observation only. The purely accidental error of a single meridian circle observation of a star is closely ±0.2″. With graduation error, and the error of nadir reading included, the probable error of a single latitude observation is closely ± 0.3″. The single zenith telescope observations have probable errors of about half this size. The same list of stars was used throughout at Ukiah, while the list varies for nearly every year at Lick.

There is no evidence at Ukiah of an abrupt change in latitude at the epochs of the 1906 and 1911 earthquakes. An average difference of 0.04″ would be expected between any two yearly results. Ukiah lies 26 miles east of the 1906 fault line, and Mount Hamilton is 22 miles east. These distances have generally been concluded to be too large to show any indication of movement at the stations. The positions of the faults responsible for the 1903 and 1911 shocks do not appear to be on record.

Without implying anything in the nature of an apology for the quality of modern astronomical work, we must conclude that it is hardly a criterion for such small changes as are at issue in this case. The principle of natural selection, useful as it may have been in the domain of biology, must be used sparingly, if at all, in astronomical results. This does not preclude taking note of systematic errors, for the existence of which there is evidence all too ample for our purpose of as high precision as we can reach.

The differential results of the triangulation of the U. S. Coast and Geodetic Survey, covering many points in the neighborhood of the 1906 fault, appear to furnish a more precise criterion. The closing error of each triangle represents the errors of observation. No one questions the usefulness of this device, nor its validity, for the purpose of deriving the best individual results available. We commonly follow the same process in fundamental astronomical work, when we derive systematic corrections to right ascensions, by closing a cycle of a year of continuous differential results. An apt illustration, also, is the measure of graduation errors. The sum of the errors of the divisions of one circle must be exactly zero, when we arrive at the starting point of the measures, having gone round the circle. The average closing error for primary triangulation work appears to be about two seconds. Its proportional part must be assigned, as accidental error, to any absolute determination of a point, by the triangulation.

The probable error of an observed direction, for primary work, appears to be less than one second of arc. For secondary triangulation it is between one and two seconds, and for tertiary work it may be as much as five seconds.

One should guard against the assumption that the probable errors are small for any special triangle, when its closing error is small. This error is made up of several constituent parts, and they may balance in the sum of their effects; just as we have zeros in any list of residual errors and also have some residuals as large as three or four times the probable error of the individual results.

The following data have been taken from the reports for 1907 and 1910.

The test of changes in position at several miles from the fault line may be assumed to rest on the triangulation net from the base line between *Mocho* and *Mt. Diablo*. This is not a measured base, but has been connected up with the *Pulgas* base, south of San Francisco. The base line is about 36 miles long, and it lies 33 miles east of the fault, with which it is approximately parallel.

The changes of the tabulated latitudes of 41 stations, between measures before and after 1906, have been summarized below. Each group includes points on both sides of the fault at nearly the same distances. On the east side the average change is 0.02″ south, and on the west the average is 0.05″ north. The average of all changes is 0.04″, and all groups show a plus relative displacement for west minus east. The latitude of the center of the base line is 37.7°.

No.	φ	From Fault	Rel. Dis.
7	37.8°	11 miles	+0.03″
8[1]	37.7°	3 miles	+0.07″
12	38.5°	1 mile	+0.09″
10	38.9°	3 miles	+0.11″
4	37.0°	14 miles	+0.03″

The *Mocho-Diablo* base line, being 33 miles from the fault, one second of arc in the observed direction is represented by nearly a foot lineal measure, (0.01″), at the fault line. At 80 miles, a second of arc is represented by two feet. The average displacements of the groups are from two to eight times the lineal measure of a second of arc, at the respective distances. *Farallon* is the only station west of the fault showing a sensible change (0.027″) at a relatively great distance, 22 miles. The change of 2.7 feet is quite precisely twice the lineal measure of a second of arc, at its distance from the base line.

No change of latitude was found for the station, Mount Hamilton. This point is 12 miles southwest of *Mocho,* and at this distance one foot on the surface is represented by over three seconds of arc, in the observed direction. This result would indicate also that there was no sensible change at the date of the 1903 earthquake, unless the station returned to its original position by an almost equally precipitate movement.

These lineal equivalents are of course only true for arcs measured at right angles to the respective lines of sight. But the relative positions of the base line and points along the fault are in general favorable for the measurement of displacements in latitude, especially for the stations between 37° and 38°. *Farallon* lies almost due west from the center of the line, but was not observed from either end, its position being fixed by directions from stations

[1] One omitted, residual ten times the average.

close to the Coast, in the succeeding net of triangles.

The criterion then is whether the directions of the points in the neighborhood of the fault have been measured within accumulated errors of observation of the order of a second of arc. Apparently, for all stations which are close to each other, though distributed on both sides of the fault, any errors in the adopted positions of *Mocho* and *Diablo* would be systematic in their effect upon relative displacements, affecting all stations alike.

In the summations of the changes at the various stations in groups, the computed probable error of a mean displacement is $\pm 0.005''$, or half a foot. Such precision is apparently five times that of the yearly zenith telescope results.

In the astronomical observations, one foot on the surface is closely equivalent to one one-hundredth of a second in latitude. In geodetic triangulation, one foot on the surface is equivalent to one second of arc, in the direction of a point forty miles distant.

On these grounds we may conclude that the precise differential results of triangulation are better tests for very small changes on the surface than astronomical observations of an absolute character.

R. H. TUCKER

LICK OBSERVATORY,
SEPTEMBER 30, 1922

CONSERVATION AND MODERN LIFE[1]

THIS is an age of high pressure living, of seemingly increasing complexity. Our modern civilization is making such insistent demands upon us that unless we counter by equally insistent measures of self-restraint we must be overwhelmed. Am I drawing too dark a picture or using too strong words? Look into your own experience and see if your success has not been due, in part, at least, to your resistance of certain tendencies and demands, or your failure in some particular to your inability or disinclination to combat some urge, external or internal. It is true, of course, that our lives must be shaped by the culture in which we live, but it is equally true that we must do our share in shaping that culture. Mere following the line of least resistance, passive floating with the tide helps neither our civilization, our fellows nor ourselves.

This is an era of conservation. Its spirit is in the air. We are coming to realize more and more that we must conserve our resources if we are to maintain a high place in the present organization of the community. This statement holds true whether we consider our material resources or our immaterial assets, whether we look to the preservation of our own status or to the maintenance of society. It is with this necessity in mind, then, that I venture to call to your attention a few facts and principles upon which we may base our attitude toward the broader aspects of conservation. And because there is just as urgent need for conserving the elements which shall minister to our inner lives and experiences as there is for guarding those resources of more material nature I shall not confine myself strictly to those ponderable and tangible features which are usually grouped under the conservation movement.

Now whether we call ourselves conservationists or conservatives is just now of little moment. We shall find much in common in the two terms and the values they subserve. Do not both of them imply the clinging to and the preservation of all that is best in the heritage which has been bequeathed us? And what a rich heritage that has been! To what a wealth of treasure have we become heirs, whether we count our physical resources or those of spiritual natures and use. But with the conservative spirit there must also be mingled a real progressivism. Conservatism easily becomes reactionism, as progressivism is in danger of becoming radicalism if they are not actuated by a keen sense of balance. We find abundant exemplification of these statements in present day politics and in history, in the wastage of natural resources or in their undue withholding from proper use, in extreme tendencies in social life and customs, whether it be a clinging to the habits of the past or a hasty adoption of the fads of the present.

[1] Presidential address read before the Iowa Conservation Association at the Charles City meeting, July 13, 1922.

That there is real need for the conserving of our material resources no one, I feel confident, will dispute. We may classify these resources as those which subserve the necessities of our physical beings and those which minister to our inner and higher needs. I realize, of course, that no hard and fast line can be drawn between these. There is a sense in which all are necessary, since symmetrical development and well-poised usefulness of the human life can be attained only when all the ministry of nature has been offered and received. There are, however, a few materials which are basic and necessary for bodily existence. Such are the soil, the water supply, the coal and iron reserves, the vegetal and animal kingdoms, together with other less conspicuous but perhaps equally vital components of the earth's structure. Life in any form, much less in the highly complex types, can continue and thrive only where these are abundantly available and are put to constant use. Because of this their intelligent application to the needs of modern living and their equally intelligent reservation for the needs of future generations are alike imperative.

I do not propose to burden you with a mass of statistics but I do wish to present just a few facts and figures to show you how important a matter the careful use and husbanding of our natural resources has become. The soil is, of course, the basis of all wealth and civilization. Upon its intelligent cultivation depends the very life of the people. The United States proper includes 1,937,144,960 acres of land, of which 838,591,774 acres are classed as farm land. About 50 per cent. of this area is under cultivation, or about one fifth of the total acreage of the country. On this one fifth, then, the population must depend in large measure for its sustenance. How careful the tillers of the soil should be that this small fraction is put to its best use. Intensive farming, proper rotation of crops, more intelligent tillage, prevention of soil wastage, both mechanical and chemical, increased use of fertilizers—all means must be utilized if the necessary crop yields are to be maintained. At present the western states and Canada are among the foremost exporters of foodstuffs for other lands. What will happen when our own population demands all the food our farms can produce? What will happen when a still further increased population finds that the farming states can not supply its needs? It will not suffice to say that that day will never come. Unless our farms maintain and increase their yields that day will most surely come to us as it has come to other nations. The means I have already suggested will help to postpone that unfortunate time, and in addition the tillable acreage may be increased by irrigation and drainage, the losses due to injurious insects and mammals and to plant diseases may be lessened by increased knowledge, care and skill, and increasingly intelligent animal husbandry may improve the quality and quantity of our meat and dairy products.

Iowa may be proud of having both the largest acreage of improved land of any state in the Union, about 30,000,000 acres, and also the largest percentage of improved land to total area, nearly 90 per cent. This improved acreage is about one and one half times that of Texas and about two and one half times that of California. While Texas may boast of her oil booms and California of her climate Iowa must nevertheless produce the crops that shall help feed the world, for she is in the center of the richest land of the globe. The yield of the farms of the Union in 1920, including live stock on the farms, was $12,974,461,000 and that of Iowa during the same year was $1,175,504,318, about one twelfth of the total. My point in citing these figures is to emphasize Iowa's importance as a food producer and the necessity of maintaining and raising the high standard already set.

In mineral resources our country is wonderfully supplied. Probably no other land has such wide variety in such great abundance. This places upon us a stewardship of magnificent proportions and the responsibility is increased by the fact that to a degree far beyond what is true of the soil, these resources if once dissipated are gone forever. The field that has just raised a crop of oats may raise an equally good crop of corn next year, but the land from which our coal was mined last winter will never yield another such harvest.

The water which drives the turbines of Niagara may some day repeat its cycle but the gasoline that drove your car to this conference will never serve that purpose again. Yet in face of these facts millions of gallons of oil are used needlessly or are wasted in other ways. It is estimated that for every ton of coal mined thus far one half ton to one and a half tons have been wasted. We all know how carelessly iron products are handled. Machinery is exposed to the weather, tin cans are allowed to rust away, though the tin is worth large sums, and in many other ways there is a constant loss. It has been estimated that our petroleum supplies will be practically exhausted in a quarter of a century, that the available coal resources will be mined out in another hundred years and that perhaps half a century will see the exploitation of the best and most accessible of our iron ores. These estimates are based on productions similar to those of recent years. Should the output largely increase, the periods of availability will be correspondingly shortened. In this connection it may be well to state that mineral production in the United States advanced from a value of nearly $2,400,000,000 in 1915 to a value of over $6,700,000,000 in 1920, an increase of nearly 300 per cent.

In connection with the minerals and their consumption let me call your attention to the great field of service in the improvement of power-saving machinery. It is said that our steam engines utilize only 20 per cent. of the available power in the coal used. Our systems of heating are equally wasteful and must be improved if we or our posterity are not to suffer. It will not do to be thoughtless optimists. We must mingle foresight and prudence with our typical American hopeful front toward the future.

Other resources which must be held in higher esteem and cherished with greater care and foresight are our water supplies, our forests and other timber resources, together with all other beneficial plants and flowers and native animals. I shall only mention these, as they are to be discussed by more able advocates later at these sessions. I may call your attention in passing, however, to the recent news dispatches reporting nearly 400 forest fires in the far west, many of which, no doubt, were preventable, and to recent statements that insects annually destroy a billion dollars' worth of crops, a waste which the native birds would greatly reduce if given a free hand. I wish chiefly to emphasize here the point which I made earlier, that the beauties and creatures of nature which minister to our ethical and esthetic senses are as truly worthy of our care and attention as are these material necessities of which I have spoken. The world would be a cheerless habitation if it contained only iron and coal and oil and similar basic articles, so-called. Our bodies must be cared for, it is true, but are not our minds and our spirits of equal value? Shall we not then care for the things which help them to grow as well as for these others?

This leads me to another thought akin to that with which I began this address. This is an age of high-pressure living. Is it not of even greater importance that we conserve ourselves than that we care for the things of the world about us? Let me dwell for a moment then on this topic. We need to conserve our physical powers—by correct living, by judicious husbanding of all the gifts with which we are blessed, by scornful repudiation of all things which tend to weaken or break down our bodily endowments. They are ours not to waste but to use. Service is one of the pass words of the day. But service demands preparedness, and preparedness means careful training, self-restraint, symmetrical development. Again, we must conserve our mental powers and faculties. Never was there greater need of well-directed judgment, of poise, of balance, of a high sense of personal responsibility. I feel well-nigh heartsick at times at the inaneness and mental vacuity of such a mass of our young people, at their shallowness of thought and feeling, at the seeming lack of any sense of responsibility and obligation to the world in which they live and to generations yet to come. I can only hope that experience will deepen and broaden their minds and make them more fitted to fulfill those duties which must rest upon them. We are passing through a period of revulsion and reaction from the tension of the past few years, which may account in part for the condition of which I have just spoken. Financially, industrially, politically, socially we are being driven by shifting winds and carried by changing currents. Shipwreck may be avoided, but clear thinking, cool judging, wise acting must be the pilots at the wheel.

Once more, we must conserve our spiritual ideals and attainments. This is no time for narrowness of outlook. If ever there was a time when broadness of vision was demanded it is to-day. I wonder if you realize to what extent intolerance, the backward look, narrow minded conservativeness are dominating or attempting to dominate the spiritual life of the day. This too, doubtless, is a passing wave, a manifestation of the reaction which is affecting other aspects of life. But its tendencies are dangerous. They are destructive rather than constructive. They tend to shut men out from the higher realms of spiritual life and thought rather than to welcome them and to incite them to the greatest attainment. The founders of our faith and the builders of our nation were men and women whose heads were set forward on their shoulders, not backward. They advanced into the unknown and made of it a patrimony for those who followed them. They held fast the freedom they had obtained and persistently aspired for more. Had it not been so, picture to yourselves, if you please, the history of the past three hundred years. If we abate the struggle or lose the winnings they have made, picture for yourselves again, if you please, the history of the future. Broadmindedness, altruism, charity, faith, compounded with intelligence and a rational appreciation of the temper and needs of the time, these must be components in the lives of the men and women of to-day who are to shape the destinies of to-morrow.

I have attempted very briefly to summarize some of our resources, the dangers of their abuse and our obligation for their careful utilization. I have also tried to make clear our debt to the future, in the necessity of preserving to posterity as much as possible of the splendid gifts which we have received from a bountiful Creator. I have given you an impressionistic sketch rather than a detailed portrait. I am not a prophet of disaster and I fully believe that as new emergencies arise they will be met by new resources. But I do believe that the duty is laid heavily on each of us to do what in us lies to avert or at least to postpone these emergencies and by living hopefully, bravely, carefully and with our faces toward the light of the future, to conserve every resource, material and spiritual, that may contribute to an aspiring and inspiring life.

James H. Lees
Iowa Geological Survey,
Des Moines, Iowa

THE PRESENT SUPPLY OF BIOLOGICAL STAINS

As many requests have been received for information as to where stains can be obtained at present it seems well to publish a brief note listing the various manufacturers and dealers in this line at present.

Frequent inquiries are made concerning Grübler's stains. In this connection it can be said that there are at present on the market some stains of undoubted Grübler origin and others that are reputed to come from this source. There will undoubtedly be longer lists of Grübler's stains to be obtained as soon as it is easier to import them than at present; but as all of the recent investigations on stains point to the equal quality if not superiority of the American stains, there is no need of looking specially for the reintroduction of the German products. For this reason the domestic market conditions are most important at present. To understand these conditions it must be remembered that there are three different classes of concerns to deal with in this matter: (1) the basic manufacturers, (2) the specialists in biological stains and closely related chemicals, and (3) the dealers in general laboratory supplies.

The basic dye manufacturers are of little concern to the biologists, with two exceptions. These two are:

Calco Chemical Co., 136 Liberty Street, New York City.

National Aniline and Chemical Co., 40 Rector Street, New York City.

Both of these have departments that prepare special dyes for biological purposes. The National Aniline Company puts out an especially long list, so much so that this department of the company deserves to be considered with the specialists in biological stains to be mentioned below. Three other basic manufacturers—Dicks, David and Co., Varick and N. Moore Streets; Heller and Merz, 505 Hudson Street, New York City; McAndrews and Forbes, Camden, New Jersey—have shown a great deal of interest in the work and put on the market certain products that deserve to rank with the biological dyes and are handled by all the concerns mentioned below.

The specialists in biological stains either manufacture their products from the intermediates or else, whenever they know of a good source of some dye, buy it of the basic manufacturers and see that it comes up to their tests. This was and probably still is the function of Grübler and Holburn in Germany. The domestic concerns falling in this list that are at present in the business are:

Coleman and Bell, Norwood, Ohio.

Empire Biochemical Co., 920 Whitlock Avenue, New York City.

Harmer Laboratories, Lansdowne, Pa.

D. H. Pond, Blackstone Bldg., Cleveland, Ohio.

Providence Chemical Co., Providence, R. I.

as well as the Pharmaceutical Division of the National Aniline and Chemical Company, as mentioned above.

The last mentioned concern needs a further word of explanation because of a certain misunderstanding that is prevalent. In some of the earlier tests made by a committee of the Bacteriological Society, National Aniline products were listed, and they rank rather unfavorably. These, however, were the textile dyes, the only ones then sold by this company. The company has since then decided to specialize in biological stains and their present line of stains is entirely different from those mentioned in the earlier report. Another misunderstanding comes from the fact that when the Heyl laboratories failed, Dr. Heyl entered the employ of the National Aniline and Chemical Co., and the latter concern began marketing biological stains. This naturally gave rise to the impression that the National Aniline Co. has taken over the Heyl Laboratories. Such is not the case, however, and the National Aniline line is distinctly different from those previously marketed by the Heyl Laboratories.

The third class of firms mentioned above needs very little mention here because they are quite well known to the biologist. Some of these laboratory supply houses like Central Scientific Co., A. H. Thomas Co., and E. Leitz Co. buy some one line of stains from the specialists in that line and advertise this fact; others buy dyes from the basic manufacturers and sell them as stains under their own name. Among the latter the Will Corporation deserves special mention because in the past they have manufactured stains where necessary and have standardized those that they have bought exactly as done by the specialists listed above. They are at present, however, stopping the manufacture of these products, now that satisfactory American stains are readily obtainable.

This article is published in the hope that it will assist users of stains in understanding the market and buying intelligently. All the concerns mentioned as dealing particularly in this line of business have given the committee hearty cooperation and are doing their best to market a satisfactory line of stains.

H. J. Conn, *Chairman*
Commission on Standardization of Biological Stains

LOWERY LAYMON LEWIS

The death of Dr. Lowery Laymon Lewis, of the Oklahoma Agricultural and Mechanical College and Experiment Station, on September 26, has taken from the institution and the educational circles of the state a faithful worker and scientist whose loss will be keenly felt.

Dr. Lewis was born at Newport, Tennessee, on September 3, 1869. He received the B.S. degree at the Texas Agricultural and Mechanical College in 1893, and the M.S. in 1894 from the same institution. His studies were continued at the Iowa State College and in 1896 was granted the degree of D.V.M. During that year he came to the Oklahoma Agricultural and Mechanical College as professor of veterinary medicine and state veterinarian. In 1899 he also became professor of zoology and experiment station bacteriologist. He gave himself up entirely to his work not only in the departments in which he was interested but to the school as a whole. That he was highly esteemed was manifested by the fact that in 1900, in addition to his other duties, he was made dean of the School of Veterinary Medicine, and, in 1913, was also made dean of the School of Science and Literature. During the year 1915 he was made acting president and director of the experiment station. In 1921 he was made dean of the faculty.

Dr. Lewis was for a time a member of the American Association and was a working member of many scientific societies. Although quiet and retiring in personality, he was always ready to do his part in any enterprise of educational value for public welfare.

His research work was directed chiefly toward the diseases and the improvement of the livestock industry. In his earlier work he was much interested in parasiticides, anthelmintics and disinfectants. Later, he carried on a great deal of work toward the prevention and control of hog cholera and the prevention of tuberculosis in livestock. His most recent experimental work has been with the problem of sterility in domestic animals. In this connection he has shown some of the influences of a concentrated protein diet upon the potency of germ cells.

Dr. Lewis was at his best in his work about his laboratory surrounded by his students and associates. His personal interests were the last to be considered and he made it easy, and a source of pleasure, for his associates who worked with him. His own high ideals of service and love for the truth were the source of inspiration for many college generations. Many students went forth from his classroom filled with the love of science and guided by the example of his calm and thoughtful leadership to meet the problems of life with the same determination, standards and ideals that he imparted to them. Mere words can not summarize services such as he rendered to the school and state. He left an inspiration in the field of altruistic endeavor which will always be held in high esteem by his students, friends and colleagues.

JOHN E. GUBERLET
OKLAHOMA AGRICULTURAL
EXPERIMENT STATION

SCIENTIFIC EVENTS

PRECISE STANDARDIZATION OF RADIO FREQUENCIES

THE Bureau of Standards has developed a very precise method of standardization of radio wave lengths and frequencies, which is the fundamental basis of radio measurements in this country. By the process used, the frequency of radio waves is compared with that of an audible musical note. A tuning fork is mounted in such a way that it may be made to control the frequency of an oscillatory circuit. The frequency of another oscillatory circuit operating at much higher frequencies is then compared with it by means of a cathode-ray oscillograph.

This latter instrument consists of the cathode-ray tube, a special kind of vacuum tube in which the narrow stream of electrons is subjected to the action of electric fields applied by the two alternating-current generators. When neither generator is operating, the electrons, impinging on the active screen at the end of the tube, cause a single luminous spot. If one generator is connected, the spot is deflected back and forth along a single line, horizontal or vertical as the case may be, with such rapidity that it appears as a solid line. If both generators are applied simultaneously, the spot oscillates both horizontally and vertically and appears, in general, as a blurred luminous rectangle. If, however, the frequencies of the two generators bear a simple ratio, such as four to one, the spot traverses and retraverses a definite simple path, forming a figure by which the frequency ratio may be recognized. It has been found possible to compare frequency ratios as high as twenty-one to one.

The bureau is at present engaged in the standardization of a high precision standard wavemeter by this means. A tuning fork of known frequency, approximately 1,000 cycles per second, is used as the basis of the standardization. A low-frequency generator is tuned to successive multiples of this frequency by means of the cathode-ray oscillograph and corresponding settings of the wavemeter are obtained. A third generator is similarly tuned to multiples of these frequencies and thus by successive stages the standardization is extended to include frequencies as high as 5,000 kilocycles (60 meters). It is intended that this wavemeter be used as the basic standard for the standardization of commercial wavemeters.

THE DEVONIAN FOREST AT GILBOA, N. Y.

Continued operations of the New York Board of Water Supply have brought to light 20 to thirty additional specimens of these earliest trees, all of which, by courtesy of the commissioners, have come to the State Museum, with the exception of one specimen presented to the American Museum of Natural History. These great stumps have now been located at three distinct horizons in the sandstones of late Devonian age, at or near Gilboa, and thus indicate the rising and falling of the shore land on which they grew. The botanical interest attached to this extraordinary occurrence is intensified by the fact that no satisfactory solution has been offered of the relationships of these trees, though they have been known for many years. The character of the stumps themselves and such portions of their tissue as remain have not proved a satisfactory clue to their nature, but Winifred Goldring, paleobotanist, has found in their foliation and fructification evidence which has led to the belief that they are seed ferns (Pteridospermophyta), partaking of the character of Lyginopteris and allied forms, but of a simpler organization. That trees of such magnitude, rising to heights of 30 to 40 feet, should appear so abruptly in geological history is sufficient to indicate what a long unobserved record lies back of this majestic plant growth, the oldest of known forests. In due time an effort will be made to reproduce in the State Museum the conditions under which these trees grew on the sloping shores of the Appalachian.

THE BOYLSTON MEDICAL PRIZES

These prizes, which are open to public competition, are offered for the best dissertation on questions in medical science proposed by the Boylston Medical Committee. At the annual meeting held in Boston in 1920 a prize of $300 was awarded to an essay entitled "Acute Inflammation of the Nose, Pharynx and Tonsils" by Mr. Stuart Mudd, of St. Louis. For 1922 there is offered a prize of $500 and the Boyston Prize Medal for the best dissertation on the results of original research in medicine, the subject to be chosen by the writer. The Boylston Prize Medal will be added to the money prize only in case the winning essay shows special originality in the investigations detailed. Dissertations entered for this prize must be in the hands of the secretary on or before February 1, 1923.

In awarding these prizes, preference will be given to dissertations which exhibit original work, but if no dissertation is considered worthy of a prize, the award may be withheld. Each dissertation must bear, in place of the author's name, some sentence or device, and must be accompanied by a sealed packet, bearing the same sentence or device, and containing the author's name and residence within. Any clew by which the authorship of a dissertation is made known to the committee will debar such dissertation from competition. Dissertations must be printed or typewritten, and their pages must be bound in book form. All unsuccessful dissertations are deposited with the secretary, from whom they may be obtained, with the sealed packet unopened, if called for within one year after they have been received.

By an order adopted in 1826 the secretary was directed to publish annually the following votes: (1) That the board does not consider itself as approving the doctrines contained in any of the dissertations to which premiums may be adjudged. (2) That, in case of publication of a successful dissertation, the author be considered as bound to print the above vote in connection therewith.

The Boylston Medical Committee is appointed by the president and fellows of Harvard College, and consists of the following physicians; Reid Hunt, M.D., *secretary;* William T.

Porter, M.D., Edward H. Nichols, M.D., Henry A. Christian, M.D., John Warren, M.D. The address of the secretary of the Boylston Medical Committee is Reid Hunt, M.D., Harvard Medical School, Boston, Mass.

ANTI-VIVISECTION LEGISLATION IN CALIFORNIA

The proposed law prohibiting vivisection in California was defeated at the recent election by an overwhelming majority. Prior to the election the regents of the University of California, by President David P. Barrows, and the board of trustees of Stanford University, by President Ray Lyman Wilbur, issued the statement which follows:

The advance of sanitation, modern medicine and physiology, nutrition, the teaching of biology and the protection of our industries and agriculture all rest on animal experimentation. The control of the epidemic diseases of man and of animals, the management of surgical operations and of childbirth, and the certification of milk, food and water supplies would be impossible without the knowledge gained by such studies. In fact, the present-day protection of the public from diseases, which is vital to our community life, rests on animal experimentation. The University of California and Stanford University are vitally interested in the defeat of this initiative measure, since its passage would be a state-wide calamity.

Not only would it stop the research work now going on in the medical schools, hospitals and laboratories and in the Bureau of Animal Industry, but it would damage the market for most of California's food products and markedly reduce the confidence of visitors coming into the state. If California could not certify to its food and water supplies, could not guarantee protection against contagious diseases, could not provide certified milk, the effect on agriculture and industry in the state would be disastrous. The near collapse of the olive industry, due to the poisoning of a few people in eastern states, and the way in which the industry was saved by the researches carried on in the laboratories of the two universities, indicate the imperative necessity of freedom for the universities in animal experimentation. California food, instead of being looked to as an example of purity, would be shunned.

The initiative measure would make it impossible to test with birds for deadly gases in the mines of the state. It would stop the manufacture of serum for the prevention of hog cholera, the preparation of vaccine for anthrax and the various other products that are required for the protection of our industries in agriculture and that annually save millions of dollars and prevent great mortality among domestic animals. Under the act, operations on various farm animals could be carried on without anesthetics to increase the palatability of foods, but no animals could be used in experimental work if the information obtained is for the benefit of a person or of the human race.

We feel that no worse attack on the welfare of the state and on the right of the universities to seek and teach the truth could be made. Every man, woman and child, every unborn babe, every domestic animal in the state, would be affected if this measure becomes a law. It strikes at all. It is unnecessary special legislation, due to prejudice and misinformation. No one will tolerate cruelty to animals. The present laws of the state are drastic and sufficient to control any abuse. We know that there is no cruelty to animals in the laboratories of the universities. They are in charge of men and women of the highest character who are unselfishly working to better the lot of their fellowmen and to advance the interests of their community and of the state. Anesthetics are always used for animals in the laboratory in exactly the same way that they are used by surgeons in the operating rooms.

We urge upon the citizens of the state the imperative necessity of defeating this initiative measure.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Reduced railway rates for those attending the fourth Boston meeting of the American Association for the Advancement of Science (to be held mainly in the buildings of the Massachusetts Institute of Technology, Cambridge, Mass., from December 26 to 30) have been fully granted by all of the railway passenger associations excepting the Transcontinental. Furthermore, in the territory of the last-named passenger association the privilege of reduced rates on this occasion extends westward on Montana lines to points in Oregon and Washington (excepting Portland), by routes through the Missouri River and St.

Paul. The eastern lines of the Canadian Passenger Association have granted this privilege also. The railway fare for any one attending the Boston meeting from authorized points will be a fare and a half for the round trip, on the certificate plan, as in the case of last year's Toronto meeting. From unauthorized points (all in the far west) attractive excursion rates will be available. The preliminary announcement for the Boston meeting will shortly be mailed to all members of the association.

SCIENTIFIC NOTES AND NEWS

Announcement is made that the Nobel prize in physics for the year 1921 has been awarded to Professor Albert Einstein, of the University of Berlin, and for the year 1922 to Professor Neils Bohr, of the University of Copenhagen. The Nobel prize in chemistry for the year 1921 has been awarded to Professor Frederick Soddy, of the University of Oxford, and for the year 1922 to Professor F. W. Ashton, of the University of Cambridge. The prizes for medicine have not been awarded.

Dr. Royal S. Copeland has been elected United States Senator from New York by a very large majority. Dr. Copeland, who has been commissioner of public health for New York City, was professor of ophthalmology in the University of Michigan from 1895 to 1908.

Dr. Charles P. Steinmetz, of the General Electric Company, who was candidate for state engineer in New York on the tickets of the socialist and labor parties, received about three times as many votes as the candidate for governor. The vote for Dr. Steinmetz in New York City was 207,138.

Dr. William H. Nichols, chairman of the General Chemical Company, and Dr. John J. Carty, vice-president of the American Telephone and Telegraph Company, have been elected members of the council of New York University.

The Grasselli Medal, awarded every year by the Grasselli Chemical Company to the author of the best paper presented before the Society of Chemical Industry during the previous year, was presented to W. H. Fulweiler, chemical engineer of the United Gas Improvement Company, of Philadelphia, at the regular meeting of the section at the Chemists' Club, New York, on October 20.

The Pharmaceutical Society, London, has presented the Hanbury Medal, awarded every two years for the promotion of research in the chemistry and natural history of drugs, to M. Emile Perrot, professor of materia medica in the University of Paris.

Drs. Ramón y Cajal, of Madrid, and Bernardo Houssay, of Buenos Aires, have been elected honorary members of the Mexican Society of Biology. Dr. E. B. Krumbhaar, of Philadelphia, has been elected a corresponding member.

The Bavarian Academy of Sciences has elected as corresponding members, Dr. R. Tigerstedt, professor emeritus of physiology at Helsingfors, and Dr. Ramón y Cajal, professor emeritus of histology at Madrid.

Dr. Frank R. Lillie, of the University of Chicago and chairman of the Division of Biology and Agriculture of the National Research Council for the year 1922-23, will be in residence in Washington from January 1 until about the end of March. During the period before the expiration of his term on June 30, 1923, he will make occasional visits to Washington, but the major portion of his time will be spent in Chicago.

Dr. Philip S. Smith, administrative geologist of the United States Geological Survey, has been appointed acting director.

Dr. Percy Longmuir, of Sheffield, has been appointed director of research to the British Cast-Iron Research Association.

Dr. A. Loewy, professor of physiology at the University of Berlin, has accepted the charge of the institute for study of the physiology of altitudes recently founded at Davos by the Swiss government.

Mr. R. E. Priestley, of Christ's College, Cambridge University, has been elected a fellow of Clare College. He was a member of Sir Ernest Shackleton's Antarctic Expedition fifteen years ago, and also of Captain Scott's expedition in 1913. He has published numerous papers dealing with the geology of the Antarctic.

Professor Arthur Smithells, who has held the chair of chemistry at Yorkshire College and Leeds University since 1885, is to retire at the end of the current session and will take up special research work in chemistry in London.

Dr. Leon W. Parsons has resigned as assistant director of the Research Laboratory of Applied Chemistry of the Massachusetts Institute of Technology to accept a position as chief chemist of the Tidewater Oil Company, Bayonne, N. J.

Educational programs of the various institutions offering courses in chemical engineering are to be investigated by a committee of eleven appointed by the council of the American Institute of Chemical Engineers, with a view to standardizing the training required for the degree of Ch.E. The program of the committee contemplates three years' work in obtaining the adoption of recommendations of a previous committee and the publication of a list of approved schools at the end of this period. The committee consists of H. C. Parmalee, *chairman;* five representative educators: Joseph H. James, W. K. Lewis, A. H. White, R. H. McKee and S. W. Parr; and five representative industrialists: C. E. K. Mees, A. D. Little, C. L. Reese, W. C. Geer and W. R. Whitney.

The *Journal* of the American Medical Association reports that the close of twenty-five years of teaching and research in physiology by Professor H. Zwaardemaker has been celebrated by friends and students at the physiological institute of the University of Utrecht. His contributions to science include additions to our knowledge of the organs of sense, of the transformations of energy, and of the importance of potassium for the automatism of the organs. He is now studying physiologic radioactivity, and how to help the deaf. He was presented with a *feestbundel* of ninety-five scientific articles from international sources, which, with an introductory article describing his life work, form a volume of 591 pages of the Netherlands *Archives of Exact and Natural Sciences*. His portrait was also presented, to be installed in the institute.

The Pasteur Lecture for 1922 of the Institute of Medicine of Chicago will be delivered by Dr. Jacques Loeb, of the Rockefeller Institute, on Friday, November 24, 1922. Professor August Krogh, of Copenhagen, lectured before the institute on October 27 on "The exchange of substances through the capillary wall, with some applications to pathological problems." Dr. Robert Bárány, professor of otology at the University of Upsala, also addressed the meeting.

In continuation of the series of illustrated evening lectures given in the Administration Building of the Carnegie Institution of Washington, Dr. T. H. Morgan, research associate in biology and professor of experimental zoology at Columbia University, will speak on November 28 on "The constitution of the hereditary material and its relation to development."

Dr. Maynard M. Metcalf has been speaking at Purdue University, DePauw University, University of Indiana and Butler College during the first ten days of November, discussing research, the origin and future of man, animal distribution and industrial problems from the biological (humanistic) standpoint. He has held also conferences with small groups of persons specially interested in research, either from the standpoint of pupils looking forward to graduate study, or from the standpoint of institutions in their relations to research.

Dr. Joseph C. Bloodgood, of the Johns Hopkins Medical School, addressed the dentists of Boston at a special meeting on November 10, preliminary to the opening of the "National Cancer Week," on "Lesions of the oral cavity."

Dr. Irving Langmuir, research physicist with the General Electric Company at Schenectady, will give a series of three lectures at the Carnegie Institute of Technology on November 27, 28 and 29. The lectures will be given to students and executives in industrial and scientific fields in the Pittsburgh district. The subjects of lectures will be: (1) "Electron emission from heated metals"; (2) "Electron emission from thoriated filaments"; (3) "Methods of controlling electron currents in high vacuum."

Dr. James Ewing, professor of pathology at Cornell University Medical College, New York, delivered the 1922 Mütter lecture on surgical pathology, before the College of Physicians of Philadelphia, on November 1. His subject was "The principles of the radiation treatment of cancer."

Hobart College has recently formed a Science Club, the purpose of which is to promote science among the students of Hobart by means of lectures to which the people of Geneva are invited. The first lecture was held on October 31, when Dr. C. E. K. Mees spoke on "The road to wealth."

Dr. Robert Barany, professor of otology of the University of Upsala, Sweden, and winner of the Nobel prize in medicine in 1914, gave a two weeks' lecture course and several clinics for eye specialists and neurologists in St. Louis from October 9 to 21. Dr. Bárány was the guest of honor of the American Academy of Ophthalmology and Otology, which held its annual meeting in Minneapolis, last month. Dr. Bárány will give a similar course of lectures in Chicago, Denver, Los Angeles, Houston, Cincinnati, Cleveland, Boston and New York.

The Huxley lecture on "Evolutionary tendencies in man's body" was given at the Charing Cross Hospital Medical School by Sir Arthur Keith, M.D., F.R.S., on November 8.

The Netherlands Medical Association has arranged to celebrate the Pasteur centennial at Amsterdam on November 25. Addresses will be made by specialists in medicine, chemistry and microbiologic technic. Dr. A. Calmette, of the Pasteur Institute at Paris, will deliver an address.

A formal university function commemorating the centenaries of both Mendel and Pasteur will be held by St. Louis University on the evening of December 14. The address on Mendel will be delivered by Professor H. S. Jennings and the address on Pasteur by Professor Victor C. Vaughan. The ceremony will be held in the university auditorium.

W. H. Wesley, for forty-seven years assistant secretary of the Royal Astronomical Society, died on Ocober 27, in his eighty-second year.

The death is announced of Dr. Alexander Crum Brown, professor of chemistry in Edinburgh University from 1869 until his retirement in 1908.

Professor A. V. Vassilieff, of the University of Petrograd, writes: "Through the death on September 23, 1922, of Dr. Lev Alexandrovitch Tchugaiev, professor of chemistry in Petrograd University and director of the Institute for the Study of Platinum, the science of chemistry has lost a most devoted student. Professor Tchugaiev died at the age of forty-nine years from typhoid fever. The premature death of this energetic scholar possessing great knowledge and a broad mind and whose conduct has been always guided by the high ideal of devotion to science adds a new great loss to so many suffered by Russian science within the few past years. The first studies of Tchugaiev had for their object the groups of terpenes and of camphor as well as optical properties of organic compounds. But his most important researches, published in the *Comptes Rendus,* in the *Journal of the Chemical Society,* in the *Zeitschrift für Anorganische Chemie* and in the *Journal* of the Physico-Chemical Society of Russia, related to the study of complex compounds of cobalt, nickel and platinum. The last years of his indefatigable work were especially devoted to the study of platinum compounds, their electric conductivity, isomerism, etc. Perhaps the most important of all his investigations relate to the coordination theory of Alfred Werner, to the development of which Tchugaiev contributed not a little."

The one hundred and seventeenth regular meeting of the American Physical Society will be held in Chicago, at the Ryerson Physical Laboratory, on Saturday, December 2. If the length of the program requires it, there will also be sessions on Friday, December 1. The annual meeting will be held in Boston, December 26 to 30.

The second annual meeting of the Deutsche Gesellschaft für Vererbungswissenschaft was held in Vienna on September 25-27. A report in *Nature* says that, though technically a meeting of the German society only, in fact the congress was largely international in character, the visitors including representatives from England, America, Italy, Switzerland, Japan, Holland and the Scandinavian countries. Professor R. Wettstein presided, and the opening address was delivered by Professor E. Baur (Berlin). The principal discussions were opened by Professor Goldschmidt (Berlin) on "The Mutation Problem," and by Professor Ruedin (Munich) on "The Inheritance of Mental Defects." Demonstrations were arranged in the zoological laboratory of the university and in the Natural History Museum. Visits were made to the Biologische Versuchsanstalt (where Professor Steinach demonstrated his transplantation experiments in rats and guinea pigs) and to the principal libraries and art galleries in the town. Professor R. Hertwig was elected president for the ensuing year, and the society accepted his invitation to meet at Munich in 1923.

UNIVERSITY AND EDUCATIONAL NOTES

The Joint Administrative Board of Columbia University and the Presbyterian Hospital has announced that the site for the new medical center has been transferred to the university and the hospital. The land site extends between One Hundred and Sixty-fifth and One Hundred and Sixty-eighth Streets from Broadway to the Hudson River. It is in excess of twenty acres, and is valued at $4,000,000. It is the gift of Mrs. Stephen V. Harkness and Edward S. Harkness. It was also announced that an agreement has been confirmed between the Presbyterian Hospital, Columbia University and Mrs. Harkness, as donor, for the transfer of a fund of $1,300,000 to Columbia University, for the endowment of educational and scientific work in the School of Medicine and the Presbyterian Hospital. An additional $1,000,000 has been given by Mr. Harkness toward the construction of the new Presbyterian Hospital, and $1,000,000 for the school of medicine.

We learn from the *Journal* of the American Medical Association that the first building for the new University of Rochester Medical School, a laboratory building, will be completed this month. Temporary offices of administration will be established in it. An appropriation of $1,000,000 has been made by the city government for the new municipal hospital, which will adjoin the Strong Memorial Hospital. They will have a combined capacity of 460 beds. The university is to furnish the professional staff and the city the nonprofessional employees, under a contract recently approved.

Mr. Charles C. Sharp has given $17,000 to the Ohio State University as an endowment fund for the library of the department of chemistry. Mr. Sharp received the degree in civil engineering from the university in 1888.

The new dairy industry and horticulture buildings at the branch of the University of California College of Agriculture at the University Farm, Davis, were formally dedicated on October 24. The principal addresses were given by President R. A. Pearson, of the Iowa State College, on "Dairy research and education," by Dr. W. H. Chandler, professor of pomology and vice-director of research in the New York State College of Agriculture at Cornell University, on "The outlook of agricultural research," and by President David P. Barrows, of the University of California.

Dr. Edson Sunderland Bastin, professor of economic geology in the University of Chicago, has been made chairman of the department to succeed the late head, Dean Rollin D. Salisbury.

At the New York Homeopathic Medical College and Flower Hospital the following appointments are announced: Israel S. Kleiner, Ph.D., dean; Wm. E. Youland, Jr., M.D., head of the department of pathology; Archibald McNeil, M.D., professor of bacteriology; Annis E. Thomson, M.D., instructor in bacteriology; Jenny Drennan, M.D., resident pathologist.

WILLIAM WALDEN RUBEY, B.A., has been appointed instructor in geology by the Yale Corporation, with assignment to Yale College.

DISCUSSION AND CORRESPONDENCE

THE EVOLUTION OF CLIMATES: A REJOINDER

Two articles criticising and disagreeing with the writer's interpretation of the climatic history of the earth, and Dr. F. H. Knowlton's endorsement thereof, have been lately published in the *American Journal of Science*.[1]

Some of these criticisms are based upon misconceptions of the writer's interpretations and others upon a radical difference as to the source of climatic control prior to the modern era.

In "The Evolution of Climates"[2] and in previous publications the following theses are advanced:

(1) That prior to the Modern Era, of complete solar control, a dual control prevailed, in which the heating effects of solar radiation were largely intercepted by a denser and more persistent mantle of clouds than has prevailed since the Pleistocene; and that solar heating effects were principally exercised upon and above the upper surface of this cloud-sphere, and were, therefore, conservative of the lesser source beneath.

(2) That wide variations in the intensity of "The Solar Constant of Radiation" may have occurred during geologic time, but these did not directly affect climates—for the order of the distributions of temperatures and of glaciations were not conformable to solar control.

(3) That during geologic time earth heat was made available by deformations and ruptures of the crust, etc., which from time to time inaugurated activities of great heat liberating potentiality, namely, the erosion of warm crustal materials and the exposure and transformation of radioactive substances.

[1] Professor A. P. Coleman (5) Vol. 1, No. 4, 315-319. Professor Chas. Schuchert, *ib.*, 320-324. This article is abridged from a rejoinder to these criticisms, which was denied publication in that journal.

[2] Baltimore, 1922.

(4) That upon the partial exhaustion of these increments, the quickly cooling continents frequently reached low temperatures and were glaciated (*a*) in the interiors and easterly sides, as least affected by ocean influences, as in Huronian and Cretacic times; (*b*) under belts or zones of maximum anti-cyclonic circulation, as in Permo-Carboniferous time; and, later, in the final chill of Pleistocene time, under belts of maximum cloudiness and precipitation. That oceans, by reason of high specific heat, stored successive increments of earth heat and fluctuated between narrower limits than continents until Pleistocene time, when they reached glacial temperatures in polar and middle latitudes. At this stage, they ceased to yield sufficient water vapor to maintain the integrity of the previous mantle of clouds in any latitude, and the earth having lost its last available increment of its original or planetary heat, ceased to be a cooling body and became a warming body by direct exposure to and the trapping of solar radiation converted into heat by contact with the surface. That land areas fluctuated through much wider limits or, as approximately fixed by Professor Schuchert, from 110° F. to —60° F., or through 170°, while oceans fluctuated between 85° and 55°.

(5) That in this process of slow and intermittent cooling by the loss of available increments of earth heat, water was a circulating agent of high efficiency, continuously cooling land areas, and, in part, bearing the heat thus derived to the oceans; the other part became latent in water vapor.

The writer does not consider the nebular hypothesis as part of his interpretation of geologic climates and their merging into those of the Modern Era, as indicated by Professor Coleman [*l. c.*, p. 316].

No glaciation is compatible with a warm earth (Professor Coleman, *l. c.*, p. 316) and the writer nowhere claims that it is; on the contrary, he holds that the earth having been screened from solar radiation by clouds, its continents were subject to such climatic variations as the available increments of earth heat were competent to maintain inside the layers of moist air and clouds which its warm oceans were capable of sustaining. Beneath this screen glaciations frequently occurred non-conformable to solar control; all of which, except the last, merged into a non-zonal distribution of milder climates; while the last merged into the zonally distributed climates of to-day distinctly under solar control.

A uniform and steady supply of heat from the earth's interior under the assumed screen of clouds is not held in the theory which Professor Coleman criticises. On the contrary, it is held that this supply was neither uniform nor steady, but highly variable in both supply and exhaustion.

The periods of glaciation as compiled by Professor Schuchert[3] are accepted as marking variation of climate of greater or less extent and severity in various localities and zones throughout known geologic time. None of these can be reconciled with a mild and equable climate controlled by any source or sources of heat and particularly not to a climate controlled by solar energy; for no glaciation has been recorded conformably to solar control. All were non-conformable thereto and contradictory thereof, but they can be reconciled with periods during which the available increments of the internal heat were exhausted to such an extent that land masses in various latitudes cooled below 31° F. The glaciation of tropical latitudes during Permo-Carboniferous time is particularly fatal to any assumption of solar control; for had this, or any other glaciation, been imposed under solar control it would have commenced in polar latitudes and advanced equatorward, and would have retreated poleward. No glaciation has been so laid down and none except the Pleistocene has so receded and given place to a disposition of climates distinctly zonal and as distinctly under solar control; and the fluctuating advances and retreats were at such short intervals that corresponding fluctuations in solar energy could not be reasonably assumed.

The mantle of clouds need be neither supposed nor assumed. It recorded its effects in glaciations and reglaciations in nearly a score of instances, and it recorded its failures in each interglacial epoch and in the present progressive deglaciations. By no other known means could solar energy have been intercepted to such an extent as to permit frequent glaciations of portions of the earth in latitudes which could not have been sufficiently chilled without such interception.

The writer accepts the variability of climates on continental areas from the dawn to the close of geologic time, as presented by Professor Schuchert [*Smithsonian Inst. Report*, 1914, p. 305]. This variability is well established.[4]

It is also well established in Permo-Carboniferous[5] and Pleistocene glaciations that maxima were attained along quite well-defined zonal lines.

Continental temperatures in tropical and in polar regions now vary within the limits of 110° F. and —60° F., or a range of 170° F.; and ocean temperatures range between 85° and 31° F. or through 54° F. It is a reasonable inference that during geologic climates continental temperatures had approximately the same extreme range, but the range of ocean temperatures for the greater part of geologic time, as admitted by Professor Schuchert, was between 85° F. and 55° F., or through 30° F. But it manifestly took from Proterozoic until Pliocene for oceans to pass through these extremes and only in the Pleistocene did oceans of polar and middle latitudes reach the present lower limit, with their extreme range of 54° F. The present extreme range of continental temperatures between tropical and polar latitudes of 170° F. is the same as the annual range in central Canada and Siberia, and the annual range of ocean temperatures in the same latitude is less than one tenth (1/10) of this.

The comparison of the range of ocean temperatures prior to the Pliocene of 30° F. with the present range of 54°, and the ease with which continental temperatures can range within twelve months through 170° F. supports the writer's views regarding geologic climates.

The prime and radical difference between the conclusions of Professor Schuchert and those of the writer are, as to the source of control, namely, that until oceans chilled to the temperatures marked in Pleistocene time, a dual source of climatic control prevailed, and

3 *Smithsonian Inst. Report*, 1914, 305-306.

4 Osborn, "The Age of Mammals," pp. 372-3.

5 Schuchert, *ib.*, 280-282.

this control was distinctly different from the zonal climatic arrangement of to-day, as manifested by the climatic phenomena recorded in Permo-Carboniferous and in Pleistocene times. The greater part of the "plexus of problems of unparallel difficulty" presented in the Permian is involved in the attempts to fit Permo-Carboniferous glaciations and the concurrent climatic phenomena to the unproved assumption of solar control. This is true of all glaciations, and of the reglaciations following interglacial warmth which so distinctly contradict solar control that it is difficult to understand why the assumption of solar control has been held with such rigid orthodoxy. Neither critic meets the prime question of a dual versus a solar control of geologic climates.

Marsden Manson

Berkeley, California,
October 9, 1922

THE EFFECTS OF CAPTIVITY ON A SEX CHARACTER

Late last winter I noticed a gravid female in a tank containing European brown trout at the New York Aquarium, and suggested that she be removed and stripped.

As is well known, the males of many salmonidæ, including salmon and most trout, develop a hook on the lower jaw in the breeding season, which is serviceable in their fights at the spawning grounds. Specimens with hooked jaws were therefore selected from the brown trout tank for milt to fertilize the eggs.

Then it was discovered that a hook-jawed individual might be a female. This phenomenon was unknown to us, and as far as we know has never been recorded. But we soon found that we had made no unique discovery, for about the time the brown trout eggs were changing into fry in the hatching troughs, the Aquarium received a visit from Dr. Francis G. Macnaughton of Dunshire, St. Andrews, Scotland, who has experimented largely with European trout. When the writer told him of the females with hooked jaws, he said that in Europe this phenomenon has not infrequently occurred as a result of captivity.

Precisely what effect captivity may have upon the somaplasm to bring about this curious condition, we leave to conjecture; but what a startling biological event it would be if a lioness were to grow a mane and other female animals in captivity developed the secondary sexual characters of the male!

Ida M. Mellen

The New York Aquarium

MISUSE OF THE QUESTIONNAIRE

To the Editor of Science: A questionnaire is being mailed to "persons whose addresses are given in the book 'American Men of Science'" to ascertain "what proportion of American men of science are believers in the current religion, what proportion are not," etc. As the questions are in many cases like the famous "Will you leave off beating your mother?" probably the majority of us will ignore them. The bias of the questionnaire is so obvious, it might well be ignored were it not that we shall probably hear before many months that 97 per cent. of American men of science are utterly without religious beliefs, "as shown by a recent careful investigation." Hence I wish to make this early protest against this particular questionnaire and the possibility of drawing any reliable conclusions from the replies received.

Hubert Lyman Clark

October 25, 1922

QUOTATIONS

MOTORLESS FLIGHT IN ENGLAND

The French airman, M. Maneyrolle, won the prize of £1,000 offered by the *Daily Mail,* by a wind flight on October 21 lasting three hours and twenty-two minutes. The notable successes registered during the recent French contests, and especially during the German contests, raised the question whether British fliers could rival the feats of their foreign colleagues, and the offer of a prize of £1,000 by the *Daily Mail* led to the organization, at Itford Hill and Firle Beacon on the South Downs, of the first British gliding contests since the war, which commenced on October 16 and continued through the week. Additional prizes were offered by the Royal Aero Club and others. The entry of British machines and pilots was very encouraging, there being some two score British fliers, besides foreign aviators, notably the Dutch airman, M. Fokker. A large number of short flights and some quite long flights were made; yet on the whole the results of the meeting were not of a sensational nature until the last day of the meeting. The general conclusion is that British aviators do not fall behind those of Germany, and that it is possible to find suitable arenas in this country for the practice and display of motorless flight. The most notable achievement of the first day of the contest was a thirty-seven-minute glide by M. Fokker, but this was surpassed by a fine flight executed by Mr. F. P. Raynham. This aviator had already taken a place in the front rank of British pilots in the recent air-race round England: he added to his laurels by remaining in the air in a motorless machine for one hour and fifty-three minutes, thus putting himself in the same category as the German record-makers, Martens and Hentzen. But on the last day, Saturday, two world-records were nevertheless established. J. R. Olley went up in a Fokker biplane, and remained in the air with a passenger for forty-nine minutes, while M. Maneyrolle, in a tandem monoplane glider, succeeded in remaining in the air for three hours twenty-two minutes, thus winning the *Daily Mail* prize and beating the previous record, that of Hentzen, by twelve minutes. During the last ninety minutes of his flight, M. Maneyrolle was accompanied by a monoplane glider flown by Squadron-Leader A. Gray, and it was night when the two machines landed within 100 yards of the point from which they started. These competitions on the South Downs will serve as an encouragement to motorless flight in this country, and will help in the accumulation of knowledge and experience on one of the most interesting developments in modern aeronautics.—*Nature.*

SCIENTIFIC BOOKS

The Theory of Functions of a Real Variable. By E. W. Hobson, Sc.D., LL.D., F.R.S., Sadleirian Professor of Pure Mathematics and Fellow of Christ's College, in the University of Cambridge. Second edition, Vol. 1. Cambridge at the University Press, 1921. Pp. xvi + 671.

Because of the war and relativity, we are at present in a period of increasing scepticism towards so-called established principles and facts. Many still believe, however, that mathematical knowledge, at any rate, is beyond dispute. For these there will be great disappointment in the pages of Hobson. The book reads in places like unconvincing philosophy; and instead of statements made with full personal conviction, we find, at times, conflicting opinions of "authorities"—beings supposed, by some, to be unknown to mathematicians—and inconclusive attempts at mediation. And yet it is on the Theory of Functions of a Real Variable that rigor in Mathematical Analysis depends. The first edition appeared in the course of Zermelo's work on *Wohlordnung,* when mathematicians were just beginning to get their bearings on certain controversial matters; after a lapse of fourteen years, there is the same indecision. Other writers on Real Variables and Point Sets—for example, Hausdorff, Carathéodory and Hahn—adopt a single point of view and proceed joyfully without misgiving. Professor Hobson wants to give a comprehensive report—his book is the most voluminous treatment of the subject—to include historical matter, and to be as fair as possible, "no attempt has been made to give dogmatic decisions between opposed opinions." This wish to be fair makes Professor Hobson exchange, at times, the rôle of mathematician for that of reporter; it has the advantage, however, of making the reader independent of the author—a significant advantage when we observe that even among mathematicians instances are observable of opinions held not on their merits but on the ground of personal and nationalistic associations.

The rôle of the mediator, however, is apt to be a hard one, not only in industrial, but even in mathematical affairs. For fear of being one-sided, he may lose vivacity. Thus we read on page 238 [author's italics], *"In order that a transfinite aggregate . . . may be capable of being ordered, a principle of order must be explicitly or implicitly contained in the* *norm by which the aggregate is defined.* Or again, page 239, " . . . an aggregate has a cardinal number only when it is one of a plurality of equivalent aggregates, distinct from one another." Again, what success can be expected from an attempt to clarify the notion of aggregate by the introduction of a new word, "norm," itself of debatable meaning? Professor Hobson intimates that something must be "universally accepted" to be admitted as mathematical knowledge; but he does not mention the attack made by Brouwer and Weyl upon some of the fundamental theorems in Analysis. Still again, it may be asked, if (page 6) "the justification [for a certain assumption] is to be found in the fact that no contradiction arises in the theory based on it," why is not the multiplicative axiom justified? Zermelo's *Grundlagen* have led to no contradiction.

The present edition is "revised throughout"; "the parts of the subject dealt with in the first five chapters of the first edition have been expanded into the eight chapters of the present volume." This expansion is due chiefly to the recent developments in the Theory of Integration. The theories of Hellinger, Young and Denjoy are also included. The mathematical world owes a debt of gratitude to Professor Hobson for presenting in a smooth, connected exposition a huge mass of research, a considerable part of which is of recent origin.

The style is, on the whole, very lucid, great pains being taken to prepare the reader's mind for the reception of new ideas. However, here and there we find a lack of compactness—witness the proofs that cover pages 97 and 98, and which may be compressed into one tenth of the space by the use of points with rational coordinates. The treatment retains, in part, something of the freshness of a memoir and will thus prove more stimulating, in one way, than treatises written with a constraining finish.

At this late date, strange to say, the definition of cardinal number as given by Professor Hobson is not without an objectionable feature. Russel is right. Professor Hobson's reference to the "degree of plurality" is like saying, "You know what I mean"; it does not make his definition mathematically acceptable.

On page 259 occurs the following statement: "No elaborate theory is required for functions which retain their complete generality, . . . since few deductions of importance can be made from that definition which will be valid for all functions." It may be of interest to remark that this view is rendered untenable in the light of the results to be announced soon in the *Proceedings of the National Academy of Sciences* in a paper by the reviewer, entitled "New Properties of All Real Functions."

Henry Blumberg
University of Illinois

Analysis Situs. The Cambridge Colloquium Lectures, Part II, Vol. V. By Oswald Veblen. Published by the American Mathematical Society, 501 West 116th Street, New York. 150 pp., octavo. 1922.

The Cambridge Colloquium lectures on Analysis Situs were delivered in 1916, but the publication having been postponed because of the war, the lectures were completely rewritten before publication, and the resulting book is a treatise on the elements of Analysis Situs. It is furthermore the only modern book on the subject. By a study of this book it is possible to acquire a knowledge of Analysis Situs without going through the many widely scattered memoirs as was formerly the case. Every one interested in Analysis Situs will welcome Professor Veblen's book as an important and useful contribution to the subject. Part I by G. C. Evans on Functionals and their Applications was published in 1918.

H. L. Rietz

SPECIAL ARTICLES

ZOSTERA MARINA IN ITS RELATION TO TEMPERATURE[1]

In connection with some work on the temperature control of the geographical distribution of the marine algæ, it seems to be demonstrated that the terms eurythermal and stenothermal apply only to the power of endurance of a wider or narrower range of temperature

[1] Preliminary communication.

without indicating definitely, as least in the case of the eurythermal species, just what temperature limits are vitally concerned with the persistence of the species. An attempt has been made to establish definite temperature zones, to each of which certain species are normal, and to explain the presence of any species, normal to one zone, in a zone of different temperature, by the fact that the invaded zone, as it was designated, has its temperature raised or lowered to that of the normal zone of the species by some agency or condition, local or general, and for a sufficient length of time to allow of the reproductive processes of the invading species to be effectively carried on. This idea has been set forth in an article entitled "Stenothermy and Zone Invasion." (*Amer. Nat.*, Vol. 54, pp. 385-397, 1920.)

In connection with this investigation, it seemed very desirable to attempt to determine the behavior of a group of aquatic plants other than the Algæ and I turned my attention to the marine spermatophytes, popularly known as sea grasses, eel grasses, or grass wrack. The inquiry, at first, was purely statistical, merely assembling what was known of these plants as to their distribution, their times of flowering, and the relation of their distribution and flowering to isothermal lines of temperature, especially to those of the maxima. The results of this inquiry are set forth in a paper entitled "Geographical Distribution of the Marine Spermatophytes" (*Bull. Torrey Bot. Club,* Vol. 47, pp. 563-579, 1920). It seems, from the data available, that out of 34 known species, 26 are stenothermal, *i. e.*, confined to a single zone of temperature of 5° C. amplitude of the maxima; 6 are somewhat eurythermal, occurring in two such zones; and 2 are broadly eurythermal, occupying 3 or more of such zones. Of the last category, *Zostera marina* L., the common eel-grass of the north Atlantic coasts, is the most pronounced and the most puzzling. After assembling such data as were readily available as to season of reproduction in different portions of its range, I ventured to suggest that the normal zone of *Zostera marina* L. must be the North Temperate, whose waters possess a summer temperature of 15° to 20° C., and that the extension of the distribution of this species as far north as the Upper Boreal is due to the effect of insolation upon the shallow, enclosed waters of its habitat in the invaded zones, and, on the other hand, that the invasion southward into the northern portion of the Tropical Zone is possible on account of the seasonal lowering of the temperature of the waters during the winter and spring.

Since I am able to visit the Atlantic Coast only at very infrequent intervals, I appealed to correspondents and to the U. S. Commissioner of Fisheries to assist in determining the exact status of the temperature conditions of the life-history of *Zostera marina* L. The Commissioner promptly and favorably responded and issued instructions to make the collections desired at the stations at Key West, Florida, Beaufort, N. C., and Woods Hole, Mass. At the Key West station, Ezra Stiles, Jr., early demonstrated that *Zostera marina* L. is absent but that the Turtle Grass, *Thalassia testudinum,* is abundant and presents certain problems. With the transfer of Mr. Stiles to an inland station these observations came to an end. At the Beaufort station, Charles Hatsel, and at two very different localities at Woods Hole, R. A. Goffin have made collections monthly or bi-monthly for some seventeen or eighteen months, together with the proper temperature data. I am deeply indebted to these members of the staff of the Bureau of Fisheries for their most valuable and painstaking cooperation.

I, myself, was able to supplement the observations at the stations of the Bureau of Fisheries by collections made at various stations about Narragansett Bay, R. I., in May, June and July of 1921, and Professor Thurlow C. Nelson of the New Jersey Agricultural Experiment Station kindly made collections throughout the year at stations of the Oyster Commission on the coast of New Jersey.

Since *Zostera marina* L. grows in extensive patches, whose individual plants are fairly uniform in behavior, all that is necessary is to gather a fair sized bunch of plants, dry and forward with the proper data. The extensive mass of material accumulated has not been critically gone over as yet, but sufficient examination has been made to show that it will assist greatly in unraveling the intricacies of the life history of this species from the point of view of morphological changes and their relation to temperature variation. One fact, indeed, is clearly apparent and that is this: the reproductive season begins at 15° C. or very close to it and extends only to 20° C. or closely in its neighborhood. The vegetative processes preceding anthesis and maturing of seed have also fairly narrow, but different, temperature relations, as do also those succeeding the maturing of seed. The active period of growth and reproduction seems to be normally included within an interval of 10° C., *i. e.*, from 10° C. to 20°. During the colder as well as during the warmer periods of the year, according to the particular zone, normal or invaded, *Zostera marina* L. enters into a state of quiescence, total or nearly so, but revives when the proper temperature for vegetative activity of one sort or the other comes again. The material now in my hands as the result of this cooperation seems ample for clearing up these points, and a more detailed report is in preparation.

There seems to be no dependence on a particular period of illumination in the case of the various stages of growth and reproduction —in other words, no photo-periodism in the sense of Garner and Allard. This negation stands out very clearly.

William Albert Setchell
University of California,
August 23, 1922

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY
S. E. Sheppard, *chairman*
Robert E. Wilson, *secretary*

Experimental studies of the radiation hypothesis: Farrington Daniels. The decomposition of nitrogen pentoxide is a favorable reaction for testing deductions from the radiation hypothesis, since it is a unimolecular, gas phase reaction which takes place at room temperature. The influence of the temperature of the walls of the containing vessel and their optical nature have been investigated. Nitrogen dioxide is an important factor in determining its velocity. The influence of various solvents has been studied. The effect of visible and infra red light has been investigated. Experiments have been carried out to determine whether the vessel walls can supply sufficient energy to cause the reaction. A search has been made for the emission of light predicted on the basis of the radiation hypothesis.

Some deductions from statistical mechanics: W. H. Rodebush. Marcelin derived an equation for the temperature coefficient of the rate of a chemical reaction which agreed with the empirical Arrhenius equation. Tolman has shown that this derivation was incorrect. A rigorous derivation of a similar equation is given. By combining this equation with the assumptions of the quantum theory a physical basis is obtained for the empirical equation of Dushman, which has been shown to have considerable validity. The equation contains a constant which is characteristic for the molecule involved so that complete validity of the Dushman equation for all different kinds of molecules could not be expected.

The "creepage" corona, a new type of silent discharge: F. O. Anderegg and H. E. Bowers. The effect of a dielectric material in an electric field has been studied by C. W. Rice *(Proc. Am. Inst. Elec. Eng.*, 1917). K. B. McEachron has found that glass rods may increase the yield of ozone *(Purdue Univ. Eng. Expt. Sta. Bull. 7)*. A study of their results shows that the action of the dielectric material in the "creepage" discharge is probably partly catalytic. Experiments have been made with a variety of dielectric materials including fragments of ordinary glass, quartz glass and of earthenware, with and without beeswax impregnation; also blue and white flint and of hematite. The effect of these materials upon air and upon carbon monoxide subjected to a silent discharge has been studied under a variety of conditions. Preliminary results are given, strongly supporting the contention that catalytic action and ionic activation are superimposed in this type of discharge.

The effect of container walls on chemical reactions in the corona: F. O. Anderegg and K. B. McEachron. In the effort to trace out the causes which contribute to the common lack of reproducibility in results, in the study of chemical reactions in the corona discharge, experiments have been extended over a considerable period of time. The surface of metallic electrodes is disintegrated so that "polarization" and variation in chemical action may result. If a dielectric material is placed between the electrodes, the variable effects of internal and surface changes of the dielectric may be superimposed upon the discharge, the result being variable yields. Some of the products of the reactions in the discharge are liable to be absorbed on the walls, the amount absorbed depending upon the condition of the walls. Under certain conditions complete inhibition of the usual reactions results.

A comparative study of the absorption spectra of phenylazophenol derivatives in the visible region of the spectrum: C. S. ADAMS, C. E. BOORD and ALPHEUS W. SMITH. This paper is a continuation of the work previously published by Smith and Boord. The present study includes fifty-seven azoderivatives, fourteen of which have not been previously described. Alkali salt causes a displacement of the absorption band toward the red end of the spectrum, the degree of displacement varying with the solvent medium. Substitution causes displacement toward the longer wave lengths, the order for substitution in the phenyl nucleus being, in ascending scale, para meta ortho and in the phenol nucleus being ortho meta. The nitrophenyl derivatives form an exception to this rule. Weighting of the molecule by substituents follows Nietzki's rule. This is particularly true of the methyl derivatives. For the halogens Cl Br I, symmetry of the molecule seems to have a marked effect upon the absorption. Restoration of the symmetry of azobenzene by substitution of the same group in both para positions produces a marked hypso-chromic effect.

The potentials of silver: Silver halide—halide electrodes in light. Part I: S. E. SHEPPARD and FELIX A. ELLIOTT. Single potentials of an illuminated electrode were measured by the potentiometer compensation method, in a cell composed according to the system:

Light	KBr aq	Dark
Ag, AgBr, x KBr aq	sat.	x KBr, AgBr:Ag or 0.1 N HBr, H_2, Pt

Hence an illuminated electrode could be coupled with an identical unilluminated electrode, or with a standard hydrogen electrode. The following factors in the preparation have to be controlled to secure reproducibility: (1) preparation of the silver surface; (2) halogenizing the electrode; (3) "ripening" the halogenized surface, and aging. With electrodes thus prepared it was found that the potentials, at an illumination of 16 C. M., were reduced as the concentration of bromide was increased, and also by increased bromination in preparing. With constant intensity of light the electrodes rapidly attained a maximum potential, which then fell off (solarization). Repeated intermittent exposure and darkening, up to 160 minutes, showed no noticeable fatigue.

Oxidation potentials of permanganates with other manganese compounds: D. J. BROWN and S. B. ARONSON.

Energy changes in the reduction of quinones: J. B. CONANT and L. F. FIESER. The free energy, total energy and latent heat of reduction of a number of derivatives of benzoquinone, naphthoquinone and anthraquinone have been determined by measuring the oxidation-reduction potential and its temperature coefficient. The free and total energy changes are very different for different types of quinones. The latent heat of reduction is approximately the same for all the quinones measured. A method has been developed for measuring the potential in alcoholic solutions and applied to a number of substances too insoluble to be measured in aqueous solution. The potential of a given quinone is somewhat greater in alcoholic than in aqueous solution but essentially constant in 50, 75 and 95 per cent. alcohol. The potentials in two different solvents are related by an equation involving the solubilities of the oxidized and reduced compounds.

The effect of substitution on the free energy of reduction. I. Benzoquinone derivatives: VICTOR K. LA MER and LILLIAN E. BAKER. The reproducibility and validity of the electro-metric titration method of measuring oxidation-reduction potentials has been established as less than ± 0.2 Mv., when precautions are taken or corrections made for errors, such as removal of H^+ during the reaction, dissolved oxygen, variation in contact potential, etc. (see below). A ground glass stopper makes an excellent junction for titration work, reproducible to ± 0.05 Mv. for dilute HCl against saturated KCl. Measurements on homologous quinones in acid solutions where the activity ratio quinone hydroquinone is unity show that halogen substitution raises, while alkyl substitution lowers the value of Π_0, the normal potential of reduction in the order Cl $>$ Br $>$ None $>$ Methyl $>$ dimethyl $>$ methyl, isopropyl $>$ m dimethoxy $>$ phenylene (napthoquinone).

Electrometric Oxidation—reduction titrations of pure compounds and mixtures: LILLIAN E. BAKER and VICTOR K. LA MER. Calculation and experiment show that complex formation (quinhydrone) in the case of nine substituted quinone-hydroquinone systems, is not sufficient to cause any perceptible drift in the values of Π_o at least in acid solution when the latter is determined over a wide range of concentrations by the method of Clark, the concentration of the quinone substances varying between .001 to .003 M. Impurities whose potentials approximate that of the system under examination so closely as to evade detection by differential titration cause pronounced drifts, the extent of which depends upon the amount of impurity present as well as whether the impurity has the higher or lower potential.

Electrometric titrations of silicic acid: William Stericker. Silicic acid was titrated with sodium hydroxide in order to determine what salts it formed. The sol was prepared from recrystallized sodium metasilicate and was carefully purified by dialysis. The pure sol gelled readily. There was no indication of the presence of hydrogen ions or of the formation of any salts. The titration of a sodium silicate solution indicated that this may have been due to polymerization of the acid. Although the first results would indicate that sodium silicate is completely hydrolyzed in dilute solution, titrations with phenolphthalein indicator show this is not so.

Synthesis of urea with the enzyme urease: Edward Mack and Donald S. Villars. The reversible action of enzymes has been already shown in several cases, but has never been demonstrated for urease. In the present paper, it is proved beyond any doubt that the equilibrium in the reaction $(NH_2)_2CO + 2H_2O \rightleftharpoons (NH_4)_2CO_3$ can be approached from the $(NH_4)_2CO_3$ side, and that the presence of urease hastens very decidedly the attainment of equilibrium. Previous failure to detect the effect was due to (1) starting with too dilute a solution of $(NH_4)_2CO_3$ and (2) not waiting a long enough time for the action, which even in the presence of urease is slow.

The action of urease in the decomposition of urea: Edward Mack and Donald S. Villars. From the work of E. A. Werner and others it seems probable that urea in its reaction with water to form ammonium carbonate takes two courses: (1) it forms ammonium cynanate as an intermediate product, which is itself changed to ammonium carbonate; and (2) it forms ammonium carbamate, which is hydrolyzed to carbonate. By a process of elimination, it has been possible, in the present paper, to show that it is the transformation of urea into ammonium carbamate which is catalyzed by the presence of the enzyme. Process (1) is not affected by urease. It proceeds at its normal rate in the presence of the enzyme.

The acceleration of the hydrolysis of mustard gas by alkaline colloidal solutions: Robert E. Wilson and Everett W. Fuller. A careful series of experiments was carried out to determine the mechanism by which alkaline colloidal solutions, such as those of sulfonated corn oil, so greatly accelerate the removal of mustard gas from contaminated clothing. It was found that these accelerating solutions do not increase the solubility of the mustard gas in the aqueous phase nor the specific rate of hydrolysis, but that in solutions of proper alkalinity they act as carriers of mustard gas. The acid produced by the hydrolysis precipitates out tiny oil globules in the aqueous film adjacent to the liquid mustard gas, and these globules rapidly dissolve unhydrolyzed mustard gas, and are then swept up into the alkaline portion of the solution and redissolved, thus permitting rapid hydrolysis of the mustard gas which they carry. Part of the acceleration is also due to the fact that these colloidal solutions keep the mustard gas spread out in a thin film on the cloth, instead of causing it to draw up into globules, as happens in the presence of solutions of higher interfacial tension.

Hydrogen ion concentration and photochemical reaction velocity: G. S. Forbes and J. C. Woodhouse. The speed of photochemical oxidation of quinine by CrO_3 in unvaried concentrations is nearly constant from $0.5NH_2SO_4$ at least to $2.5NH_2SO_4$. Below 0.5N, the order of reaction with respect to hydrogen ion N_H increases. At 0.01N (the lowest concentration practicable) it is about 1 and is rapidly increasing, presumably toward 2 the value of N_H in the dark. Previously N_{CrO_3} had been shown, as small concentrations were reached, to increase from 0 to 1, its value in the dark. The conclusion follows that the oxidation is a reaction stage separate from a preceding stage of photochemical sensitization, and slow with respect to it only at low concentrations. Such relations are doubtless more common than suspected.

The inhibition of the photochemical decomposition of hydrogen peroxide solutions: Wm. T. Anderson, Jr., and Hugh S. Taylor. (1) The inhibitory effects of 25 typical organic compounds on the photochemical decomposition of hydrogen peroxide solutions have been studied in four definite spectral regions of the ultra-violet; (2) The inhibition by such agents has been associated with the absorptive capacity of the organic compounds for ultra-violet light. A striking correlation between these factors has been obtained in the case of benzene, several esters, acids, amides, ketones and alkaloids. The retarding action of amines and alcohols requires an explanation based on other causes than adsorption of light; (3) It has been shown that the inhibitors act more efficiently when in the peroxide solutions than when in a screening solution of similar thickness and concentration.

The reduction of copper oxide by carbon monoxide and the interaction of carbon monoxide and oxygen in the presence of copper and of copper oxide: H. A. Jones and Hugh S. Taylor. (1) The reduction of copper oxide by carbon monoxide has been shown to be an autocatalytic process, copper being the autocatalyst; the reduction occurs at a copper-copperoxide interface; (2) The retarding action of carbon dioxide and of oxygen on the primary reaction of the reduction process, *i. e.*, the formation of the copper nuclei, has been pointed out; (3) The mechanism of the carbon monoxide-oxygen catalysis over copper oxide has been shown to be alternate reduction and oxidation of the copper oxide; (4) The mechanism of the catalysis in the presence of copper has been shown to be oxidation of an adsorbed layer of carbon monoxide; (5) It has been established that oxygen is a poison in the combination of carbon monoxide and oxygen over copper.

The calculation of critical values for binary mixtures: A. G. Loomis. One of the greatest experimental difficulties in the study of the pressure-temperature composition surface for binary mixtures in the accurate determination of the critical values for the various mixtures. It is shown in this paper that by employing the equation of Dieterici, which is quite accurate in the critical region, the entire critical line may be very closely calculated; this equation leads to better results than the equation of van der Waals. The composition of the mixture with minimum critical temperature can be very accurately calculated by finding the expression which makes $\frac{ax}{bx}$ a minimum, where ax and bx are the attraction and volume constants, each expressed as a quadratic function of the composition. By employing the conditions for phase equilibrium on the critical line and introducing the equation of state in the expression for the free energy of the system, the composition of the mixture with maximum vapor pressure is accurately calculated when the values V_1 and V_2 of each phase are equated and put equal to $2b$, as demanded by the equation of Dieterici.

Compound formation and ionization in fused salt mixtures: James Kendall, E. D. Crittenden and H. K. Miller. A study of the freezing-point curves for a large number of systems of the types aluminum chloride—metal chloride, aluminum bromide—metal bromide, antimony trichloride—metal chloride has shown that here, as in other fields, the extent of compound formation between the two components is primarily dependent upon the diversity of their constituent radicals. The effect of subsidiary factors, such as valence, unsaturation, internal pressure and atomic volume, has also been investigated. Ionization is found to run parallel with compound formation in the few systems for which data are now available. The work is being continued.

A low temperature electrolyte: W. H. Rodebush and Theodore O. Yntema. Hydrogen chlorid and nitric oxid form a compound at low temperatures of an intense purple color. This is of interest because G. N. Lewis has pointed out that nitric oxid is the only molecule containing an odd number of electrons that is not colored. It was predicted that this compound would show conductivity in the liquid state. This prediction was verified, a conductivity of 10^{-3} being easily obtained at 130° K. This is believed to be the lowest temperature at which electrolytic conduction will be obtained. Speculations are offered as to the nature of the compound.

Transference numbers of sodium and potassium in mixed chloride solution: R. F. Schneider and S. A. Braley. The transference numbers of sodium and potassium have been determined in solutions with a total concentration varying from 0.1 to 1.6 N and with varying salts ratios of from 3 KCl and 1 NaCl to 1 Kcl and 3 NaCl. While the conductance of such solutions conform to calculated values on the basis of the isohydric principle the ratios of the transference are widely different from the calculated. At a total concentration of 0.2 N and a salt ratio of 3 Kcl to 1 NaCl the transference number of the sodium becomes practically zero, indicating that the sodium is not only transported as the cation but is also tied up in a complex anion to such an extent that it moves in both directions at the same rate. The data show that the theory of complete dissociation as advocated by Ghosh can not possibly hold.

Charles L. Parsons,
Secretary

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TRENDS OF MODERN BIOLOGY[1]

I

AN occasion such as this is thought-provoking. Why should anybody endow a chair of biology? When I began the study of the subject a little more than a quarter of a century ago such things were not done. In most of our large universities biology had a fairly secure position, but in all but a very few of the small colleges, at one of which I am proud to say I had the privilege to study, if present at all it was so distinctly only on sufferance. Much doubt existed and was often expressed as to whether this novel subject had any disciplinary value in the training of the youthful mind, or had any particular cultural worth in the producing of better citizens. Those of us who were irresistibly lured, by the fascination of the wonderful field opened to our vision, to spend most of our time in the biological laboratory, were looked upon by our fellow collegians as queer freaks of nature, and would certainly have been called Bolsheviks had that overworked appellation been current verbal coin in those days. For the subject distinctly lacked respectability. It was thought by those who pursued the classics or other orthodox lines of educational conduct to be a messy business, was known to be smelly, and was generally held to be low. This attitude inevitably called forth a defense reaction on the part of its callow devotees, which resulted in distinctly worse messes and smells than were really requisite for the successful pursuit of knowledge in the field.

Now all this has changed. Biology has come

[1] Papers from the Department of Biometry and Vital Statistics, School of Hygiene and Public Health, Johns Hopkins University. No. 80.

An address delivered at Mount Union College, Alliance, Ohio, October 20, 1922, on the occasion of the dedication of the Milton J. Lichty Chair of Biology in that college.

into its own, and the security of its position in the educational world can not be shaken even by so doughty a champion of the powers of intellectual darkness as Mr. Bryan. What has happened in these twenty-five years in biology? And what of the present and of the future? Can we find in the efforts and achievements in this field due warrant for that intellectual respectability that biology has now gained, and for that clear faith in the future which is implied in Dr. John A. Lichty's splendid endowment which we are here gathered to dedicate?

Perhaps as good a method as any of getting light on this matter will be to attempt a review of the major trends of biology in the past and the present. In doing this we shall find that in every case these trends of thought and research have been responses to some quite naïve and simple bit of intellectual curiosity, of the sort likely to arise in a child's mind, if he turned his thought at all to living nature about him. It may fairly be said that up to the time of Darwin and Wallace and the "Origin of the Species," all biology busied itself with the answering of one phase or another of the following two naïve questions:

First, how many and what different kinds of animals and plants exist, or have existed, on the face of the earth.

Second, regarding living animals and plants as ingenious and complex contrivances, but after all not fundamentally unlike other contrivances, how are they put together and how do they work?

Every boy and girl who collects butterflies, or who pulls a wasp to pieces in order to locate and with safety observe the behavior of its "stinger," is in a rough and ready way repeating in his own development the history of the growth of our present knowledge of biology. He is trying on the one hand to get together a collection of the different kinds of living things about him, and on the other hand to inform himself as to their structures and functions.

Since the publication of the "Origin of Species" a third question, essentially just as naïve, but less easy to deal with objectively and practically, has occupied a great part of the attention and effort of biologists. But that it indicates a sort of intellectual curiosity not essentially one bit more sophisticated than the other two, is plain enough if we remember that all peoples to the remotest historical time, and including even savages, have not only thought about it, but also have had theories about it. This question we may put in this way:

Third, whence, why, and how came the animals and plants which inhabit the earth to be here at all?

It is, as I have said, in an attempt to answer these three questions, in some one or other of their aspects, that all we know to-day about biology has developed and grown. It is an impressive fact, recently discussed with great brilliancy by James Harvey Robinson[2] that always in science, biology no less than all the rest, the motivating problems which have led to the advancement of knowledge have been simple naïve questions about quite commonplace things. He says:

> Those to whom a commonplace appears to be most extraordinary are very rare, but they are very precious, since they and they alone have made our minds. It is they who have through hundreds of thousands of years gradually enriched human thought and widened the gap that separates man from his animal congeners. Without them the mind as we know it would never have come into existence. They are the creators of human intelligence. The mass of mankind must perforce wait for some specially wide-eyed individual to point out to them what they have hitherto accepted as a matter of routine or failed altogether to notice. These mind-makers are the questioners and seers. We classify them roughly as poets, religious leaders, moralists, story-tellers, philosophers, theologians, artists, scientists, inventors. They all are discoverers and pointers-out. What eludes the attention of others catches theirs. They form the noble band of wonderers. Commonly unnoticed things excite a strange and compelling curiosity in them, and each new question sets them on a new quest. They see where others are blind, they hear where others are deaf. They point out profundities, complexities, involutions, analogies, differences and dependencies where everything had seemed as plain as a pike staff.

Robinson, in what I have quoted, lays em-

2 Robinson, J. H.: "The Humanizing of Knowledge," SCIENCE, N. S., Vol. 56, pp. 89-100, 1922.

phasis on the kind of man who sees the problem. Perhaps it may help by ever so little in the production of such men in this laboratory which we are starting on an enlarged career of usefulness to-day, to emphasize the importance for success in biology of being simple-minded.

II

Our first question about the different kinds of living things which people this earth led to the important branch of biology which is called taxonomy or classification. This was for a long time the dominant trend of the subject. The first step toward a proper knowledge of the phenomenal world is obviously to get the phenomena classified in an orderly scheme. In biology this takes the practical form of getting different kinds of plants and animals described, named and classified. Linnæus was able to classify all the plants and animals known up to 1735. Nowadays no one person would think of attempting so colossal a task, and if he did would fail by virtue of the inadequacy of the human life span. Instead we find the worker in the branch of biology to-day devoting his life to one, or at most a few, groups of animals.

From its once dominant position taxonomy has apparently fallen to-day, one must reluctantly confess, into rather lower repute in the mind of the general biological public. Neither our professors nor our students of biology appear, with a few brilliant exceptions, to be interested in it. One forms the impression that perhaps four fifths of the Ph.D.'s turned out in zoology at the present time not only never have, but probably never will, for themselves, identify an animal strange to them, and as for deciding whether the unknown creature has been previously described, or placing it in proper taxonomic relation to its nearest relatives, such a problem would be as far beyond their powers as it is beyond their desires. By a curious paradox many modern biologists take precisely that attitude towards and about the living world around them in the practical conduct of their every day working life, which they would logically be expected to take if it were their deepest conviction that each living thing were the product of an act of special creation—God-given and therefore not to be worried about—and that such a process as evolution had never occurred.

Yet it is beyond question that if a young man embarking on a biological career has a desire to make an enduring contribution to knowledge, of permanent value, and incapable of being upset by any future developments of the subject, his best chance of doing this laudable thing is by becoming a careful, accurate taxonomist. If he describes accurately, carefully and completely a hitherto undescribed species of animal or plant, in such a way that any one who reads carefully the description can recognize and identify the thing described, he has chiseled for himself an indelible record in the history of man's intellectual progress.

Some there are who will argue that while what has just been said may be true, the niche in the tablets of history carved in this way is too slight to be of any significance, that, in short, systematic or taxonomic work has only a small and unimportant intellectual content, as compared with other sorts of biological study. Such a view of the case seems to me to be singularly lacking in vision. It means that the commonplace elements in taxonomic work have been allowed to overwhelm in their view its broad and deep significance. The labors of the taxonomists have alone given us such picture as we have of the inter-relationships, unity in diversity, and diversity in unity, of animate nature as a whole. It is the systematist who has furnished the bricks with which the whole structure of biological knowledge has been reared. Without his labors the fact of organic evolution could scarcely have been perceived, and it is he who to-day really sets the basic problems for the geneticist and the student of experimental evolution. His facts are the raw material from which the laws of organic evolution, in the sense that we speak of physical laws, must be worked out. An example of what is apparently a real law of organic evolution, deduced directly from the simplest taxonomic statistics, is found in the fact that the sizes of genera of plants and animals, as measured by the number of species each contains, are not distributed in frequency according to the normal curve of error, as most chance determined phenomena are, but instead obey with extraordinary exactness, as has been shown by Willis and Yule,[3] the rule that the logarithms of the *frequency* of genera plotted to the logarithms of the *size* of the same genera (*i. e.,* the number of species in each), give a straight line.

It is with much satisfaction that we find the leading exponent of the reigning mode in present-day biology, Bateson,[4] saying of taxonomy:

I had expected that genetics would provide at once common ground for the systematist and the laboratory worker. This hope has been disappointed. Each still keeps apart. Systematic literature grows precisely as if the genetical discoveries had never been made and the geneticists more and more withdraw each into his special "claim"—a most lamentable result. Both are to blame. If we can not persuade the systematists to come to us, at least we can go to them. They too have built up a vast edifice of knowledge which they are willing to share with us, and which we greatly need. They too have never lost that longing for the truth about evolution which to men of my date is the salt of biology, and the impulse which made us biologists. It is from them that the raw materials for our researches are to be drawn, which alone can give catholicity and breadth to our studies. We and the systematists have to devise a common language.

The separation between the laboratory men and the systematists already imperils the work. I might almost say the sanity, of both. The systematists will feel the ground fall from beneath their feet, when they learn and realize what genetics has accomplished, and we close students of specially chosen examples may find our eyes dazzled and blinded when we look up from our work-tables to contemplate the brilliant vision of the natural world in its boundless complexity.

It seems probable that we shall before long witness a return to a saner attitude than has prevailed in the last quarter of a century in regard to systematic zoology and botany; and in the training of our students, by not beginning specialization too soon and too violently, give them a more adequate conception than they now get of the orderliness and the diversity which together characterize animate nature as a whole.

III

The dominant mode in biology in my student days was morphology. I was nurtured on the somewhat arid problems of vertebrate cephalogenesis and the components of the cranial nerves. Probably few students in these days are excited by such problems. A vague awareness that there are such things as cranial nerves no doubt suffices and everyone is just as happy. The whole subject of pure morphology, as it was cultivated twenty-five years ago, seems singularly sterile now. It was a highly developed discipline, with a set of rules as rigid, and also be it said about as soul-stirring, as those of the Greek grammar. In its fine spun theories about homology, metamerism and the like, biology got off on a wrong track, which, as is now practically universally admitted, had only a blind ending.

But this does not mean, as those of the younger generation are apt rashly to conclude, that the old morphology was of no value. Intrinsically it was of great value. Few things will transcend in importance in the study of biology, the finding out of all that can be learned about the way in which living machines are put together. As long as this purely descriptive purpose was the primary and essential object of morphological study, all was well. The business only began to go bankrupt when it took on an essentially metaphysical purpose, and a logically bad, not to say hopeless one, at that. For what the pure morphologists of the eighties and early nineties were trying to do was to infer from purely static phenomena (the intimate structure of the body) the dynamic relations in a course of events (organic evolution). Such a task would have been perceived to be hopeless long before it was, except for the seductive lure of certain rules by which the game was played, which rules (such as ontogenetic recapitulation

3 Willis, J. C., and Yule, G. U.: "Some Statistics of Evolution and Geographical Distribution in Plants and Animals, and Their Significance," *Nature*, February 9, 1922, pp. 177-179.

4 Bateson, W.: "Evolutionary Faith and Modern Doubts," Science, N. S., Vol. 55, pp. 55-61, 1922.

of phylogeny, certain aspects of homology, etc.) were mistakenly supposed to be natural laws, whereas in point of fact, at the best they were only imperfect expressions of certain inherent necessities of the philosophic principle of organization, and at the worst just plain buncombe.

It is unfortunate that in the reaction against this sort of thing which has occurred in the last quarter-century the pendulum has swung so far as to deprive the present day student of biology of a good deal of the exact rigid morphological training that he got in earlier days. There never has been any better training for hand and eye and mind than that which went with the getting of an adequate understanding of the comparative anatomy of the vertebrates, no matter what field of biology the student subsequently entered upon as a specialty. So generally inadequate is the training in this field, now, I am told, that several of our best medical schools have found it necessary to devote a not inconsiderable part of the time allotted to anatomy in the medical curriculum, to the study of vertebrate comparative anatomy, because it is essential to the right understanding of human anatomy, and the students do not have it when they come, although they have the bachelor's degree and have been required to take biology.

We have seen, in the brief sketch which has so far been given of the course of biological events, that two trends of thought and research that were formerly of major importance have on the whole fallen somewhat into a state of desuetude. It will pay us to inquire a little more carefully into the reasons for this change of interest and esteem, because otherwise we are apt to reach the erroneous conclusion that taxonomy and morphology were never of any real importance or significance in the development of human knowledge, and that our forefathers only deluded themselves in thinking that they were. The fundamental reason for the decline in the cultivation of these two disciplines has already been touched upon. It is found in the fact that taxonomy and morphology, as originally practised in their pristine purity, dealt solely with static aspects of vital phenomena. Now the only thing of really compelling interest and significance about life is its dynamic character. Organisms live and do things. It is only this which makes them more interesting than bricks or paving stones. But by a curious quirk of the evolution of intellectual matters, the only group of people, before the publication of the "Origin of Species," who, as a group if they perceived this somewhat obvious fact, did anything about it, were the physiologists.

The historical development of physiology was bound up with and a part of that of medicine, rather than what we now call general biology. The first systematic treatise professedly dealing with physiology as an integral part of general biology was Claude Bernard's "Physiologie générale" and appeared only in 1872. The significance of this is that, in the main, and with only a few notable exceptions, those who prior to that time had been interested in physiology had been almost wholly concerned with workings of the mechanisms solely of the human body, and even in this somewhat narrow field, the significance of the findings for the science and art of medicine held the foremost place in esteem. All this has, of course, changed with the considerable development during the last quarter of a century, of general physiology under the leadership of such men as Loeb in this country, Bayliss in England, and Verworn in Germany.

But at its best physiology concerns itself chiefly with only certain of the *internal* dynamic phenomena of living things, and this is only a small part of the sum total of the activities which constitute life. That all biology should primarily be concerned with dynamic matters was first brought powerfully to the attention of thinking men by Darwin. The significance of Charles Darwin's work upon the intellectual development of his and subsequent times has been variously described and estimated. If we go down to real fundamentals it seems to me that we must conclude that one of the most important elements, at least, lies in the making it so plain as never again to be misunderstood, that the essential problems of biology are questions of dynamic relationships and not of static phenomena.

The immediate effect of Darwin's work, at least so far as zoology was concerned, was a curious one. It led to an enormous development of research in what is perhaps the most essentially static branch of biology, namely, pure morphology. The process of reasoning was something like this. Since evolution leaves a record of its progress in the structures of animals, by studying these structures intensively it ought to be possible to reconstruct not only the course, but even also the method, of evolution. Von Baer's so-called law, to the effect that ontogeny repeats phylogeny, was held to be the key that would unlock all the secret places of organic evolution, and the biological world went more or less mad over embryology.

But as has already been pointed out, this line of attack proved to be sterile, so far as the problem of evolution is concerned. Ontogeny does not repeat phylogeny with anything like that degree of fidelity which would be required if it were to be the means of unravelling the tangled thread of evolutionary progress. And the observed static end results given by the structures of existing animals are capable of being produced in too many different ways, as we now know, to make possible any precise conclusions from the mere study of their form as to the dynamic course of events which led to their existence.

IV

When this fact had become evident and sunk deeply into the consciousness of the working biologists, the way was cleared for the beginning of the great movement towards modern general biology. It is an odd mischance of fate that Darwin, who is the real founder of modern general biology, should not have seen any of its fruits in the declining years of his life, but instead only an abortive development resting on a ridiculously unsound philosophy. When biology, at the very end of the nineteenth century, got once more on the right track (for much earlier in its history it had been there, and only got diverted by a bad philosophy as to how the problems of evolution could be solved) a new world was indeed opened to our vision. And the password to it was experimentation. To the working biologist organisms once more became living things, not desiccated or pickled corpses. I cannot recall that in my undergraduate days there ever was a *living* animal in the laboratory, with the exception of protozoa. Certainly none was ever studied in any but a thoroughly pickled condition. As one looks back now on those days he is horrified not alone at the tortuosity of the intellectual pathway by which we attempted to come upon a knowledge of life, but also at the awful waste of alcohol!

The keynote of the new biology was dynamic and its methods were, in the main, experimental. Each of the old disciplines took on a new life. Morphology became experimental morphology; evolution became experimental evolution; a new shoot, ecology, sprang up from the gnarled old root of the taxonomic tree; and in some sense as the crowning glory of the whole edifice, animal behavior and comparative psychology began to flourish and attain a respectability never enjoyed by the labors of the old-fashioned naturalist, who observed what he called the "habits" of animals and plants.

Since these movements I have named comprise nearly the whole of the major trends of biology in the twentieth century it will perhaps be worth our while to examine a little more carefully into the philosophy and significance of each of them. For on and out of them is to grow the biology of the future, with all the great advances in knowledge which it has in store.

V

Modern experimental morphology may fairly be said to begin with Roux. His philosophy may be summarized in this way: organisms are machines which in their operations follow the laws of mechanics. Their structures are as they are because of the operation of these laws upon the plastic and adaptable material of which they are composed. It is the task of developmental mechanics to discover the specific physical and chemical laws which determine the form of particular structures of the living body. On the whole the most feasible way to go about accomplishing this result is to observe the results which follow upon the experimental modification of the physical and chemical conditions which environ the embryonic development of particular structures. Then in the favorable case we shall be able definitely to connect and correlate particular physico-chemical events with particular biological events in a causal way. We shall replace metaphysical speculation in the field of morphology with observed physical causation.

The results of the last quarter century have abundantly justified the faith of Roux and his followers in soundness of this philosophy. So close are we to the events themselves, however, that we cannot justly appreciate, I believe, the enormous significance of the advance in our knowledge of the fundamentals of biology which have come as the result of the labors in this field of a host of workers, under the leadership of Roux in Germany and of Morgan in this country. The important advances in this field have, in the main, come from these two countries.

The great activity in the fields of experimental morphology and developmental mechanics has also been in considerable degree responsible for the growth and healthy condition of another major trend in modern biology, namely cytology. This is pure morphology at its best, resting on the sound philosophical purpose of the exact description of the minute anatomy of the cell. In this field America has again been a leader. E. B. Wilson's book, "The Cell in Development and Inheritance," may well be said to mark an epoch, at least in American biology. The achievements of cytology in the last quarter century have been of no mean importance. This field of research, for example, has played the leading role in clearing up the age old problem of the determination of sex. The discovery by McClung of a mechanism in the germ cells, the accessory or sex chromosomes, and the subsequent great extension and solid grounding of this knowledge by Wilson and his students, have served to take out of the realm of mysticism and put into the clear light of ascertained fact the answer to one of the great biological riddles. Again, in this same period cytological research has laid the structural foundation of the mechanism of heredity. The student of the history of science will note here an interesting fact. Discoveries of major importance in regard to dynamic biological events have here been made by a purely static, descriptive mode of research. This is unusual. Why it has happened so fortunately is because the American workers in cytology, in the period of which we are speaking, have at every stage worked in the closest touch with the experimentalists, and have directed their descriptive studies to problems which have made themselves compellingly obvious from and in the experimental work which was going on at the same time, and in many cases in the same laboratory. A static method has worked in correlation and cooperation with a dynamic experimental method. We see beautifully exemplified here one of the main functions of descriptive science in general, in relation to experimental science. The descriptive worker endeavors to lay the structural foundation of the dynamic events with which the experimentalist directly concerns himself. The fruitfulness of this method and ideal of work in morphology, as compared with sad sterility of the point of view which vainly attempts to solve *in toto* dynamic problems by a purely static mode of research as the older morphology did, is apparent in the recent history of biology.

VI

Jennings has somewhere said that "An animal is something that happens." While this happy phrase might well be taken as the slogan for all modern biology, it expresses with particular aptness the point of view of that major trend in recent biological history in which its author was the one of the most considerable pioneers and leaders, namely the study of animal behavior. The development of this subject into the prominence it has enjoyed in the last quarter of a century does not represent altogether quite so sharp a break with the philosophy of an earlier time as was the case in the development of experimental morphology. The field naturalist had always properly esteemed the importance of things which happened, and there exists, in the older literature of popular and amateur natural history, a considerable mine of rather accurate observations about the behavior and habits of animals under natural conditions. Perhaps some day students of animal behavior from the modern view-point will adequately work this body of ore. It will not be an easy, nor a completely profitable task. The trouble of course is that, generally speaking, the naturalist of the old school was not analytical, but rather anecdotal, in his interest in the behavior and habits of animals.

It was just this difference that marked off the new school of animal behavior from the old. If what living things do is the most important consideration in distinguishing them from non-living things, it would seem clear that our knowledge of biology in general is bound to be increased if we apply to the study of what they do such precise analytical experimental methods as will give definite knowledge of at least some of the variables concerned in the determination of why they do it. In short, instead of interpreting what animals do in terms of a crude anthropopsychism why not be objective, and by experimentally modifying and controlling the animal's behavior learn something of the biological processes back of it?

Around 1900 it was pretty unanimously agreed that this was the thing to do, and it was done. For a few years a glib familiarity with "tropisms" and "reflex movements" was as essential to biological respectability as a corresponding acquaintance with "genes" and "crossing-over" is now. Two schools of thought and opinion crystallized, the one led by Loeb and the other by Jennings. They may be characterized, with perhaps the least chance of giving offense to anybody, as respectively the more simply mechanistic and the less simply mechanistic ways of regarding the happenings called life. The two cohorts of followers fought and bled on the battle-fields of "forced movements," "trial and error," and so on, with the utmost nobility and sacrifice of ink.

Quite unfortunately, as it seems to me, this fundamentally important line of research so brilliantly inaugurated, began after a decade or so to languish. Loeb turned off to physical chemistry and Jennings to genetics, and with the generals gone the armies melted away, to ally themselves to what they supposed to be more auspicious, or at least more fashionable movements. The case well illustrates the potency of the sheepish elements in human behavior. For no informed person supposes for a moment that all the problems of animal behavior and comparative psychology have been completely solved. Quite on the contrary the field has just been well opened up. And it is my conviction, based on some personal experience, that there is no other discipline which gives the student such an insight and grasp of fundamentals in the philosophy of biology as does the first-hand study of animal behavior. Every student in training for a career in any field of biology will find it extremely valuable in his future work to have done a piece of careful work in animal behavior under competent direction and guidance.

VII

We come now to the consideration of what, directly and in its numerous ramifications, is the dominant mode in present-day biology. I refer, of course, to experimental evolution. Beginning philosophically as a reaction against the sterility of pure morphology as a method of solving the great problems of organic evolution, it owes its actual origin as a major movement in biological thought to two circumstances, first, the bringing to light of the long-forgotten papers on the mode of inheritance of characters in certain plants by the Austrian monk, Gregor Mendel; and second, to the inauguration of the biometric method in biology by Francis Galton, Karl Pearson, and W. F. R. Weldon. It was plain enough to the writers of the Neo-Darwinian school, as indeed to everybody else who had grasped anything of the meaning of Darwin's work, that the basic factors in organic evolution were variation and heredity. Why not, then, study these factors directly, intensively, experimentally, and quantitatively? There could possibly be but one sensible answer to this question. And because this is so is the reason that genetics and biometry came upon us with such a rush, and have grown and prospered so vigorously.

Bateson, in the address to which I have already referred, tells the story of this change in viewpoint in the study of evolution very well, and I cannot do better than quote him again:

Discussion of evolution came to an end primarily because it was obvious that no progress was being made. Morphology having been explored in its minutest corners, we turned elsewhere. Variation and heredity the two components of the evolutionary path, were next tried. The geneticist is the successor of the morphologist. We became geneticists in the conviction that there at least must evolutionary wisdom be found. We got on fast. So soon as a critical study of variation was undertaken, evidence came in as to the way in which varieties do actually arise in descent. The unacceptable doctrine of the secular transformation of masses by the accumulation of impalpable changes became not only unlikely but gratuitous. An examination in the field of the interrelations of pairs of well characterized but closely allied "species" next proved, almost wherever such an inquiry could be instituted, that neither could both have been gradually evolved by natural selection from a common intermediate progenitor, nor either from the other by such a process. Scarcely ever where such pairs co-exist in nature, or occupy conterminous areas do we find an intermediate normal population as the theory demands. The ignorance of common facts bearing on this part of the inquiry which prevailed among evolutionists, was, as one looked back, astonishing and inexplicable. It had been decreed that when varieties of a species co-exist in nature, they must be connected by all intergradations, and it was an article of faith of almost equal validity that the intermediate form must be statistically the majority, and the extremes comparatively rare. The plant breeder might declare that he had varieties of Primula or some other plant, lately constituted, uniform in every varietal character breeding strictly true in those respects, or the entomologist might state that a polymorphic species of a beetle or of a moth fell obviously into definite types, but the evolutionary philosopher knew better. To him such statements merely showed that the reporter was a bad observer, and not improbably a destroyer of inconvenient material. Systematists had sound information but no one consulted them on such matters or cared to hear what they might have to say. The evolutionist of the eighties was perfectly certain that species were a figment of the systematist's mind, not worthy of enlightened attention.

Then came the Mendelian clue. We saw the varieties arising. Segregation maintained their identity. The discontinuity of variation was recognized in abundance. Plenty of the Mendelian combinations would in nature pass the scrutiny of even an exacting systematist and be given "specific rank." In the light of such facts the origin of species was no doubt a similar phenomenon.

Now while it is true that genetics has by no means solved the problem of evolution as yet, and probably by itself never can and never should have hoped to, the intensive pursuit of this line of inquiry during the last decade has enormously advanced our knowledge of general biology. In the first place, thanks to the brilliant work of Morgan and his students with *Drosophila,* we have firmly welded the last links in the chain of a definite proof of the causal connection between particular visible details of nuclear structure in the germ cells and particular somatic characters transmitted from parent to offspring in inheritance. The "mechanism of heredity" is no longer a thing to speculate and build broad nebulous hypotheses about. We definitely *know* a good deal about this mechanism and how it works.

In the second place genetics, with cytology as a working partner, as we have already noted, has solved at least in broad outline, the problem of the causation of sex. In the third place, the general results of modern genetic study taken as a whole, and particularly the intensive study of the breeding of animals and plants which the getting of these results has entailed, have made it highly probable, as I think most geneticists, at least, will agree, that natural selection as postulated by Darwin, has had but little if anything *directly* to do with the causation of the evolution of the living things about us. That natural selection is a process always and everywhere going on in nature (except in the case of civilized man, where its operation has been in large degree suspended by virtue of certain attributes of civilization itself) no competent observer of nature can possibly deny. But that it either does or could bring about evolutionary results attributed to it by Darwin seems in the light of our present knowledge, indefinitely more improbable than it did twenty-five years ago. To give all the reasons which exist to support this view would be wholly impossible with my time limitations. But that these reasons have been convincing to a great number of the most distinguished students of biology in recent years is certain. Because some of them have frankly given expression to their doubts, has led many well-meaning, but wholly uninformed, and somewhat unintelligent, persons to conclude that leading biologists no longer "believe in evolution." Nothing could be more hopelessly wrong than this conclusion. Every biologist who has got beyond a first elementary course in the subject knows that organic evolution is an observed and observable fact of nature, of something like the same obviousness and certainty as the fact that unsupported pieces of matter fall to the earth. I suppose that no one, even a "Fundamentalist," would think of asking a physicist if he "believed in gravitation." It is equally absurd to ask a biologist if he "believes in evolution." But just as one may appropriately discuss today the relative merits of Newton's and Einstein's views as to certain phases of the problems presented by the phenomenon of gravitation, so may he with propriety debate the significance of Darwin's theory of natural selection as a causative agent in the phenomenon of organic evolution.

It must seem to a young man or woman embarking now upon a career in biology that the only thing in the subject of any particular importance is genetics. I wish to point out, with a gravity as becoming as it is difficult to maintain while emitting such a platitude, that this is not true. There is a great deal in biology about which we are abysmally ignorant which partakes neither of chromosomes, nor Mendelism, nor yet of "crossing-over." And, if I mistake not, little light is likely to be shed on these dark places by the just now so brilliantly flaring torches that I have mentioned. The advancement of biology has at least one point in common with another fascinating subject, the adornment of women. Both progress evolutionally by a series of waves of fashion. Just now genetics is the reigning mode in biology. Nothing could be more charming, but it is neither the only nor the final word in charm.

It is apparently hopeless to expect anything like a reasonably balanced development in biological research, and, in consequence, of teaching. And perhaps if we had it we should all be bored. But it can do no harm if we think once in a while about some of the fundamental problems of biology which practically no one is even making an attempt to investigate experimentally, and towards the solution of which we are apparently making little progress. Time will not permit to say all that I should like to on this point, but I feel that I must in some degree indicate that what I have just said about the inadequacy of genetics as at present pursued, is not merely an idle gibe. To this end I shall discuss briefly two matters, adaptation and heredity.

The really difficult problem of evolution is adaptation. The original student of adaptation as a biological problem was Lamarck. It was the problem that lay behind and beneath all of Darwin's work, and he was almost the last investigator who in any systematic way busied himself with the problem. It seems to me that there are only two later students of this problem whose work is of very considerable importance, Hans Driesch and Lawrence J. Henderson. There is an objectively manifest teleology in animate nature. No thoughtful person can fail to be deeply impressed with the ingenuity and beauty with which organisms and their parts are adapted to the attainment of certain ends beneficial to the individual and the race. How came these adaptations about? What is the explanation? In the principle of natural selection Darwin put forward the first and, so far, the only mechanistic explanation of adaptation, though to Hume not Darwin should be given the credit of origination so far as this particular phase of the problem is concerned. It took away, if correct, at one stroke any necessity for the operation of supernatural causes in the explanation of the living world. It was this aspect of Darwin's theory of natural selection which disturbed thoughtful theologians vastly more than the fact of evolution itself, the descent of man from lower animals. For it was and is always possible, even if not plausible, to argue that the Creator chose to work in an evolutionary manner in the building of the world. But a strictly mechanistic explanation of adaptation, if adequate, destroys completely the very keystone of the arch of any theistic philosophy. Nothing could undermine more completely the prestige of a theistic agency than to prove that it is unnecessary—than to show, in short, that the supposed results of its infinite wisdom and omniscience not only would have occurred, but actually did happen as a result purely of natural, mechanical causes without any external, supernatural intervention.

The question, however, is: did the manifold adaptations which we see in living nature in actual fact arise through the operation of the processes of trial and error and natural selection? A final answer to this question seems to me impossible in the present state of knowledge. In the eighties and nineties the answer would have been, among biologists if not among philosophers, almost unanimously affirmative. Today the case seems much more doubtful. *Formally* it is possible to explain many particular adaptations by natural selection. Some it appears impossible to explain in this way, even formally. What wants intensive investigation is the whole biology, from every conceivable angle, of *particular* adaptations. No more important problem exists. And its difficulty should act as a stimulus rather than a deterrent to its study. To solve it, or indeed to contribute significantly to its solution, will require a different point of view and a different method from that of present-day genetics.

It may seem a little ungracious to suggest, in view of the brilliant results of genetic work which I have already mentioned, and which I yield to no one in admiration of, that the present dominant mode of research in genetics can give us only an incomplete and, philosophically considered, somewhat superficial knowledge of heredity, but I am unable to convince myself that such is not the fact. My views on this point have not changed since I discussed it in detail some seven years ago. I then said[6]:—

Mendelism finds its limitations, just as did the biometric methods in the fact that from the logical standpoint it is essentially a statistical method which studies only the laws of distribution of things given or assumed. It examines only the distributiou of hereditary specificities, and not at all, directly, their origin or determination. The former aim cannot be the goal of genetic science. A method which can travel only so far cannot hope to say the last word in the discussion of the problem of heredity. As a mode of research the Mendelian method of analyzing the progeny distributions rather than the ancestral will always be used. It was indeed one of the most brilliant methodological discoveries in the history of science. But it has limitations in the direction of what it can accomplish per se in elucidating the problem of heredity.

It is altogether usual in current discussions of variation and heredity to neglect completely everything which comes between the two end terms of the ontogenetic series, the germ cell on the one hand and the adult soma on the other. But clearly what goes between is a most essential part of heredity itself. It is astonishing how little has been done on these extremely obvious problems.

Two of the four general methods which have been employed in the investigations of the problem of heredity have been seen to be essentially statistical, and two essentially biological. The statistical methods—the biometric and the Mendelian—differ fundamentally only in that the former investigates primarily the ancestry and the latter primarily the progeny. Logically exactly the same distinction was found between the two purely biological methods—the cytological and the embryological. The former studies the ancestry of the germ cell (gametogenesis), the latter the progeny of the germ cell (somatogenesis).

All of these methods are valuable, and each has contributed to our present knowledge of heredity. No one of the methods alone can, however, solve the problem. They all have at least one fundamental limitation in common. This is that they offer no means of directly getting at any definite information regarding the origin, cause, or real nature of that specificity of living material which is the very foundation of the phenomenon of heredity. The distribution of hereditary specificities, their putative morphological "bearers," and many other things about them have been studied more or less exhaustively. The things themselves have been speculated about, but not investigated to any but the slightest extent.

6 Pearl, R. Modes of Research in Genetics. New York (Macmillan), 1915.

VIII

In bringing to a close this brief and inadequate review of the major trends of biology I want to say a few words about a purely practical movement which is rapidly gaining force and seems likely shortly to have a pronounced effect upon the development of the whole subject, including its theoretical aspects, and particularly its teaching. I refer to the rapidly growing recognition of the fact that all of the activities of all living things, including man, are properly a part of biology in a greater or less degree. The practical importance of this lies in its corollary that the biologist may and probably does have something important to contribute towards the solution of the most various sorts of human problems, agricultural, medical, social, economic, and so on. During the last quarter of a century it has been increasingly forced upon the attention of university teachers of biology that students of sociology, of philosophy, of medicine, of economics, and of many other subjects, who had no intention to become professional biologists, not only wanted to, but needed to know something about biology. At first covertly resisted, this need is now frankly being recognized and in some degrees met by the reorganization of courses, and departures of varying degree from the traditional method of teaching this subject. This is, I think, entirely healthy and desirable. There is going along with this broadening of the viewpoint of biological teaching a welcome broadening of the opportunities for a useful and profitable career in biology. There are already many kinds of applied biology attracting young men and women. And quite beyond the range of these somewhat narrow specialties, we are witnessing such phenomena as the employment of research workers in general biology by a great corporation manufacturing electrical appliances, to mention but a single instance.

To one who embarked upon a biological career twenty-five years ago, solely because he was seduced by the charm of the subject, and who in yielding renounced, against the advice of family and friends, the supposedly certain and considerable rewards which would come if he continued, as he had tentatively started, on a career in which he might finally become a teacher of Greek, the opportunities for the biologist of the present day seem somehow humorously magnificent.

If in what I have said I have succeeded in any degree in indicating the intellectual justification of Dr. John A. Lichty's splendid gift to Mount Union College for the endowment of its flourishing department of biology, my principal object will have been achieved. Under the able leadership of Professor M. J. Scott we may confidently expect the work of the department to go forward in close touch with each new and promising field of endeavor which biology presents. I can not allow myself to close without expressing, as a biologist, my deep admiration and profound respect for the breadth of vision and deep philosophical insight which is implied in the endowment by a worker of the field of medicine of a chair of general biology. The Milton J. Lichty Chair of Biology is another enduring demonstration of the fact that the most enchanting of all the sciences has really come into its own.

Raymond Pearl

School of Hygiene and Public Health,
The Johns Hopkins University

EARTH-CURRENT OBSERVATIONS[1]

The Department of Terrestrial Magnetism of the Carnegie Institution of Washington is planning to install earth-current lines for systematic observations at its magnetic observatories. During this year such lines are being installed at the Watheroo Magnetic Observatory, about 120 miles north of Perth, Western Australia, and some time later similar installations will be made at the Huancayo Magnetic Observatory, about 125 miles east of Lima, Peru; both of these magnetic observatories are conducted under the auspices of the Department of Terrestrial Magnetism. Various initial investigations concerning best methods of earth-current

[1] Presented before the Philosophical Society of Washington, February 25, 1922. The full paper is published in the March-June, 1922, issue of *Terrestrial Magnetism and Atmospheric Electricity*, pp. 1-30.

measurements are at present in progress at the Department's laboratory in Washington.

In order to take advantage of the previous experience gained in earth-current work, and to ascertain the direction in which further study is desirable, the writer undertook a discussion of the available data, especially of the 11-year series, 1910-1920, obtained at the Observatorio del Ebro, Tortosa, Spain. For the first time comparisons could be made between the phenomena of terrestrial magnetism, earth currents, and atmospheric electricity, as dependent upon extensive observations at the *same* station. Accordingly, it has been possible not only to confirm and extend certain results previously reached by others, but also to draw important new conclusions.

It is hoped that the present investigation, which had to be confined to a discussion of the observational data on magnetically-calm, or on electrically-calm days, may be supplemented later by a discussion of earth-current data on disturbed days.

The chief conclusions may be stated as follows:

(*a*) The resultant horizontal earth-currents, as observed at the Ebro Observatory, flow, on the average for the year, in the direction from about 29° west of North to 29° east of South, or, approximately, in the direction from the Magnetic North Pole towards south-southeast. The average value, for the magnetically-calm days during 1914-1918, of the potential gradient of the component of the current flowing from true North to South was 0.20 volt per kilometer, and that of the component towards geographic East was 0.11 volt per kilometer, or about one half of the north-south component. The resultant horizontal potential-gradient was 0.23 volt per kilometer, which during electric or magnetic storms may reach a value 0.8 to 1.0 volt per kilometer.

(*b*) The annual variations of the earth-current potential-gradients and of the components of the Earth's magnetism, as observed at the Ebro Observatory, may be related to one another as cause and effect only to a very minor extent; both sets of variations may have to be referred, more or less, to common causes. The range of the annual variation of the north-south electric component is about 2.5 times that of the west-east component.

(*c*) The diurnal variation of earth currents as observed at the Ebro Observatory along lines somewhat over one kilometer long is remarkably similar to that observed at Berlin along telegraph lines, 120 and 262 kilometers in length, from 1884-1887. In both cases the diurnal variations for the component of the current along the meridian is considerably more pronounced (2-3 times) than that along the parallel of latitude. The diurnal variation in the north component of the earth's magnetism is not such as to correspond to the direct magnetic effect of the diurnal variation of the west-east component of the earth currents. A similar conclusion had to be reached with regard to the east component of the earth's magnetism and the north-south component of the earth currents. The general conclusion was that the north-south earth-current might be the result of electro-magnetic induction, caused by the fluctuation during the day of the west-east component of the earth's magnetism. *If it be recalled that all analyses of the diurnal variation field of the earth's magnetism have shown that the magnetic diurnal variation is in part to be ascribed to electric currents circulating in the regions overhead and in part to currents circulating within the earth's crust, exact agreements between magnetic variations and earth-current variations are not to be expected. It further remains to point out that until we have some knowledge of the actual course or distribution of the earth currents in the earth's crust and as to how the conductivity of the crust may vary with temperature and other meteorological causes during the day and at the actual place of observation, attempts to find a quantitative relationship between terrestrial-magnetic and earth-electric effects may be futile.*

(*d*) The horizontal vector-diagrams both for the magnetic and earth-electric components vary during the sun-spot cycle in about the same proportion. The earth-current vector-diagram is symmetrical about a line approximately in the direction of the Magnetic North Pole.

(*e*) The extreme diurnal range of the Ebro earth currents reaches its highest values near the equinoctial months, and lowest near the solstitial months. Earth currents, atmospheric electricity, the Aurora Borealis, and the earth's magnetic disturbances, all show similar annual variations in the ranges of their fluctuations.

(*f*) The potential gradients of earth currents and of atmospheric electricity apparently vary during the sun-spot cycle, the former decreasing in the direction of normal flow of current, and the latter increasing with increased sun-spot activity. The diurnal ranges of the potential gradients of earth currents, as well as of atmospheric electricity, just as is the case for the diurnal variation of terrestrial magnetism, increase with increased sun-spot activity.

(*g*) There is evidence of a similar six-hour wave in atmospheric electricity, earth currents and terrestrial magnetism.

The analyses referred to in (*c*) are chiefly those by Schuster, Fritsche, Chapman, Walker, and Miss van Vleuten, the method of investigation employed by them being that first suggested by Gauss, which is based on the well-known Amperian rules of deflection of a magnetic needle by an electric current. The general result reached by these investigators, as stated in (*c*), has been accepted by every modern magnetician; it post-dates the investigations by Airy and Weinstein quoted by Dr. Sanford in his recent article[2]. In this connection it may be pointed out that the conclusions drawn by Dr. Sanford do not depend upon simultaneous earth-current and magnetic data at the *same* station, as was the case in my investigations.

As stated above, my present conclusions apply only to possible relations between the *diurnal variation* phenomena of earth currents and of the earth's magnetism. It does not appear that definitive conclusions can be safely reached until we have at the *same* station unquestioned coincident magnetic and electric data, and until we can furthermore consider in our comparisons only that portion of the magnetic diurnal variation caused by systems of forces below the earth's surface.

A fresh examination is also being made regarding the relations between earth currents and severe disturbances of the earth's magnetism, such as occur during the so-called magnetic storms. There are some indications which may support the views recently advanced by Satyendra Ray[3], though I am not prepared just now to make a definite statement.

With the view of giving renewed stimulus to systematic earth-current investigations, a special committee, "to consider and report on best methods and instruments," was formed at the Rome meeting of the International Section of Terrestrial Magnetism and Electricity last May. The chairman of the committee is Sir Arthur Schuster, and the secretary, Dr. S. J. Mauchly, of the Department of Terrestrial Magnetism.

Louis A. Bauer
Department of Terrestrial Magnetism,
Carnegie Institution of Washington

COLLABORATORS IN THE STANDARDIZATION OF BIOLOGICAL STAINS

From time to time reports from the Committee on Standardization of Biological Stains have appeared, dealing with the investigations in progress. Many congratulations have been received by the chairman of the committee on the results accomplished; but as these accomplishments would have been impossible but for the very hearty collaboration of a long list of investigators, credit for the work should be given where it belongs by publishing the following list of committee members and collaborators:

COMMITTEE MEMBERS

F. W. Mallory, Boston City Hospital, Boston, Mass.

F. G. Novy, University of Michigan, Ann Arbor, Michigan.

[2] Earth currents and magnetic variations, Science, October 27, 1922, p. 466.

[3] Ray, S., "Ueber parallele Störungen von parallelen erdmagnetischen und erdelektrischen Elementen," Zs. Physik, Berlin, v. 7, 1921 (201-205).

S. I. Kornhauser, School of Medicine, Louisville, Kentucky; in charge of the work for the American Society of Zoologists.

L. W. Sharp, College of Agriculture, Ithaca, N. Y.; in charge of the work for the Botanical Society of America.

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E. Artschwager, Bureau of Plant Industry, Washington, D. C.

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W. G. Stover, Department of Botany, Ohio State University, Columbus, Ohio.
George L. Streeter, Johns Hopkins Medical School, Baltimore, Maryland.
W. R. Taylor, Department of Botany, University of Pennsylvania, Philadelphia, Pa.
E. F. Voigt, Board of Health, Fort Smith, Arkansas.
E. M. Wade, Board of Health, Minneapolis, Minnesota.
H. B. Ward, Department of Zoology, University of Illinois, Urbana, Illinois.
Wanda Weniger, N. D. Agricultural Experiment Station, North Dakota.
Anna W. Williams, Department of Health, Research Laboratory, New York City.
G. B. R. Williams, Paris, Illinois.
C. L. Wilson, Cornell University, Ithaca, New York.

The work so far accomplished by these collaborators includes: an extensive study of American methylen blues, fuchsins, gentian violets, and eosins for bacteriological purposes; a study of eosin, methylene blue, hæmatoxylin, orange G and safranin for various histological purposes; while work is in progress at present on a number of other stains, including methylen green, Bordeaux red, brilliant green, brilliant cresyl blue, cresylecht violet, pyronin, and acid fuchsin. The results accomplished are so promising that there is reason to believe that the most commonly used stains can be regarded as standardized before the following winter is over. It will then be possible to work out some method of certification of stains which come up to the standards.

None of this work would have been possible but for the cooperation of such a large number of investigators, who have responded to every call for assistance in a most gratifying way. It was not anticipated at the start that such a large number would be found to take part willingly in an investigation of this sort. The work, of course, has been entirely voluntary. The committee would like, whenever reporting on any stain, to give due credit to all of these collaborators but as such a course is impractical the best plan seems to take the present occasion to make their names public and express appreciation for their assistance.

H. J. Conn,
Chairman
Committee on Standardization of Stains,
National Research Council

SCIENTIFIC EVENTS

THE RAMSAY MEMORIAL

The unveiling of the tablet in Westminster Abbey in memory of Sir William Ramsay, to which reference has been made in Science, was the last act in connection with the memorial, a history of which is summarized in the London *Times*. In 1917 an appeal was issued for £100,000 by a committee, under the presidency of Mr. Asquith, and under the chairmanship of the late Lord Reay. At a subsequent date, the Prince of Wales became patron of the fund. The sum collected in cash is £57,645.

In addition, the fund has been augmented by a number of research fellowships instituted by various dominion and foreign governments, of which the capitalized value is estimated at about £60,000, so that the total sum raised in response to the appeal may be regarded as being nearly £120,000. This sum is believed to be the largest ever raised in any country as a memorial to a man of science.

The sum collected in cash includes subscriptions from Great Britain and Ireland, America, Australia, Canada, Chile, China, Denmark, France, Greece, Holland, India, Italy, Japan, New Zealand, Norway, Straits Settlements, Switzerland and Portugal.

The following governments have instituted fellowships of the value of £300 a year: Canada, Greece, Italy, Norway, Sweden, Denmark, Spain, Holland, while the Japanese government has instituted a fellowship of the value of 4,320 yen (approximately £463). French and Swiss fellowships have been instituted, part of the cash contribution in those countries being used for the purpose.

These fellowships are intended to lead to an orientation of many of the most promising young scientists of the world to England. Chemists from Norway, Sweden, Denmark, Holland, Switzerland, Japan and the United States are already at work in England. The Italian and Greek fellowships are at present vacant, and the Spanish felowship has not yet been filled, although it has been provided. Fellows are studying in London, and at Oxford and Cambridge, at the Imperial College of Science and Technology, Glasgow, and at Liverpool. A number of British fellows are also at work.

The Ramsay Committee has carried out a number of the objects which were set out in the original appeal. A sum of £25,000 has been laid on one side for the purpose of a laboratory of chemical engineering, to be established at University College, London, where Sir William Ramsay held his professorship for twenty-six years. This building has not yet been erected, though arrangements are now in progress.

A sum of £14,000 was handed over to a body of trustees, consisting of Sir George Beilby, Sir Hugh Bell, Lord Crowe, Mr. H. A. L. Fisher, Sir Donald MacAlister, Dr. J. C. Irvine and Sir Robert Hadfield, for the purpose of founding Ramsay Memorial Fellowships in Chemical Science for British students. Each fellowship is of the value of £300. In addition, a sum of £6,000 in respect of Glasgow subscriptions was handed over to the same trustees to provide a fellowship of £300 a year for a Glasgow candidate.

A medal has been struck from a design of the French sculptor, M. L. Bottée. A sum of £210 has been paid to University College, London, for the institution of a Ramsay Medal from M. Bottée's design, to be awarded annually to the most distinguished student of chemistry at University College.

There remains a small balance of the Ramsay Fund, after providing for the cost of the memorial tablet, the disposal of which has not yet been definitely settled.

THE ZEITSCHRIFT FÜR PRAKTISCHE GEOLOGIE

Dr. Philip S. Smith, acting director of the U. S. Geological Survey, permits us to print the following letter from Dr. Franz Beyschlag, president of the Geologischen Landesanstalt, Berlin:

On account of the sad financial conditions in our country it is probably known to you that the question of the existence of the *Zeitschrift für praktische Geologie*, published by me and my colleague Krusch, is at stake. Cost of printing and postage have risen so high that we shall be compelled to discontinue the *Zeitschrift* in a short time, unless help comes. From the request of your librarian to the publisher of the *Zeitschrift*, Wilhelm Knapp in Halle, I gather that there is a lively demand in America for this *Zeitschrift*. From that I conclude with right that there is an interest in the existence of our publication and that it is not unlikely that some subscribers can be obtained. Therefore I would be especially thankful to you if you would endeavor to secure in the interested circles there a considerable number of subscriptions. The publisher could send the numbers regularly through the American Institute in Berlin so that there would be no postage. In this way you would render the

Zeitschrift an extraordinary service and it might perhaps be possible to keep it alive. For our common strivings in the field of practical geology it would be calamitous if this Zeitschrift, after so long existence, was now compelled to go under through financial difficulties. It is a good medium for scientific publication so that authors also would suffer through the passing of the publication. For your efforts in the interest of this matter, I pledge my highest thanks.

SIGMA XI AT THE UNIVERSITY OF IDAHO

The thirty-eighth chapter of Sigma Xi, to be known as the Idaho Chapter, was installed at the University of Idaho on June 5. Fifteen active members, who were elected to the society while connected with other educational institutions, composed the petitioning group.

The installation exercises were conducted by Dr. Henry B. Ward and Dr. Edward Ellery, president and secretary of the national society. The charge to the chapter was delivered by Dean Ellery and the symposium was conducted by Dr. Ward. Eighteen science men who were formerly associated with the University of Idaho Sigma Xi Club were invited to attend the installation ceremonies. Several active members of the Washington State College faculty were also in attendance.

The following officers were elected: *President,* Dr. J. E. Wodsedalek; *vice-president,* Dr. M. F. Angell; *secretary,* Dr. Henry Schmitz; *treasurer,* Professor C. E. Behre.

A formal banquet was held in the evening at Lindley Hall, University Campus. Among one hundred guests of the chapter were Dr. Ward, Dean Ellery, Dr. A. H. Upham, president of the university; Dr. E. A. Bryan, commissioner of education of Idaho; Miss Ethel Redfield, state superintendent of public instruction; Dr. Melander, of Washington State College; members of the Idaho Board of Regents, the associate members of the former Idaho Sigma Xi Club, and the deans and heads of the arts and letters divisions of the university. Dr. J. E. Wodsedalek acted as toastmaster and toasts were responded to by Dr. Ward, Dean Ellery, President Upham and Commissioner Bryan.

The installation took place during commencement week. Dean Ellery delivered the baccalaureate sermon and Dr. Ward gave the commencement address. Dean Ellery's subject was "The hills of human help," while that of Dr. Ward was "The struggle of man with wild life in North America."

THE ASSOCIATION OF AMERICAN GEOGRAPHERS

The annual meeting of the association, in connection with the Geological Society of America, will be held at the University of Michigan, Ann Arbor, by invitation of the regents of the university, on Wednesday, Thursday and Friday, December 27, 28 and 29, beginning on Wednesday at 1:30 P.M.

The president's address will be given at the opening of the session Thursday afternoon and will be followed by a series of invited papers. Later in the afternoon, by special invitation, the association will visit an exhibit of rare maps belonging to Mr. William S. Clements, a regent of the university.

Sessions will be held in the natural science building where exhibition and smoking rooms are available. Members desiring to exhibit papers, maps, etc., should inform Professor C. A. Sauer in advance.

The arrangements include:

Round table conference (open to members and invited guests), Wednesday evening, December 27.

Smoker tendered by the regents of the university, Thursday evening, December 28.

Luncheon, as guests of the university, Friday noon, December 29.

A joint meeting for physiography papers with the Geological Society of America.

The secretary will be glad to receive the names of non-members to whom the preliminary program should be sent. All interested in geography, or any of its allied subjects, are welcomed at the program sessions of the association.

Harlan H. Barrows,
President

Richard E. Dodge,
Secretary

Storrs, Connecticut,
November 7, 1922

THE ECOLOGICAL SOCIETY OF AMERICA

The Ecological Society of America will hold its eighth annual meeting at the Massachusetts Institute of Technology on Wednesday, Thursday and Friday, December 27, 28 and 29, 1922. In addition to the general sessions, joint meetings will be held with the American Society of Zoologists and the Botanical Society of America.

Titles and abstracts of papers to be placed on the program should be in the hands of the secretary by December 1, in order to be printed for distribution before the meeting. Persons not members of the society may present papers on the recommendation of a member.

A dinner to which all persons interested in the society and its activities are invited will be held at the Athens Café, 694 Washington Street, on Wednesday evening. The hotel headquarters will be at the Parker House, Tremont Street, where rooms will be available at rates from $2.50 up. Reservations should be made at an early date.

A. O. Weese,
Secretary
James Millikin University,
Decatur, Illinois

THE AMERICAN SOCIETY OF NATURALISTS

The fortieth annual meeting of the American Society of Naturalists will be held in Boston, Massachusetts, on Friday, December 29, in the buildings of the Massachusetts Institute of Technology.

The headquarters of the society will be at the Hotel Somerset, which is also the headquarters of the American Association for the Advancement of Science. Rates at the Somerset are as follows: One in a room, with bath, $4 to $6; two in a room, with bath, $5 to 7. Members are advised to make reservations early. Information concerning other accommodations will doubtless be available for the final announcement of the society in December.

The morning session will be devoted to a celebration of the birth of Gregor Mendel and of Francis Galton in 1822. For this program the following speakers have been secured: E. M. East, T. H. Morgan, J. Arthur Harris and George H. Shull.

A symposium on Geographical Distribution has been arranged in conjunction with the American Society of Zoologists. For this program, papers by Glover M. Allen, Thomas Barbour, E. R. Dunn, C. H. Eigenmann, P. P. Calvert and C. T. Brues have been secured. It may be possible to announce others later.

A memorial to the late Professor Sedgwick, in the form of a lecture by Professor E. B. Wilson, is scheduled for Friday afternoon, closely following the Naturalists' symposium on geographical distribution.

Following instructions given by the Naturalists last year, the officers of the society participated, during the year, in conferences looking toward federation of the biological societies of America. Notices concerning these conferences have several times appeared in Science. The final result of these meetings is a proposed constitution of such a federation which was printed in Science for September 29. It is expected that reprints of this article in Science will be distributed to members of the society along with the final announcement in December. The question of accepting membership in the federation will be presented at one of the business meetings of the society.

The annual dinner, with the address of the president, Professor W. M. Wheeler, will be given on Friday evening at the Hotel Somerset.

Blank forms for the nomination of candidates for membership in the society may be obtained from the secretary. Attention is called to the rule that nominations must be in the hands of the executive committee at least a year before being acted upon. Accordingly, nominations to be voted upon in 1923 must reach the secretary before the close of the meeting of 1922.

A. Franklin Shull,
Secretary
University of Michigan,
Ann Arbor, Michigan

SCIENTIFIC NOTES AND NEWS

At the dinner of the Natiional Academy of Sciences, held in connection with the New York meeting on November 15, the Draper Gold Medal was presented to Professor Henry Norris Russell, of Princeton University. Dr. C. G.

Abbot, director of the Smithsonian Astrophysical Observatory and secretary of the academy, a former recipient of the medal, made the presentation address and Professor Russell replied.

Friends of Professor Chandler presented in 1910 to Columbia University a fund which constitutes the Charles Frederick Chandler Foundation. The income is used to provide a lecture by an eminent chemist and for a medal to be presented to the lecturer. Previous lecturers on this foundation have been Dr. L. H. Baekeland, W. F. Hillebrand, W. R. Whitney, F. Gowland Hopkins and Edgar F. Smith. The lecturer this winter will be Dr. Robert E. Swain, professor and head of the department of chemistry, Stanford University, whose subject will be "Atmospheric pollution by industrial wastes." The lecture will be in Havemeyer Hall, Columbia University, on January 9, 1923, at 8:15 P.M.

M. Arthus, professor of physiology at the University of Louvain, has been elected correspondent of the Royal Academy of Medicine of Belgium. Dr. Depage has been chosen the recipient of the quinquennial prize for the best work published in the field of medical science for the period 1916-1920.

Professor de Castro, dean of the Medical School of Rio de Janeiro and delegate from Brazil to the League of Nations, was given an ovation recently at Paris, in the presence of the ambassador from Brazil and many of the professors and students of the university. De Castro delivered an address on monoglandular and pluriglandular dystrophies.

The following physical chemists have been named as editors of the *Journal of Physical Chemistry:* By the Chemical Society of London, Professors T. M. Lowry, J. W. McBain and James C. Philip; by the Faraday Society, London, Professor F. G. Donnan; by the American Chemical Society, Dr. A. L. Day, Professor G. A. Hulett, Dr. Irving Langmuir and Professor W. Lash Miller. Through the efforts last summer of Dr. Charles L. Parsons, secretary of the American Chemical Society, this publication, edited by Dr. Wilder D. Bancroft, of Cornell University, hitherto a strictly American journal, was brought under the auspices of the two leading British societies and the American group.

Mr. Kenneth M. Gould, formerly associate editor of the *American Journal of Public Health,* has severed his connection with the American Public Health Association and the American Social Hygiene Association, to become editor of the publications for the Rockefeller Foundation. The *Journal* will be edited in future by Dr. Henry F. Vaughan, commissioner of health of Detroit, Michigan, assisted by an editorial board composed of Dr. M. P. Ravenel, of the University of Missouri, and Mr. A. W. Hedrich, secretary of the association.

Mr. Willis H. Rich, of California, has been appointed assistant in charge of the division of scientific inquiry of the Bureau of Fisheries. Mr. Rich has been connected with the bureau's investigation work on the Pacific Coast salmon since 1913, having been closely associated with Dr. Charles H. Gilbert, of Stanford University.

C. Robert Moulton is leaving the University of Missouri, department of agricultural chemistry, with which he has been associated for the past fifteen years, to become head of the Bureau of Nutrition for the Institute of American Meat Packers in Chicago.

Mr. Paul Croll, formerly research chemist of the New Jersey Zinc Company, has been engaged by the Patton-Pitcairn Division of the Pittsburgh Plate Glass Company.

The *Journal* of the American Medical Association states that Professor Ramón y Cajal was not able to be present at the recent unveiling of the portrait statue at the medical school of Zaragoza, but a letter from him was read in his name, saying that he doubted whether he would have had courage to witness the unveiling of his statue even if his health had allowed it. He said he feared the statue would ask, "What have you done to deserve this honor? Are you not ashamed to be so distinguished when no memorial has been erected to . . ." and he named several Spaniards who had won international recognition among the scientists of their day. He added that the car of Spanish civilization has been running along too long on merely the two golden wheels of art and literature. It needs two more wheels to keep abreast with the rest of the world, a wheel of science and a wheel of industry.

Edwin F. Hopkins has resigned as plant pathologist of the University of Missouri to accept a position as plant physiologist with the Marble Laboratory, Inc., of Canton, Pa. He will be engaged in a study of problems related to cold storage.

Leave of absence has been granted by the Corporation of Yale University to Dr. Lafayette B. Mendel, Sterling professor of physiological chemisry, to enable him to deliver a course of lectures on the Hitchcock Foundation at the University of California in the late spring of the present university year. It is the intention of Professor Mendel to leave New Haven after the dedication of the Sterling Chemistry Laboratory in April, to join the faculty of the University of California for the intersession, which continues from May 14 to June 23, 1923. Professor Mendel has chosen for his subject "New aspects of the physiology of nutrition."

Dr. Charles H. Gilbert, of Stanford University, California, who during the past summer has made an extensive investigation of the salmon fisheries in the Alaska Peninsula Fisheries Reservation, created in February, 1922, was in Washington from October 18 to 26 conferring with officers of the Bureau of Fisheries regarding conditions that he had found in the reservation, outlining future work to be taken up there and discussing the regulations necessary for the calendar year 1923. Dr. Gilbert visited Seattle on November 16 and 17 for the purpose of conferring with people operating in the Alaska Peninsula Reservation and discussing permits that will be issued for the operations that will be allowed in the reservation the coming year.

A Danish scientific mission, under the leadership of Professor Olufson, accompanied by the French savant, Professor Bourcart, of the Sorbonne, left Paris early in the present month on a six months' expedition in the northern Sahara, where it will cover a distance of some 3,000 miles. The members of the mission include the botanist, Dr. Gram, and the geologists, Drs. Storgaard and Kayser. The party, which will start from Tunis, intends to make a detailed study of the Shat-el-Jerid. From Nefta it will proceed to Tuggurt, and thence to Wargla, in the Algerian Sahara. Next it will go to Insalah, and endeavor to explore the Hoggar Mountains.

Chas. R. Fettke, associate professor of geology aud mineralogy at the Carnegie Institute of Technology, Pittsburgh, Pa., has completed an investigation of the oil resources of the coals and carbonaceous shales of Pennsylvania for the State Bureau of Topographic and Geological Survey.

Dr. Charles P. Berkey, professor of geology at Columbia University, has returned from China where he was with the Third Asiatic Expedition of the American Museum of Natural History.

Dr. Edgar F. Smith, former provost of the University of Pennsylvania and president of the American Chemical Society, gave a lecture at the University of Pennsylvania on November 3 on Joseph Priestley, under the auspices of the Priestley Club.

A course of eight lectures on "Secretion and Internal Secretion" was given by Professor Swale Vincent, M.D., D.Sc., professor of physiology in the University of London, at Middlesex Hospital Medical School, during November.

Dr. Joseph S. Ames, professor of physics at the Johns Hopkins University, director, Office of Aeronautical Intelligence of the National Advisory Committee for Aeronautics, spoke on November 23 before the Franklin Institute of Philadelphia, on "Recent aeronautic investigations and the airplane industry."

Dr. August Krogh, professor of zoophysiology in the University of Copenhagen, lectured at the University of Pennsylvania on November 14 and 15 on "Nervous and hormonel control of capillary contractility" and on "The exchange of substances through the capillary wall." Dr. Krogh addressed a special meeting of the Entomological Society of Washington on November 8 on the subject of insect respiration.

DR. HUGH POTTER BAKER, executive secretary of the American Paper and Pulp Association, formerly dean of the New York State College of Forestry, lectured on "Forests and forestry in New England" before the Middletown (Conn.) Scientific Association on November 14.

PROFESSOR ELIAS JUDAH DURAND, chairman of the department of botany in the University of Minnesota, died at his home in St. Paul on October 29, of cancer. He was born in Canandaigua, N. Y., in 1870 and after graduating from Cornell University in 1893 became a fellow, assistant and instructor in botany at the university. In 1910 he went to the University of Missouri as assistant professor of botany, being made associate the next year. In 1918 he was called to the University of Minnesota as professor of botany. He was the author of important contributions to mycology.

UNIVERSITY AND EDUCATIONAL NOTES

THE annual report of the treasurer of Yale University for the year ending June 30 records an unusually large number of gifts, made to meet the conditions of the $3,000,000 subscribed to general endowment by Mrs. Stephen V. Harkness. As a result of these contributions and the establishment of six new professorship funds in memory of John W. Sterling, '64, of almost $250,000 each, the total of Yale's endowment funds is shown to be $32,662,011.95, an increase of $6,985,001.25 in the last year. Gifts for building and other non-permanent funds received in the same period aggregated $1,651,290.68, while gifts to income amounted to $740,642.24. Included in the latter were contributions of $185,000 from the General Education Board and $30,000 from the Commonwealth Fund to enable the Yale School of Medicine to provide funds for the reconstruction of two wards in the New Haven Hospital, and to build laboratories in that institution, with which the school is affiliated; $70,000 more from the Commonwealth Fund towards the expenses of the department of surgery; and $286,664 received through 9,493 contributors to the Alumni Fund, the principal of which was also increased by $147,060.41.

THE West Indian Agricultural College, which was formally opened by Sir Samuel Wilson, governor of Trinidad and Tobago, on October 16, has begun its session in a temporary building erected at St. Augustine. Eighteen students have been enrolled, including three post-graduates, and this is regarded as a promising start for a new institution of the kind. Tenders have been invited for the construction of the permanent college building, of which Major H. C. Corlette, is the architect.

DR. CHARLES WESLEY FLINT was inaugurated as chancellor of Syracuse University on November 17.

DR. EDMUND C. SANFORD, president emeritus of Clark College and at present head of the department of psychology, has been appointed acting president of Clark University in the absence of President Wallace W. Atwood. The trustees have granted to President Atwood a four months leave of absence for travel in Europe. President Atwood expects to visit the leading educational institutions of Europe, and will observe teaching methods in western Europe.

DR. STANHOPE BAYNE-JONES, associate professor of bacteriology at Johns Hopkins University, has been appointed professor of bacteriology at the University of Rochester.

DR. HOWARD DE FOREST, formerly of the Indianapolis Normal School science department, and of the botany department of the University of Kansas, has been appointed assistant professor of botany at the University of Southern California in Los Angeles.

MISS ELIZABETH EVANS LORD, psychologist for the Chicago Juvenile Court, has been appointed clinical and research assistant in the Yale University Psycho-Clinic.

DR. H. STANLEY ALLEN, of the University of Edinburgh, has been called to the chair of natural philosophy in the United College of St. Andrews University, which became vacant at the end of the last academical year by the retirement of Professor Arthur Butler.

DISCUSSION AND CORRESPONDENCE

RELATIVITY

To the Editor of Science: Like many others, I commonly read whatever, from books to mere notes, by Dr. Edwin E. Slosson, comes to my notice. Generally I am well pleased, but an exception has just occurred. I very much dislike that pleasantly written article on Relativity in the *Scientific Monthly* for November, 1922. I dislike it because, giving the words used the only meanings recognized by layman and scientist alike, save a few specialists, several of the assertions are sheer nonsense. Certainly no system of equations, however clever, can prove to one of common sense, the existence of a real fourth dimension; that time and space are not wholly independent; that just because we and the Martians may be unable to synchronize our clocks there is no 'now"; that time is "curved"; that a phenomenon may be seen before it happens; that the mere inclusion of gravitation in a more comprehensive expression eliminates it from nature; and so forth, and so on, through a long list of absurdities—absurd, that is, if their customary meanings be given to the words used.

Such expressions catch the attention, because they seem to declare the truth of amazing paradoxes, but they are, after all, mighty poor paradoxes, for their whole secret is nothing but the assigning of strange meanings to familiar words; a sort of cryptic writing. Naturally, all such "crazy" expressions, crazy so long as unexplained, inevitably breed contempt for science and the scientist.

Let us, then, in popularizing the thoughts of specialists, first understand clearly just what those thoughts are, and then put them in the words and circumlocutions of the other fellow. The real relativist is not playing hob with our understanding of nature, however different his descriptions of certain phenomena may seem; but if the language of his average popularizer is to be taken literally, and no hint, as a rule, is given of any other meaning, more topsy-turvy indeed than the Land of Alice is this finite, limitless universe that simultaneously will be, was, and is.

W. J. Humphreys

TINGITIDÆ OR TINGIDÆ

In connection with this subject there are some other points which I think should be mentioned. The Ionic genitive Τίγγιοζ and the Attic genitive -εωζ show without a doubt that the word Τίγγιζ is an ι-stem. In Latin it would be an i-stem, Tingi, and the genitive Tingis.

That there is a Latin word Tinge of which the stem is Tingit does not concern us for Fabricius did not use it. He could easily have done so had he wished. While these words have the same root they have different stems. The International Rules instruct us to add -idæ to the stem of the name of the type genus. They do not expect us to worry about other words based on the same root. Fabricius was a Greek purist and he based his name on the word Τίγγιζ, -ιοζ (Ionic, -εωζ (Attic). In writing this word in Latin he did so correctly using Tingis in the genitive. The stem of the name of the type genus is, therefore, Tingi. The family name correctly should be Tingiidæ.

It is unfortunate that Westwood omitted one i in writing the family name but before the days of the International Commission this was sometimes done. We often write Mantidæ for example based on Mantis, genitive -ιοζ (Ionic), -εωζ (Attic). If we follow the International Rules we must insert the other i and write Tingiidæ. And most of us agree that the rules should be followed.

A. C. Baker

Bureau of Entomology

A CHEMICAL SPELLING MATCH

In Science for October 20, Dr. L. O. Howard comments in rather facetious vein upon a chemical spelling match described in the number for September 29. He mentions his struggles with chemical names during the twenty years he was permanent secretary of the A. A. A. S. and rather approvingly drags in a quotation from Forel, who seemed to think that no true scientist uses long words. Dr. Howard is more specific and applies this to chemistry. He arouses not the resentment but the sympathy of the chemist because of the suspicion that he is envious of a body of knowledge (call it science for short) that has such a precisely descriptive and stable system of nomenclature as chemistry.

The chemist, if diligent, can make at least one new compound every day or so and in his spare moments give it a name. Often it is easier than deciding what to call a new baby. The name he gives will generally stick, because only on rare occasions does some other chemist come along and show that the harness got twisted when the radicals were hitched up. Then all that is needed is to rearrange the component parts of the name or to substitute "ortho" for "para" or "meta."

The name tells what the substance is. Doubt arises when a short and easy name is applied. For the chemist a good name is rather to be chosen than great wealth of description, because it is self-contained. The naturalist must have detailed descriptions, preferably with plates, and is happiest when he can make comparison with "type specimens."

In his spare moments the botanist or zoologist digs around in old books and journals with the hope of resurrecting an old name for some familiar plant or animal. This is called stabilizing the nomenclature. It is done because such and such a congress decided that the race for supremacy and final adoption shall be won, not by a name that has come swiftly down the years and is known by all, but by one that stayed at scratch, hidden in some dusty volume.

Shuffling the cards for a new deal is another delightful diversion. For such names as X........ a........ (Smith) Jones *comb. nov.* special honors are awarded, particularly to Jones. The pity of it is that somebody else may come along and soon the specimen becomes Y........ b........ (Brown) White *comb. noviss.* In this way the nomenclature becomes fixed.

What is queer about a chemical spelling match? To name a compound for which the formula is given, or to do the reverse, is good training for the memory. Can one imagine a botanical or an entomological spelling match? Could "aster" or "grasshopper" be drawn in recognizable detail by the contestants? The optimistic chemist will concede that the respective drawings could with some confidence be labelled "flower" or "bug," but could an expert name the species? Yet the pitifully unscientific chemist who uses long words to cloak his ignorance can at once tell the correct names of two such closely related species as H_2SO_3 and H_2SO_4.

C. E. Waters

Washington, D. C.
October 27, 1922

MUSCINA PASCUORUM MEIGEN IN NEW ENGLAND

This European fly has made its appearance in considerable numbers this year in Massachusetts and Connecticut. The first specimen was collected in Connecticut, August 6, and it is still (November 14) quite common in the vicinity of Boston. The muscid is about three times the size of the house fly, bluish black, with a whitish, pruinose covering. A detailed account is in preparation and any information as to its further distribution will be greatly appreciated.

Charles W. Johnson
Boston Society of Natural History

SCIENTIFIC BOOKS

The Minds and Manners of Wild Animals. By William T. Hornaday, Sc.D., A.M. New York: Charles Scribner's Sons, 1922. Pp. x + 328.

If every man devoted to his affairs, and to the affairs of his city and state, the same measure of intelligence and honest industry that every warm-blooded wild animal devotes to its affairs, the people of this world would abound in good health, prosperity, peace and happiness.

To assume that every wild beast and bird is a sacred creature, peacefully dwelling in an earthly paradise, is a mistake. They have their wisdom and their folly, their joys and their sorrows, their trials and tribulations.

As the alleged lord of creation, it is man's duty to know the wild animals truly as they are, in order to enjoy them to the utmost, to utilize them sensibly and fairly, and to give them a square deal.

With these reflections, the dean of scientific directors of American zoological parks presents his volume on the minds and manners of wild animals. And with the following picture—reproduced here only in part—the curtain falls:

On one side of the heights above the River of

Life stand the men of this little world—the fully developed, the underdone, and the unbaked, in one struggling, seething mass. On the other side, and on a level but one step lower down, stands the vanguard of the long procession of "Lower" Animals, led by the chimpanzee, the orang and the gorilla. The natural bridge that *almost* spans the chasm lacks only the keystone of the arch. . . . .

The great Apes have traveled up the River of Life on the opposite side from Man, but they are only one lap behind him. Let us not deceive ourselves about that. Remember that truth is inexorable in its demands to be heard.

Into this book Dr. Hornaday has put much of his philosophy of life as well as the choicest of his observations on the behavior of wild animals in nature and in captivity. The moral purpose which impelled the writer to expression is the defense of dumb creatures. Our author takes special pains to humble man by dwelling on his shortcomings. The reader is told that, though endowed richly with mind and gifts of expression and therefore capable of noble achievement in service and self-development, man at his worst is the most bestial of animals and more brutal than the so-called brutes.

"The minds and manners of wild animals" will disappoint not a few scientific students of animal behavior because it is not an exact systematic and analytic description of animal experience and action. It will delight almost everyone else by its directness, sincerity and naturalness. For the tens of readers who may get next to nothing from the book because of the "experimentalist bias"—to which the reviewer must plead somewhat guilty—there will be thousands who gain useful knowledge, insight and a more intelligent appreciation of wild animals.

The book should be taken, in the opinion of the reviewer, as a notable contribution to natural history, not as a scientific treatise on comparative psychology. It contains a wealth of amusing, interesting, thrilling and enlightening incidents and personal observations, a somewhat biographical assemblage of reflections and conclusions and a unique thought-provoking collection of brief characterizations of animal intelligence and temperament. Such is the contribution to animal behavior and rights which Dr. Hornaday has made from his almost unexampled wealth of experience as zoologist, hunter and scientific director of zoological gardens. The information presented should be of very considerable practical value to all who have to do with wild animals.

It would be a profitless task to discuss in Science the scientific grounds of dissatisfaction with a book which is primarily an account of personal experiences with wild animals. Conspicuous among them are terminology, definition, canons of judgment, inferences and generalizations. Such matters every scientific reader will note, but will he nevertheless be able, as the layman almost certainly will, to enter into and profit by the author's lifetime of intimate contact with wild animals? Let us hope so.

More to the point than a recital of the content of this volume is the injunction, "Read it and thus enter into the author's knowledge, sympathetic appreciation and insights." Truth is great. The ways of observing it are as varied as human intellect and temperament. It were a pity to lose the value of the naturalistic in our praiseworthy attempts to exalt the experimental study of animal behavior and experience.

Robert M. Yerkes

SPECIAL ARTICLES

PROOF OF THE POWER OF THE WHEAT PLANT TO FIX ATMOSPHERIC NITROGEN

In a series of wheat cultures in solutions, we have recently proved conclusively that wheat plants, even in only six weeks of growth, can fix large quantities of nitrogen from the air. They possess this power whether nitrogen is supplied to the roots or not.

Seventeen years ago, Jamieson[1] made the startling announcement, based on experiments, that all green plants possess the power of fixing atmospheric nitrogen. He supplemented this announcement by another to the effect that

[1] *Report of Agr. Res. Assn.*, Aberdeen, 1905, *et seq.*

special organs exist on the young leaves of plants whose function it is to fix the air nitrogen and he called these organs "albumen generators." This supplement to Jamieson's first announcement and the somewhat loose statement of his proffered evidence on the nitrogen fixation, coupled with the indelible impression of Lawes and Gilbert's and Boussignault's experiments and conclusions, caused the scientific world as a whole to scout or ignore Jamieson's evidence and the earlier contentions of Ville and a few others to the same effect. In 1911, Mameli and Pollacci[2] published a statement of experimental results which were not subject to the criticisms pertinent in Jamieson's case and which proved conclusively that a variety of green plants possess the power of fixing atmospheric nitrogen. Later statements by them[3] only confirmed their earlier assertions. They did not accept Jamieson's supplementary statement relative to the mechanism of the fixation in question.

Even the world of science is so conservative as not to have caused a general acceptance of the contentions of Jamieson and Mameli and Pollacci, despite the fact that Moore and Webster[4] and Moore, Webster and Whitley,[5] as well as Wann,[6] have more recently furnished ample confirmatory evidence with fresh water and marine algæ as material. In order to furnish further evidence for securing an acceptance of this new view of nitrogen fixation which is directly opposed to the old established view and to obtain data for the wheat plant which has not been studied in that regard, the writers have recently carried out an experiment resulting as indicated in the general conclusion introducing this brief note. Wheat plants were grown in "Shive's best" solution of an osmotic pressure of 1.3 atmospheres. These solutions were so constituted as to have approximately the same concentration throughout, regardless of whether or not nitrogen was present. The containers for the solution were quart Mason fruit jars and the usual technique was employed. Five wheat seedlings per jar, and six jars of each kind of solution were employed, thus testing thirty plants with each solution. In the case of the solution containing no nitrogen, twelve jars were employed, six of them being kept in the greenhouse until seeds were formed. All the other plants were grown for a period of six weeks only. It is impossible now to go into the many interesting features of this and other experiments which we are conducting on the important subject of nitrogen fixation. Suffice it to say that in a number of series of wheat plants grown without nitrogen and with varying quantities of nitrate, definite evidence was adduced that all the wheat plants fix nitrogen from the air. Even excluding the nitrogen content of the culture solutions at the end of the experiment, because of some irregular data in the analyses, there is a gain of nitrogen from the air which varies in different series from 13 to 21 per cent. of the total amount of nitrogen found in the plant. With the nitrogen in the solutions taken into account, these values will be much larger.

A series of experiments with barley is now being completed, and promises to yield similar results to those obtained with wheat. Legumes and other plants will now be studied, and many other features of the subject investigated. There can be no question now, however, that the teaching of all our books, and nearly all our teachers on the subject to-day are erroneous and must be changed completely to accord with the facts presented by us, and by the other investigators whom we have cited above. As Moore and Webster have put it, authority has too long held sway over logic and experimental fact. It is high time to let those considerations rule. A full, theoretical and historical discussion of this problem will be given in the detailed account of our experiments.

C. B. Lipman
J. K. Taylor

[2] *Atti dell'Instituto Botainco della R. Universita de Paria*, Vol. 13, p. 351.

[3] *Ibid.*, Vol. 14, p. 159, and Vol. 16, p. 197.

[4] *Proc. Roy. Soc. Lond.*, Series B, Vol. 91, p. 201 (1920).

[5] *Ibid.*, Vol. 92, p. 51 (1921).

[6] *Amer. Jour. Bot.*, Vol. 8, pp. 1-29, January, 1921.

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY

C. S. Brinton, *secretary*

T. J. Bryan, *chairman*

JOINT SYMPOSIUM WITH DIVISION OF BIOLOGICAL CHEMISTRY

Subject: Edible Fats and Oils. Part A—Manufacturing and Technical

David Wesson, *chairman*

Manufacture of edible fats and their compounds: L. M. Tolman.

Refining losses in the manufacture of edible oils: B. H. Thurman. Each step through the refining process will be discussed relative to various vegetable oils, cotton, peanut, soya bean and cocoanut. The action of refining materials in removing undesirable products and impurities is the largest source of shrinkage on most oils. Methods for determining the percentage of impurities, such as lecitro-proteins and coloring matter, will be given, both from laboratory and factory determinations. There are emulsions formed and broken, which are described in detail, giving some experiences of handling them in the factory. One that is not yet handled successfully and causes loss should be interesting to the colloidal chemist. Another step in the process illustrates selective absorption by Fuller's earth and carbon black. Losses due to volatility and solubility are accounted for with averages for different vegetable oils.

Corn oil—its preparation and uses: A. F. Sievers. Corn oil is produced as a by-product in the hominy and cornstarch industries. From eighty to one hundred million pounds are produced annually, of which about 70 per cent. is refined for food purposes. Corn oil is classed as a semi-drying oil but has poor drying qualities and therefore does not enter largely into the manufacture of paints. It is used in the manufacture of soap and in making its greatest progress for practically serving the same purposes as cottonseed and peanut oils. Its physical and chemical properties are similar to cottonseed and soya bean oils. The oil prepared from dry process germs is generally lighter in color and contains less free acid than that made from wet process germs.

Edible fats in the baking industry: Charles A. Glabau. This paper is based on the data obtained in our laboratory which to us is quite interesting especially where the homogenizer has entered in. The paper bears the following subtitles: (1) Introductory; (2) defining the various kinds of bakery products in which edible fats are used; (3) how the fats are introduced and incorporated; (4) why fats are added to bakery products; (5) the results obtained by adding graduated quantities of fat to bread doughs (stereopticon plates); (6) tracing the fat through the dough mass with coal tar derivatives (stereopticon plates); (7) introducing a new method of incorporating fat and mixing the dough; (8) the results obtained by homogenizing fats used in the bakery; (9) the distribution of emulsions through the dough mass; (10) determining the carbon dioxide diffused through doughs containing prepared emulsions and doughs in which the fats are incorporated in the general manner; (11) conclusion.

The action of shortening in the light of the newer theories of surface phenomena: Washington Platt and R. S. Fleming. The following definition of shortening and shortness is used: "Shortening is any fat or fixed oil used as an ingredient in baked products. That material has the greatest shortening power which, when baked in a dough under standard conditions, gives to the product a minimum breaking strength and a minimum crushing strength." A cookie is seen to be essentially a mass of gluten and starch, soaked in a concentrated sugar solution. Shortening is the only material in dough not soluble in water or wetted by it. Shortening brings about its effects by extending throughout this dough or cake in layers which separate the particles of the dough or cake from one another and prevent the formation of a continuous solid mass. When care is taken to prevent change of the specimen on mounting, the fat may be seen microscopically in the dough and cake, extending in films around the starch grains. An investigation was made to determine the cause of the difference between the shortening power of the common fats. Viscosity, surface tension *vs.* air and melting point considered alone are seen to be of minor importance. Plasticity is seen to be a more important factor. The work of Langmuir and of Harkins on phenomena at liquid interfaces is correlated with the differences in shortening power. The close connection between the action of shortenings and of lubricants is emphasized.

Certain physical and chemical requirements of fats in the evaporated milk industry: Harper F. Zoller. The evaporation of milk in a vacuum pan at the temperature and pressure under factory operation necessitates the consideration of factors in connection with the constitution and physical make-up of fats which are uncommon in all other industries in which fats are used. The fat should have an iodine absorption number below 30. It must contain a minimum of fatty acid esters which, when hydrolized, will yield fatty acids possessing unusual flavors or odors (*e. g.*, arachidic, theobromic, erucic, ricinoleic, etc.). Its "ethyl ester value" should be quite high, preferably, in the purified natural fat, above 12. The content of stearin and pulmitin should not be high enough to raise the melting point above 50° C. It should be a fat which is readily purified and should not therefore contain substance such as phytosterol, sitosterol, alkyl amines, etc. Happily enough, cocoanut oil and palm nut oil which are widely used in the margarine industry because of their availability and physical properties come closer to these requirements than do any of the commercial fats save butter fat. Inasmuch as the margarine industry used cocoanut oil it was but natural that the compound milk industry should choose it. From the standpoint of condensation in the vacuum pan in the presence of the milk, a good grade of cocoanut oil works more admirably than does butter fat itself. The same may be said of palm nut oil. The high iodine number of some butter fats, 28-42, renders it subject to slight rancidification (hydrolysis) in the vacuum pan and subsequent sterilization. Partially hydrogenated cotton oil may be used providing its iodine number is kept about 30, so that its melting point will not interfere with the pan process.

The analytical detection of rancidity: ROBERT H. KERR. The analytical tests used for the recognition of rancidity, the chemical and physical differences between rancid and sweet fats, and will give some consideration to the mechanism of rancidity and the changes involved in its development.

Rancidity and a method for its detection: H. C. BASHIOUM and R. J. NOBLE. Rancidity of two types, "A" and "B"—"A due to volatile fatty acids, "B" due to volatile fatty acids and aldehydes. Rancidity "B" detected and comparatively estimated by means of Schiff's Reagent (pararosaniline acetate dissolved in dilute sulfurous acid solution). A 0.5-1.0 per cent. solution of the oil in kerosene or preferably benzene is shaken with an equal volume of the reagent in a separatory funnel, continuously or intermittently for 30 minutes. If the oil be rancid, a violet to blue coloration will appear immediately or within a few minutes in the benzene or kerosene layer. The color developed is proportional, within limits, to the degree of rancidity. The test is very delicate and especially suitable for the detection of "B" in cereal products containing small amounts of oil.

The oil, fat and wax laboratory, Bureau of Chemistry, Department of Agriculture, and its relation to the vegetable oil and fat industry: GEORGE S. JAMIESON and WALTER F. BAUGHMAN. An account of the vegetable oil and fat investigations conducted by this laboratory, discussed under three heads: Olive oil and its substitutes, supply of fats and oils during the war and fundamental investigations. It is almost impossible to get adulterated olive oil past the barriers at our ports. The small amount of adulterated oil on the market is sophisticated in this country by small firms. During the war our imports of fats and oils exceeded our exports. The first complete survey of the fat and oil industry was made. It was not possible to increase production of cottonseed oil, but production and importation of peanut and soya bean oils were greatly increased. Many new possible sources of oil were investigated. The chemical composition of some of the vegetable oils have been determined. A representative number of authentic samples of cottonseed and peanut oils have been analyzed to establish the limits of variations in the chemical and physical characteristics of these two oils. A new method has been developed for determining the amount of neutral oil in crude oils. Work is in progress on the isolation and identification of all constituents of cottonseed oil and their effect on refining.

Colorimetry as applied to the vegetable oil industry: DAVID WESSON. Cottonseed oil has always been sold on color and various means have been devised from time to time for reading and recording color. Modern conditions have called for more accurate instruments than those used in the past, using Levibond Tintometer glasses. The Eastman Kodak colorimeter furnishes an ideal instrument for measuring and recording the color of samples where colorimetric measurements only are desired. Where it is necessary to analyze a color as in research work, the new Keuffel and Esser color analyzer is to be preferred.

A brief note on the examination of the fat from Theobroma grandiflora: W. C. TABOR.

A rapid quantitative method for the determination of arachidic-lignoceric acid mixture in peanut oil: ARTHUR W. THOMAS and CHAI-LAU YU.

The chemical composition of sunflower seed oil: GEORGE S. JAMIESON and WALTER F. BAUGHMAN. Sunflower seed oil is used in various foreign countries as a food oil and in making butter substitutes, soaps, varnishes and enamels. Several million pounds of the seed are produced annually in the United States for poultry feed and the production could be greatly increased. The whole seed contains 27 per cent. to 30 per cent. oil and the kernels which constitute about 53 per cent. of the seed contain approximately 53 per cent. oil. It is a drying oil. S. G. 25/25 is 0.9193; refractive index 20°, 1.4736; iodine number (Hanus), 130.8; saponification number, 188.0; unsaponifiable matter, 1.2 per cent.; saturated acids, 7.1 per cent.; unsaturated acids, 86.6 per cent.; iodine number of unsaturated acids, 147.9. The oil consists of glycerides of the following acids: oleic, 33.4 per cent; linolic, 57.5 per cent.; palmitic, 3.5 per cent.; stearic, 2.9 per cent.; arachidic, 0.6 per cent.; lignoceric, 0.4 per cent.

The chemical composition of soya bean oil: WALTER F. BAUGHMAN and GEORGE S. JAMIESON. The oil was pressed from mammoth yellow variety of soya beans by an expeller. Specific gravity, 25°/25°, .9203; refractive index 20°, 1.4736; iodine number (Hanus), 128.0; saponification value, 189.5; unsaponifiable matter, 0.6 per cent.; saturated acids, 11.5 per cent.; unsaturated acids, 83.5 per cent.; iodine number of unsaturated acids, 148.7. Bromine addition derivatives of unsaturated acids were made and analyzed. The methyl esters of saturated acids were fractionally distilled under diminished pressure and fractions analyzed. Oil was found to consist of glycerides of following acids: linolenic, 2.3 per cent.; linolic, 51.5 per cent.; oleic, 33.4 per cent.; palmitic, 6.8 per cent.; stearic, 4.4 per cent.; arachidic, 0.7 per cent.; lignoceric, 0.1 per cent.

On the use of n-butyl alcohol in the determination of the titer test of fats and oils: H. A. SCHUETTE and J. H. DRAIZE. A study was made of the effect of substituting n-butyl alcohol for glycerol or ethyl alcohol as a saponifying medium in the official methods for determining the solidifying point of the mixed fatty acids, or titer test, of fats and oils. Inasmuch as the melting point, iodine absorption number and titer test of the mixed fatty acids of a series of fats and oils were found to be substantially the same when sodium n-butoxide, glycerol potash or a hydro-alcoholic solution of sodium hydroxide were used as saponifying agents, it is concluded that the former may be substituted for the others without loss of accuracy. A complete and more rapid saponification, without scorching of the resulting soap, is possible.

The fat soluble vitamin: H. C. SHERMAN. This paper constitutes a review of present knowledge of the fat-soluble vitamin with special reference to recent advances and practical applications to some food problems. While the fat-soluble vitamin has been studied mainly by means of experiments upon rats, it is now known to have very important functions in the nutrition of animals generally, including men. It is needed by adults as well as during growth. A food supply containing only enough of the fat-soluble vitamin for growth will not support full vigor. When the food furnishes too little of the fat-soluble vitamin the body is weakened and becomes more sensitive to infection. On the other hand the body is able to store this vitamin in cases in which the food furnishes more than is required for current needs. The vitamin should be reckoned with as an important factor in food values. The supplementary relationship between foods of high fuel value and those of high vitamin value is discussed.

Color vs. vitamin content of fatty foods: LEROY S. PALMER.

Commercial vitamin preparations: WASHINGTON PLATT.

Thoroughness of digestion of different kinds of fats and oils: C. F. LANGWORTHY.

Studies of the vitamin potency of cod liver oils. II. The effect of season on the vitamin potency of cod liver oil—spring oil. ARTHUR D. HOLMES. The present paper is one of a series reporting experiments undertaken to determine the vitamin "A" potency of cod liver oils obtained at different seasons of the year. To obtain oils of known origin the author personally obtained oils of cod livers from cod fish and rendered the oils under laboratory conditions. Attention is being given to other factors which vary during the year, such as physical condition, sexual activity and diet of fish. Tests with early spring oil from emaciated fish show that .00202 grams of oil daily is fully adequate for the vitamin "A" growth requirements of albino rats.

The influence of light on the synthesis of vitamin A in sprouting white and yellow corn: J. S. HUGHES and W. R. HORLACKER. A sample of yellow corn having a high vitamin A content and one of white corn having a low vitamin A content were sprouted both in the light and dark. The vitamin A content of the sprouts not including the grain was tested by the usual feeding test with rats. The sprouts from both the white and yellow corn grown in the light had a high vitamin A content. The sprouts from neither the white or yellow corn grown in the dark contained much of this vitamin. The results indicate that the vitamin A content of the seed has very little influence on the vitamin A content of the sprout, but that the sunlight is an important factor in the synthesis of vitamin A.

Suggestions in technic vitamin work: EDWARD

F. Kohman. We hear much about the destruction of vitamins by the action of heat and oxidation. Vitamin A is said to be especially sensitive to oxidation and vitamin C to both heat and oxidation. But with the exception of a very few instances, the experiments from which such conclusions are derived do not justify an assumption as to whether the destruction noted was really the result of heat or oxidation. No reference has been found in any experiments relating to the effect of heat and oxidation in which the oxygen content of the product or of the cooking water has been taken into account. Practically all fruits contain more or less atmospheric oxygen both in solution and mechanically trapped. To eliminate this a high vacuum is not sufficient unless the container is jarred by rather sharp blows. More important is the oxygen held in solution by the water used for cooking. This can not be removed with less than five minutes boiling, nor is a vacuum effective unless the container is jarred. For temperatures less than boiling, hours are required, and during this time the dissolved oxygen would be more available for oxidation of the vitamin than the oxygen of the air which is in contact with the surface. Air-free water dissolves air very readily and therefore must be kept out of contact with air until used.

The chick as an experimental animal in vitamin studies. II—With respect to the fat-soluble vitamins: A. D. Emmett and Gail Peacock. Continuing the study of comparing the chick with the rat and pigeon the findings relative to the fat-soluble vitamins indicate in the case of the White Leghorn breed that they are fairly suitable for test purposes. In marked contrast with the pigeon, the fat-soluble vitamin requirements of the chicken are very much greater. The most prominent symptoms are weak legs, partial paralysis, enlarged knee joints, dropping wings, weak eyes, accompanied by xerophthalmia which stimulates roup, diminished pigmentation of comb, bill, legs and feet, labored breathing, poor oxidation and loss in weight. In other words, the chick (male or female) needs both the antirachitic and the antiophthalmic fat-soluble vitamins, while the pigeon appears to need relatively little of either. A lack in these requirements is apparently more markedly evidenced in chicks three to four weeks old than in those that are six to nine weeks old. In fact, the onset of the symptoms are so rapid in the younger animals that it is very difficult to bring about a correction of the ailments before death ensues. For practical test purposes our data, which includes some 600 birds, suggest that chicks about seven weeks old are the most suitable. Compared with the rat, the chick has its limitations as a test animal. It occupies more space, consumes more food, has a greater range of variation in rate of growth, being more difficult to handle and bring through the early and critical period of growth.

Milk and ice cream as fatty foods: Jerome Alexander. Since milk contains 88 per cent. of water, the legal 3 per cent. fat means 25 per cent. of the total solids, so that milk is a fatty food. When the casein coagulates it mechanically entraps the fat, thus forming a greasy curd which is hard to digest. Cows' milk has a low protective ratio, *i. e.,* the ratio of casein to lactalbumin, and therefore readily forms greasy curds unsuitable for the human stomach. Increasing the protective ratio by adding any colloidal protector (gelatin, eggs, etc.) prevents this difficulty, and is of especial importance in ice cream, where the fat content is much higher than in milk. The effect of colloidal protection in artificial milks and cheese is still to be worked out.

A new method for the determination of vanillin: H. C. Bashioum and Fred Y. Herron. This method depends upon the properties of the aldehyde group rather than those of the phenolic group as is usually the case. In practice, the solution containing vanillin is saturated with hydrogen sulfide in the presence of hydrochloric acid, whereupon a white precipitate of thiovanillin is produced. The precipitate is filtered off, washed with water and then dissolved in dilute sodium hydroxide solution in which it easily dissolves, producing a yellow color, the intensity of which is proportional, within limits, to the concentration of thiovanillin.

The soda equivalent of sour milk used in baking: Mary P. Wilson and H. A. Webb. Baking soda and sour milk can not be titrated together with any known indicator. A method of preparing alizarine test paper of approximately N/20 strength (one No. 3 quinine capsule of soda in ¼ standard cupful of water), drying and "spotting" with mixtures of the N/20 soda, measured in drops, and ¼ teaspoon of the sour milk under examination, was worked out. When the spot shows no color change, the number of spots made permit calculation of the equivalent amounts of baking soda or baking powder per cup of milk of any degree of acidity.

Charles L. Parsons,
Secretary

SCIENCE

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SCIENCE

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE BOSTON MEETING

PLANS for the Fourth Boston Meeting of the association and associated societies are in a very satisfactory state of progress. The local arrangements are being very efficiently cared for by the local committee, whose chairman is Dr. S. C. Prescott, of the Massachusetts Institute. The secretary of the local committee is Mr. Arthur L. Townsend, also of the Massachusetts Institute. The preliminary announcement for the meeting will be sent, about December 1, to all whose names are on the roll of the association. As has been announced previously, those attending the meeting will have the benefit of special railway rates, a fare and a half for the round trip, on the certificate plan. This privilege is available for almost all of the United States and Canada.

The sessions will be held mainly in the buildings of the Massachusetts Institute of Technology, in Cambridge. These buildings have a floor-space of over fifteen acres. Each society will be able to have its session rooms near the rooms of the other societies, and still under the same roof.

Boston is well provided with good hotels and transportation facilities are very convenient. The announcement will contain the usual list of hotels, prices, etc. Those wishing to make arrangements for rooms before receiving the preliminary announcement should address the local representative of their society, care of the secretary of the local committee. It is better to address the hotel directly, which can be done immediately after receiving the announcement. The association hotel headquarters will be the Somerset Hotel.

Three general sessions are thus far arranged for the fourth Boston meeting. The opening session will be held on the evening of Tuesday, December 26, in Walker Memorial Hall at the Massachusetts Institute. At this session the retiring president of the association, Professor E. H. Moore, of the University of Chicago, will deliver an address on "What is a Number System?" The president of the association, Dr. J. Playfair McMurrich, of the University of Toronto, will preside.

The second general session will be held on the evening of Wednesday, December 27, in Walker Memorial Hall. This session is to be under the joint auspices of the Society of Sigma Xi and the A. A. A. S. The address of the evening will be the Sigma Xi address, this year by President Livingston Farrand, of Cornell University, on "The Nation and its Health."

A general session will be held on Friday afternoon, December 29, in Huntington Hall, Rogers Building, on the old institute site, Boylston Street, Boston. On this occasion the William Thompson Sedgwick Memorial Lecture, under the auspices of the Massachusetts Institute, will be given by Professor Edmund B. Wilson, of Columbia University, on "The Physical Basis of Life."

The following list shows the societies, and the names of their secretaries, that have thus far informed the permanent secretary's office that they are planning to meet with the association at Boston:

Section A (Mathematics), William H. Roever, secretary; Washington University, St. Louis, Mo.

American Mathematical Society, R. G. D. Richardson, secretary; Brown University, Providence, R. I.

Mathematical Association of America, W. D. Cairns, secretary; Oberlin College, Oberlin, Ohio.

Section B (Physics), S. R. Williams, secretary; Oberlin College, Oberlin, Ohio. (Otto Koppius, of Oberlin College, will act as secretary for the Boston meeting, in Dr. Williams' absence in California).

American Physical Society, Dayton C. Miller, secretary; Case School of Applied Science, Cleveland, Ohio.

American Meteorological Society, Charles F. Brooks, secretary; Clark University, Worcester, Mass.

Section C (Chemistry), W. D. Harkins, acting secretary for the Boston meeting; University of Chicago, Chicago, Ill.

Section D (Astronomy), F. R. Moulton, secretary; University of Chicago, Chicago, Ill.

American Astronomical Society, Joel Stebbins, secretary; Washburn Observatory, Madison, Wis.

Section E (Geology and Geography), E. S. Moore, secretary; University of Toronto, Toronto, Canada.

Section F (Zoological Sciences), H. W. Rand, secretary; Harvard University, Cambridge, Mass.

American Society of Zoologists, W. C. Allee, secretary; University of Chicago, Chicago, Ill.

Entomological Society of America, C. L. Metcalf, secretary; University of Illinois, Urbana, Ill.

American Association of Economic Entomologists, Albert F. Burgess, secretary; Melrose Highlands, Mass.

Section G (Botany), Robert B. Wylie, secretary; State University of Iowa, Iowa City, Iowa.

Botanical Society of America, I. F. Lewis, secretary; University of Virginia, University, Va.

American Phytopathological Society, G. R. Lyman, secretary; Bureau of Plant Industry, Washington, D. C.

American Fern Society, Stewart H. Burnham, secretary; College of Agriculture, Ithaca, N. Y.

Sullivant Moss Society, Edward B. Chamberlain, secretary; 18 West Eighty-ninth Street, New York, N. Y.

Section F, G (Zoology and Botany).

American Society of Naturalists, A. Franklin Shull, secretary; University of Michigan, Ann Arbor, Mich.

Ecological Society of America, A. O. Weese, secretary; 1321 W. Wood Street, Decatur, Ill.

American Microscopical Society, Paul S. Welch, secretary; University of Michigan, Ann Arbor, Mich.

American Nature-Study Society, Anna Botsford Comstock, secretary; 123 Roberts Place, Ithaca, N. Y.

Section H (Anthropology), E. A. Hooton, secretary; Peabody Museum, Cambridge, Mass.

American Anthropological Association, A. V. Kidder, secretary; 215 Main Street, Andover, Mass.

Section I (Psychology), Frank N. Freeman, sec-

retary; University of Chicago, Chicago, Ill.
American Psychological Association, Edwin G. Boring, secretary; Clark University, Worcester, Mass.
Section K (Social and Economic Sciences), Frederick L. Hoffman, secretary, Babson Institute, Wellesley Hills, Mass.
American Metric Association, Howard Richards, secretary; 156 Fifth Avenue, New York, N. Y.
Section L (Historical and Philological Sciences), Frederick E. Brasch, secretary; 6963 Morton Place, Rogers Park, Chicago, Ill.
Section M (Engineering), L. W. Wallace, secretary; 719 Fifteenth Street, N. W., Washington, D. C.
Section N (Medical Sciences), A. J. Goldfarb, secretary; College of the City of New York, New York, N. Y.
Section O (Agriculture), P. E. Brown, secretary; Iowa State College, Ames, Iowa.
American Society of Agronomy, P. E. Brown, secretary; Iowa State College, Ames, Iowa.
Society of American Foresters, W. N. Sparhawk, secretary; Forest Service, Washington, D. C.
American Society for Horticultural Science, C. P. Close, secretary; College Park, Md.
Society for Promotion of Agricultural Science, J. G. Lipman, secretary; New Brunswick, N. J.
Section Q (Education), A. S. Barr, secretary; 1924 Hazelwood, Detroit, Mich.
Societies not specially related to any particular section:
The Society of Sigma Xi, Edward Ellery, secretary; Union College, Schenectady, N. Y.
Gamma Alpha Graduate Scientific Fraternity, A. H. Wright, secretary; 113 E. Upland Road, Ithaca, N. Y.
Phi Kappa Phi, L. H. Pammel, secretary; Ames, Iowa.

Burton E. Livingston,
Permanent Secretary

AUTUMN MEETING OF THE EXECUTIVE COMMITTEE

The meeting was called to order on October 21 at 2:10, in the office of Science Press, New York City, with the following members present: J. McKeen Cattell, H. L. Fairchild, W. J. Humphreys, Burton E. Livingston, Herbert Osborn, Henry B. Ward. Dr. Fairchild was elected chairman for the session. The following are the main items of business transacted:

1. The minutes of the last meeting of the committee having been already approved by mail, the permanent secretary read the minutes of the proceedings by mail and telegraph, in the interim since the last meeting, which were approved.

2. The permanent secretary's annual report on the affairs of the association was read and discussed and it was accepted. The principal features of this report are subjoined.

3. The permanent secretary's financial report was accepted and ordered to be audited.

4. A letter from the general secretary was read, mentioning that preparations are in progress for a program on the "Origin of Ideas," for the Boston meeting, under the leadership of Dr. James Harvey Robinson, and that preparations are well advanced for a joint meeting of Section C (Chemistry) with the Physiological Section of the Botanical Society of America, with a program on "Photosynthesis and the Light Relations of Plants."

5. The treasurer was authorized to exchange the association's holdings in U. S. Victory 4¾ per cent. notes, which are to be retired, for 4¼ per cent. U. S. Treasury bonds (1947-1952) of equal face values.

6. The chairman of the Committee on Convocation Week (Dr. J. McKeen Cattell) presented an informal report, which was accepted. This report will appear in Science.

7. Fifty-seven members were elected to fellowship in the association, on regular nominations approved by their respective section secretaries. The newly elected fellows are distributed among the sections as follows: F, 40; I, 15; L, 1; K, 1. (It is highly desirable that all members who are eligible to fellowship in the association should be elected. Nominations are made by any member on special nomination blanks secured from the permanent secretary's office or from any section secretary.)

8. Certain editorial features of the journal Science were discussed. It was voted that the present practice be continued of publishing in full the retiring presidential and vice-presidential addresses given at the annual meeting.

9. Several communications from the secretary *pro tem.* of the executive committee for the proposed federation of American biological societies were read and a resolution was adopted stating that the American Association for the Advancement of Science approves the general aims and purposes of the proposed federation, and wishes to cooperate with the federation in all possible ways.

10. A communication recommending action by the association, on the subject of proposed changes in the copyright laws of the United States, was received from Dr. M. L. Raney, librarian of the Johns Hopkins University. The questions thus raised were referred to a special committee, consisting of: Dr. C. L. Andrews, *chairman* (librarian of the John Crerar Library, Chicago); Dr. W. W. Bishop (librarian of the University of Michigan); and Dr. John M. Coulter (head of the department of botany, the University of Chicago), and this committee was requested to make recommendations to the council at the Boston meeting.

11. A communication from Dr. Charles B. Lipman (University of California), writing for the Board of Research of the University of California, and one from Dr. C. A. Kofoid (also of the University of California) were read, regarding the great present need for the preparation and publication of an up-to-date list of serial publications in science, with annotations. The executive committee expressed its approval of these communications but was obliged to defer definite action on this subject till some way may be found by which the association may be able to aid this important project.

12. A communication was received from Dr. Henry B. Ward (of the University of Illinois), recommending that the association adopt a general resolution strongly favoring the scrupulous and complete preservation of the national parks of the United States and Canada, against any form of desecration by any commercial interest. Such a resolution was adopted; its text will appear later in SCIENCE.

13. The permanent secretary was authorized to conduct an intensive membership campaign in the states of New England and New York, just preceding the next annual meeting, this campaign to be based on a special request addressed to every member resident in the specified region, asking him to secure two or more new members for the association.

14. It was unanimously voted that the permanent secretary be instructed to cable and write to Sir Ernest Rutherford, president of the British Association for the Advancement of Science, inviting him to attend the fourth Boston meeting and to deliver an address, probably on Thursday evening, December 28, with the understanding that the association would meet his expenses.

15. The committee adjourned at 6:30, to meet at Boston, at 10 A.M., December 26. The evening was spent in an informal discussion of the affairs and prospects of the association.

BURTON E. LIVINGSTON,
Permanent Secretary

ANNUAL REPORT OF THE PERMANENT SECRETARY

Publications. About 6,200 copies of the "Booklet of Information" have been sent to prospective members. About 6,500 copies of a four-page leaflet have been sent to the medical men of New England, inviting them to become members of the association. At the end of September a calendar card, emphasizing the association year (October 1 to September 30) was sent to each member with the statement of his dues. About 11,700 copies were sent out. Along with the calendar card went an explanatory leaflet on membership.

Circularization for new members. During the fiscal year 1922, 23,933 invitations to join the association were sent to members of affiliated societies. The cards show that 1,114 new members have thus far been secured in this way. The invitations sent out in the circularization of non-members listed in "American

[1] A summary of the annual report of the permanent secretary, on the affairs of the association, for the period from October 1, 1921, to September 30, 1922. Presented to the Executive Committee at New York City on October 21, 1922.

Men of Science" numbered 4,370, and 106 new members have been secured from that group. All members of the Society of Sigma Xi have the privilege of joining the American Association for the Advancement of Science without paying the usual entrance fee, but it has thus far been found impossible to send a special invitation to each of these, on account of difficulty in securing the membership lists of all chapters of the society. All members of the society who are not already members of the association are asked to send their names and addresses and the names of their respective chapters, to the permanent secretary's Washington office. He will send them literature that will be of interest. At the close of the fiscal year 1922, about 16,200 special invitations to join the association were sent to members of affiliated societies. About 6,500 of these invitations went to medical men in New England.

Organization. Each section secretary has received a card list of the members enrolled in his section, with a cabinet for holding the cards. These lists are duplicated in the Washington office, and both sets are kept up to date by additions and alterations.

Each section secretary has been asked to secure a mail ballot of his section committee, for at least two nominations for vice-president and chairman of his section, these nominations to be returned to the Washington office, for the use of the council, on a special blank. It will be remembered that the sections nominate, and the council elects, section chairmen and section secretaries. When a section holds a business session, the nominations secured from the section committee are to be acted on by the section as a whole. More than one nomination is to be presented to the council, in order that the latter body may have opportunity for choice. The council needs also to know how the votes stood in the section committee.

A constitution for the proposed federation of American biological societies was adopted at the Woods Hole meeting, August 4, of the *pro tem.* executive committee for the federation, at which meeting Dr. Herbert Osborn very kindly represented the association. The proposed constitution has been submitted to the council of the association, and should be considered at the Boston meeting, when it will be necessary to decide whether the association will become a member of the new federation. The constitution has been published in SCIENCE (Vol. LVI, No. 1448, p. 359, September 29, 1922). The *pro tem.* committee voted that the aim of the federation would be to make use of the organization of the association, avoiding the duplication of organization wherever possible. It is emphasized by the secretary of the *pro tem.* committee that the main activities of the federation are apt to concern publications, not the organization of meetings. The *pro tem.* committee expressed its thanks to the association for the financial help received in connection with the Woods Hole meeting, and requests the association to continue help of this kind during the formative period of the federation. A similar request has been made of the National Research Council. Copies of the proposed constitution for the federation have been sent by the permanent secretary to all members of the section committees of the four biological sections of the American Association for the Advancement of Science, together with letters asking each member to write to his section secretary in regard to the proposed federation and the attitude that should be taken by the association toward it, a carbon copy of each letter being also sent to the permanent secretary's office. A number of replies have been received and the permanent secretary hopes, with the aid of the four section secretaries concerned, to make a report on this matter to the Executive Committee at the first committee session of the Boston meeting. All members of the biological sections are invited to write to the proper section secretary in this connection, sending copies of their letters to the permanent secretary. To be considered in his report, letters should be in the section secretary's hands before December 1.

Divisions, Local Branch and Affiliated Academies. The membership and financial relations, between the association and the divisions, the local branch and the affiliated academies, are shown for the last three years in the following tabulation:

	PACIFIC DIVISION			SOUTHWESTERN DIVISION			STATE COLLEGE BRANCH	AFFILIATED ACADEMIES		
	1920	1921	1922	1920	1921	1922	1922	1920	1921	1922
Total number of members, end of year....	....	1,190	1,278	....	156	176	52	851	1,437	1,488
Number of new members received during year	....	33	61	....	57	34	20	....	182	101
Allowances made during year	$1,784	$1,007	$1,126	$108	$131	$149	$27	$818	$1,141	$1,328

Membership. The increase in membership since September 30, 1920, is summarized in the following tabulation:

	Sept. 30, 1920	Sept. 30, 1921	Sept. 30, 1922
Number of members in good standing..	10,002	10,160	10,566
Total enrollment......	11,442	11,547	11,646

Changes in membership occurring in the fiscal year 1922 are shown below:

	Sept. 30, 1921	Sept. 30, 1922
Total enrollment..................	11,547	11,646
Number of sustaining members	3	3
Number of life members............	346	352
Number of annual members, paid up..............................	9,811	10,211
Total in good standing..........	10,160	10,566
Number of members in arrears for two years............	705	455
Number of members in arrears for one year.................	682	625
Total enrollment..................	11,547	11,646

Gain in membership, October 1, 1921, to September 30, 1922:		
Reinstatements	33	
New members (11 life, 1,209 annual)	1,220	
Total gain..................................		1,253
Loss in membership, October 1, 1921, to September 30, 1922:		
Dropped because of non-payment of dues	705	
Resigned	362	
Died	87	
Total loss		1,154
Net gain, October 1, 1921, to September 30, 1922		94
Transfers from annual to life membership....		4

Special attention may be directed to the marked increase in paid-up membership for the last two years, owing to the very efficient work of the executive assistant and his staff. Paid-up membership for the three years 1920, 1921 and 1922 was 10,002, 10,160 and 10,566. The rate of increase in paid-up membership from 1920 to 1921 was about 50.5 per cent. higher than was the corresponding rate of increase in total membership. From 1921 to 1922 the rate of increase in paid-up membership was about four times as great as was the corresponding total membership rate of increase. It seems that membership in good standing is a much better index of our growth than is total membership, and this feature is very gratifying.

Financial Affairs. The permanent secretary's annual financial report for the fiscal year 1922 will be published in SCIENCE after the annual meeting, at which time a statement regarding the permanent secretary's budget for 1923 will be made.

BURTON E. LIVINGSTON,
Permanent Secretary

REPORT OF THE COMMITTEE ON CONVOCATION WEEK[1]

THE committee on convocation week appointed by the council of the American Association for the Advancement of Science at the Toronto meeting, and consisting of J. McKeen Cattell, Chairman, Herbert S. Jennings, J. Playfair McMurrich, Eliakim Hastings Moore and Edwin Bidwell Wilson, begs to report as follows:

Twenty years ago the first convocation week meeting of our national scientific societies was held in Washington, from December 29, 1902, to January 3, 1903. Prior to that time the American Association for the Advancement of Science with the societies affiliated with it had

[1] This report has been presented to the executive committee and approved. It is printed in advance of the Boston meeting in order that consideration may be given to the recommendations that are made prior to their presentation to the council.

held annual meetings in the summer; the American Society of Naturalists, with an affiliated group of societies in the natural sciences, had met in the Christmas holidays. Others of the national societies had met at various times and places.

The summer meetings of the American Association were found unsatisfactory owing to the difficulty of traveling and the wide dispersion of scientific men at that season. There had been a gradual development in the direction of making the American Association an affiliation of scientific societies responsible for their own programs, and the special programs of the sections of the association were becoming less important. After long discussion, it was consequently decided to transfer the meeting to the Christmas holidays, and to make closer the affiliation with the national scientific societies.

A committee, of which the late Professor Charles S. Minot was chairman and the chairman of the present committee was secretary, proposed and arranged a convocation week meeting of the American Association and other national societies to be held during the week in which New Year's day falls. The plan was to let the meeting follow Christmas day, at a sufficient interval to allow scientific men to spend the first part of the Christmas holidays at home, devoting the second half to the scientific meetings. Extensive correspondence was conducted with universities and colleges and about sixty leading institutions agreed either to let their Christmas holidays include the entire week in which New Year's day falls, or in case that were not possible to give leave of absence to those who wished to attend the meetings.

It was thought that the official recognition of convocation week would lead the authorities of the universities and other institutions to realize that attendance at scientific meetings is a part of the academic duties and privileges of their teachers. Efforts, in part successful, were also made to obtain payment of traveling expenses by the institutions.

A further part of the plan of convocation week was to hold a greater convocation of scientific, and perhaps also of learned, societies once in four years, in alternation in Washington, New York and Chicago. It was proposed that at the intervening two-year periods the association should meet in a large central city, where there would be accommodation for all the societies to meet with it. In the alternate years—the end of the year of odd numbers in the calendar—the meeting would be held in a smaller or more remote city, and in this case it was assumed that many of the scientific societies would prefer to meet singly or in groups, often in smaller university towns. This plan has since been carried out, the four-year convocation meeting, for example, having been held at the end of 1920 in Chicago, with a very large representation of national scientific societies and scientific men. The meeting last year was held in Toronto, a smaller city, where, however, the arrangements were admirable and the attendance large. The meeting this year will be at Boston, where the facilities are ample for a large meeting.

A difficulty has, however, occurred owing to the prescientific arrangement of the calendar, according to which the same day of the week does not coincide with the same day of the month. When New Year's day came early in the week, many institutions resumed their regular work in the middle of that week, and scientific men found it difficult to be absent to attend meetings of scientific societies at the beginning of their work. The present committee was appointed with special reference to this difficulty, but was authorized to report on other problems connected with convocation week.

This year Christmas occurs on Monday and it was not regarded as feasible to postpone the meetings to the following week. The council at Toronto appeared to be nearly equally divided among three alternatives—holding the meeting during Christmas week, extending it over Sunday, or postponing it to New Year's week. It was finally decided to hold the opening session on Tuesday. This has obvious disadvantages—it shortens convocation week by a day; it requires most members of the societies who wish to be present at the opening to leave home on or before Christmas day; it does not allow a day in advance of the meeting for preparatory meetings of councils and committees. When Christmas occurs on Tuesday, as it does next year, the balance of the week is too short for the meetings of the different societies, for it is desirable that to a certain extent they meet successively rather than simultaneously in order to avoid conflicts in the programs.

Our committee has decided to recommend that when New Year's day falls on Thursday, Friday or Saturday, convocation week shall begin on Monday of that week and extend through the week; when it falls on Sunday, convocation week shall begin on Tuesday of Christmas week and shall continue five days; when Christmas day falls on Monday, Tuesday or Wednesday, convocation week shall begin two days later, namely, on Wednesday, Thursday or Friday, the meetings being continued to include, respectively, Tuesday, Wednesday or Thursday of New Year's week.

It is suggested that meetings acceptable to scientific men and to the community might occur on Sunday. Such would be meetings of councils and committees held at headquarter hotels, and perhaps public lectures. Indeed lectures might be given in the churches as is the custom at meetings of the British Association which always includes Sunday in its week of meeting. It may also be suggested that one of the main objects of scientific meetings is to bring scientific men together for acquaintance and conversation, and that Sunday could be utilized for such personal meetings, as also for smaller excursions, for informal dinners and the like.

The situation in which there appears to be most occasion for difference of opinion is when Christmas day falls on Monday or Wednesday. It might in these cases be desirable to meet the day after Christmas, so that in the first case the meeting could be completed in Christmas week and in the second case not extend beyond Wednesday of New Year's week. The committee, however, recommends that the official opening dates be two days after Christmas, though of course any society could place its first meetings on the day after Christmas and the council of the association and other councils and committees must meet on that day.

In addition to the convocation-week meetings during the Christmas holidays, it seems desirable that the association should resume regular summer meetings. The sections need not be fully organized, and it would not be expected that most of the affiliated societies would meet. The four summer meetings that have been held since the establishment of the winter convocations—in Ithaca, Hanover, San Francisco and this year in Salt Lake City—have been enjoyable to those able to be present and useful to the communities, to science and to the association.

The country is large; scientific men are many and have diverse interests. The association should aim to be of service to all in so far as this is possible without sacrifice of other interests. A meeting in summer, smaller and more informal than the winter meetings, more sectional in character, enables the association to visit universities and places not suited to a large winter meeting or impossible when there is only one meeting a year. Excursions and social features may be arranged for a summer meeting, which give it an individual character.

The committee proposes that in addition to migratory convocation-week meetings during the Christmas holidays and meetings in summer, it may be desirable to standardize other times and places for scientific meetings, more especially for meetings of committees, boards and the like. In many such groups, for example, in practically all the committees of the National Research Council, there are men working in different sciences, and the cost and time of travel could be economized if several meetings were held on the same or consecutive days.

We consequently suggest that it would be an advantage to scientific organization and research if committee and similar meetings were called in Washington in the fourth week in April; in New York City in the latter part of Thanksgiving week; in Chicago about the first of February, and in Wood's Hole in August. This would give a convenient distribution both in time and place for such meetings.

The committee does not regard convocation week meetings during the Christmas holidays as necessarily final. There is much to be said for placing convocation week in the scholastic year, so that attendance at the meetings may be regarded both by teachers and administrators as part of the privileges and duties of scientific men. It is doubtful whether students would suffer by the absence of part of their teachers for a week, and it is certain that it would be to their advantage for their teachers to attend scientific meetings. It is further the case that neither midsummer nor midwinter is the best time for traveling or for the holding of meetings. Apart from inconvenience, dysentery in summer and colds in winter are a common sequence. A convocation week in autumn or in spring might be best for scientific men and ultimately in the interest of the institutions with which they are connected.

It is perhaps not necessary for the committee to enter into a discussion of the advantages and disadvantages of large meetings. The inter-relations of the sciences are so fundamental, however, that it is difficult to make separation in time and place of meetings of societies that is not inconvenient to some and perhaps adverse to the development of inter-relations that are important for the advancement of science. It is also the case that a large meeting may impress the magnitude and importance of science on the general public. In addition it may be noted that it is not so difficult either for executive officers or for hosts to arrange for one large meeting as for many small meetings, and there are other extrinsic advantages, such as reduced railway rates.

On the other hand, it is desirable for men whose work is in the same science to meet together intimately, and the social arrangements for a small and isolated group are usually more agreeable than those for a large gathering. The compromise that has been worked out appears to be working with reasonable success, namely, that there be a general convocation-week meeting once in four years in three large scientific centers, Washington, New York and Chicago. In New York and Chicago, at least, there is ample accommodation, so that societies can have headquarters and places of meeting that will give them any desired degree of isolation.

It might also be useful to arrange a twelve year schedule for convocation-week meetings of the second class, say, in Philadelphia, Baltimore, Pittsburgh or Buffalo four years hence; in St. Louis, Cincinnati, Columbus or Cleveland eight years hence; in Boston again, or in another New England city, such as Providence, Worcester or New Haven, twelve years hence. Then it might be convenient to arrange a provisional schedule for minor convocation-week meetings for the alternate years, including those cities mentioned when not selected for the twelve-year rotation and cities such as Montreal, Toronto, Albany, Rochester, Richmond, Louisville, Atlanta, Nashville, New Orleans, Houston, Indianapolis, Detroit, Kansas City, Omaha, Minneapolis, Denver, Salt Lake City, San Francisco, Los Angeles, Portland and Seattle.

The committee consequently recommends that all national scientific societies arrange to meet in Washington at the end of the year 1924, in New York in 1928 and in Chicago in 1932, and arrange their intervening meetings with a view to this program. The council of the American Association, which is primarily composed of representatives of the affiliated societies, will in accordance with its present policy arrange places of meeting that will be convenient for all societies for the intervening even years, namely, 1926, 1930, etc. For the intervening odd years the association will arrange a program for places of meeting to which the affiliated societies will be welcome, but which will, as a rule, be in cities that are smaller and more distant from the center of scientific population. The meeting at the end of 1923 will be in Cincinnati.

In pursuance of these considerations the committee recommends the following resolutions for passage by the council:

Resolved, That the greater convocation-week meetings of the American Association for the Advancement of Science and the affiliated national scientific societies be continued as for the past twenty years at four year periods in succession in Washington, New York and Chicago, and that all national scientific societies be invited and urged to join in these meetings.

Resolved, That a corresponding twelve-year cycle of meetings for the intervening two-year periods be arranged for large cities in succession in the New England, the Central and the Atlantic States, in which it is desirable that the national scientific societies join.

Resolved, That a provisional schedule of meetings in other cities for the odd years be arranged in advance for the convenience of the scientific societies that may find it desirable to meet with the association.

Resolved, That arrangements be made for a summer meeting in 1923.

Resolved, That scientific councils, boards and committees can to advantage hold their meetings in Washington during the fourth week of April, in New York at the end of Thanksgiving week, in Chicago on or about February 1, and in Wood's Hole in August.

Resolved, That Convocation-Week be the week in which New Year's day falls when this is Thursday, Friday or Saturday; that when New Year's day falls on Sunday, it be the preceding week, that when it falls on Monday, Tuesday or Wednesday, it begin two days after Christmas and continue into New Year's week.

J. McKeen Cattell
Chairman

FUNCTIONS OF THE DIVISION OF GEOLOGY AND GEOGRAPHY OF THE NATIONAL RESEARCH COUNCIL[1]

The purpose of this paper is to ask the geologists of the country what ought to be done with the National Research Council. I do not mean to imply that there is any trouble, or any disappointment, or that the right thing is not being done now. But the council is young, very young, and also very plastic, as it should be. It has the possibilities, and the dangers, of an infant.

It may be well to state first certain dangers that do *not* exist. The organization is *not* likely to die, in the sense of ceasing to exist. If it does there will be left a million dollar building bearing the words *National Research Council* carved in marble along with the words *National Academy of Sciences.* In the second place there is no immediate danger of its not having an organization and officers. The income from a few million dollars of permanent endowment is enough to settle the question of continued existence in some form. So, for better or for worse, the National Research Council is here, probably to stay. But what the council will be like in ten years or fifty years from now is what no man knows.

When all foreseeable possibilities have been assembled, they gravitate into two main groups. The council may become, on the one hand, a dispenser of "grants" or, on the other, an agency for promoting research in other ways, mainly by stimulating, organizing or federating the research activity which arises without grants. In either case money is paid out and research comes in, more directly in the former case, indirectly in the latter. One of the questions for the future will be whether research comes higher by direct purchase or by the more roundabout method.

The above statements apply to the council as a whole, but our own interest is in a single division, Geology and Geography, which is one of seven covering Science and Technology. It does not follow that the seven will, or ought to, develop alike. Exactly opposite divisional tendencies are among the possibilities and may even prove desirable.

Before setting forth more fully the option which lies before geologists, it will be well to describe more exactly several of the possible functions of a national council of scientific men. On the approach of war in 1916-17 it suddenly became necessary to find out what was known and who knew it; also what had to be done and who could do it. It was mainly for such purposes that the National Research Council was organized under the Council of National Defense. The details of this war organization were not suited to times of peace, but the central idea held over, namely, that it paid to get scientific men together in groups to take stock of what had been done and what is being done and to advise together concerning the things that remain to be done, especially those which ought to be done soon.

[1] Published in advance to be discussed at a round table of the Geological Society of America at Ann Arbor, December 28. Discussion to be led by David White.

No other purpose can be so basic as this one of taking stock and surveying the field. It is the most essential business of men acting together. As a corporate function it can stand on its own merits with or without other functions. This step is worth while whether another is taken or not. This is the answer to the question—What can we do if we do nothing else? What is worth while if we can do only one thing? It is not yet certain to what extent this function will be realized by the council. If it is not satisfactorily performed, then some future president of the United States may have to send out another call as Lincoln did in 1864 and as Wilson did in 1916, asking scientific men to get together and tell us where we are at in science. The function thus described may hereafter be referred to as that of General Survey. Its inevitable complement is the giving out of information. This double function is the basic duty of the Research Information Service. The figurative term "Clearing House" is often used and is not inappropriate.

A second function is that of coordinating researches and of inspiring and organizing new ones. It is inevitable that any body of men performing the first function described above will be consulted by others who have problems on hand. About the first question a man asks when face to face with a new problem is: What has been done on this question by others? Who else is working on it now? If I am willing to do my share of a task too big for one man, how can I get the other phases taken care of? So the organizing and coordinating of work follows so naturally on the clearing house function that it would be difficult to keep out of it.

A third line of activity is found in financing projects. Not all valuable projects require financing. Much valuable energy needs only organizing and coordinating. The council may be a vital agency with or without the financial function. In the original plan the financial function was nowhere distinctly specified; certainly not regarded as essential.

It will be well to explain here in just what sense the council or any one of its divisions may be said to be paying out money for research. (1) The chairmen of the divisions of Science and Technology and other necessary officers are salaried. (2) Within certain limits, traveling expenses are paid. This applies to officers on duty and to members of divisions and committees in attending certain meetings of their respective bodies; also in some cases to other men invited to participate in conferences on problems and projects. (3) A staff of technical helpers is maintained for the clearing house work of the Research Information Service. (4) When all the expenses of running the organization (not here enumerated) have been paid, there remains a moderate sum to be allotted in small amounts to committees for the actual expenses of research. For the most part such sums are given merely to clear the way for starting projects which are expected to be otherwise supported. The expression "priming the pump" has been used, and describes the intention fairly well.

The great bulk of the money thus far expended under the auspices of the council has been obtained by solicitation by and for the individual division or committee having charge of a project. Generally the donor gives it for a specific purpose. Thus the responsibility for finding the money has been largely on the men whose project was to be supported. It is necessary to make this point clear, lest the impression should prevail that some men are *beneficiaries* of the Research Council in a sense that other men are not. There is no scramble to "get in on the deal," for when the pushers of a certain project have gotten in, they are still in large measure responsible for its support. I say "in large measure"; it is of course true that they enjoy the advantage of having their project stamped with the approval of twenty or more representatives of their own science, picked from the nation, and with the further approval of a body representing all sciences, whose business it is to distinguish the *most worth while* from the merely *desirable.* In addition to this advantage, there is sometimes some actual aid in solicitation by the general officers of the council and a special committee on Funds and Projects.

These are the only ways in which money is dispensed for research. It should be plain from this that the democratic or representative character of the council, designed, as it was, to express the combined judgment of scientific workers, is not in any way impaired by the function of making "grants" or selecting a list of "beneficiaries."

If the council is ever to become a dispenser of funds, the change would no doubt come about through such a growth of confidence in its work that much larger donations would be made with less and less question as to their use. It is not impossible that this will occur, but the indications that point that way do not affect our division and need not be mentioned here.

As the great question before the geologists of our country is the use which they can make of their own division, and as the possibility of raising money is often a part of that question, it will be wise to examine briefly the sources of the support thus far obtained for other purposes. The several scientific divisions differ enormously in the financial support which they have been able to command. Should this difference be regarded as a measure of efficiency or merely as an indication of difference in method? Ought Geology and Geography with equal leadership and diligence to have captured their "share" of the more than half a million dollars donated for Physics and Chemistry, or of the like amount given to Medicine? These questions may not be answered positively, but it will help some if we inquire what relation the donors have borne to the objects of their donations. In other words—What has been the nature of the "appeal" in each case? When we have finished this analysis we may ask whether Geology should be going to its friends with similar appeals.

The largest donations have come from corporations holding large trust funds whose income *must* be distributed. Each one of these corporations specializes more or less in certain fields of science and generally elects to make its donations in fields related to its central interest. Thus the Rockefeller Foundation is known to be interested in Medicine and its contributory sciences. In addition to the five million dollars given by the Carnegie Corporation for endowment and building, well over a million dollars have been pledged for research by various trusts of similar character.

Another large class of donations, aggregating to date a few hundred thousand dollars, have had for their object some improvement of technique of manufacture or other ultimate advantage in production. The donors to such projects generally represent commercial interests in the corresponding fields of industry. The researches subsidized are of fundamental character but their relation to industry or trade is sufficiently patent to afford a strong appeal to producers. Examples of this class are found in the donations for the Critical Tables of Physical and Chemical Constants and in the support of the Crop Protection Fellowships. A slightly different appeal, looking toward preservation rather than production, is found in the support of the Marine Piling Investigation.

A smaller amount must be credited to pure philanthropy or public spirit. In these cases the donor can hope for no return in the way of personal profit, as when a great retail merchant gives the money for a biological fellowship. While less than one hundred thousand dollars given directly to scientific work comes under this classification, it is fair to mention the one hundred and eighty-five thousand dollars contributed by twenty friends to purchase the site for the building.

Lastly, a few thousand dollars have been contributed by states toward cooperative researches, such as reforestation and highway problems. The appeal here is for state aid in what is properly a state function.

With this classification of donors and appeals before us, geologists should be able to run down the list and form some idea whether their science is in position to make effective appeals for money. The list of great trusts is not long and the general field that each one favors is known. Geology is by no means excluded from their interests (recall, *e.g.*, the Carnegie Corporation and the Shaler Memorial Fund) but in no case is it likely that the National Research Council would be asked to handle their donations. If the measure of usefulness of a division is found in the funds it handles, this would be discouraging. If, on the other hand, the division is primarily interested in seeing the science advance, the situation may be quite ideal. Illustrations might be given of projects first fostered by the Division of Geology and Geography and then "turned over" to other agencies.

Is there anything in the field of Geology analogous to the interests which manufacturers have in the improvement of production through study of fundamental principles? Could mining men be asked to get together and finance a study of structural geology or geochemistry? To put down the answers which these questions suggest would take more space than is permitted. The most obvious answers would not encourage such hopes for the immediate future.

Can we appeal to men on the basis of pure public spirit or scientific interest? Certainly Geography does this, if exploration may be called geographic investigation. It is quite true that money thus donated might not generally pass through the hands of the National Research Council, but that is a mere detail so long as the Council inspires the undertaking.

Almost the same may be said of state and federal funds. Little if any of this will appear on the accounts of our division, but it would be surprising and ought to be disappointing if we do not influence the work of official surveys even to the extent of inducing them in some cases to take up definite projects.

The general impression from such a casual analysis might be that our division can not well expect to be asked to administer large donations for geologic research. More largely than any other science, Geology is regarded as a governmental function and no one likes to subscribe to a governmental deficit. An observer from the outside might say that Geology is already pretty well supported. Of course geologists know it is not. But ours is not the only family whose poverty is known better inside than outside.

As for Geology in private employ, largely in mining and drilling, there remains a peculiar assumption of private interest and the value of secrecy. The pooling of interests to support researches in basic problems has not gone so far among mining men as among steel manufacturers, as the Research Council and the Engineering Foundation have good reason to know.

On the other hand the United States Geological Survey and some state surveys, despite all we say when our humor is bad, do provide deliberately for some research in pure science, and the by-product of pure science from both public and private work is large. The nature and amount of such by-products is determined largely by individual interests, as it should be. But it would be all folly to deny that there is much fine enthusiasm resulting in scattered and sometimes fruitless effort; mere lost motion. There are strategic points and timely moves in science as in war. The kind of guidance that comes from cooperation and the fullest possible knowledge of what others are doing ought to be profitable. Can the Research Council supply these elements?

The situation here referred to is exemplified in the work of our committee on Sedimentation. A few years ago it was tacitly assumed that the manner of origin of sedimentary rocks was completely stated in our elementary texts. Then individual workers began to raise questions. Interest appeared at many points and contributions began. When the Research Council was reorganized on a peace basis one of the first demands made on this division was that it organize the study of Sedimentation. The result has been a tripling of the work and, better still, a conscious planning to send workers into the darkest parts of the field. Other sciences have been drawn on for assistance. Men have been newly inspired by finding that their own little studies were highly useful in a big problem. The work may go on a few years more. There is little doubt that, fifty years hence, men will point back to the decade embracing these researches as a time in which the study of sedimentary rocks was raised to a new scientific level.

Now a point to be emphasized is that the Research Council is paying out no money for this research except for occasional conferences. The work is being done by skilfully appropriating the opportunities offered by surveys and universities. It can scarcely be said that men have left other studies for this work. In most cases they have merely been asked to direct their efforts toward a certain point, or to have in mind their bearings on another principle.

Having set forth something of various ways in which the Research Council works, it should scarcely be necessary to guard scientific men against certain misconceptions. There have been such and they have done some harm.

The first of these possible misconceptions is that the council was designed to superintend research workers and see that they did the right thing; perhaps to assign problems to this and that man and to tell others what fields to keep out of. Such a situation is purely imaginary. No doubt some newspaper writers, not knowing the ways of science, did give utterance to such dreams, but they should not have deceived scientific men.

Another assumption, less absurd but just as wrong, is that the council is an "institution" carrying on researches on its own account. It has no laboratories, not even a library, except a few reference books. It hires no investigators. It is merely a *mode of cooperation.* There is something almost fallacious about speaking of the Council as "it"; there is no *it;* nothing but *we.* The council does nothing except what men in groups have always been trying to accomplish. The only valid claim is that men's combined efforts are being spent to better advantage. Geologists *always have* conferred, analyzed their problems, cooperated and looked around for help. The only question before us is whether such activities can be facilitated by a bit of machinery for conference, correspondence, record keeping and administration.

To guard against misunderstanding it should be stated explicitly that it is highly desirable that the Division of Geology and Geography should have funds for its own projects. But the point which needs emphasis just now is that the thing which is to *justify the existence* of the Research Council is something quite different. When the geologists of our country have definitely adopted the National Research Council as a *mode of operation* they should by all means undertake to enlarge its usefulness by financial aid.

Nevin M. Fenneman
National Research Council,
Washington, D. C.

NATIONAL RESEARCH COUNCIL'S MEDICAL FELLOWSHIPS

Early this year the Rockefeller Foundation and the General Education Board jointly pledged to the National Research Council for the administration, through its Division of Medical Sciences, of medical fellowships the total sum of $500,000, payable annually through a period of five years in sums not to exceed $100,000 a year.

A special board for administering these fellowships was selected with the approval of the National Research Council and the two foundations. The board is composed of the following members with the chairman of the Division of Medical Sciences of the Natiional Research Council (at present Dr. F. P. Gay, professor of bacteriology, University of California) as chairman, *ex officio;* David L. Edsall, professor of medicine and dean of the Medical School, Harvard University; Joseph Erlanger, professor of physiology, School of Medicine, Washington University, St. Louis; G. Carl Huber, professor of anatomy and director of the anatomic laboratories, University of Michigan; E. O. Jordan, professor of bacteriology, University of Chicago; W. G. MacCallum, professor of pathology and bacteriology, Johns Hopkins University; Dean D. Lewis, professor of surgery, Rush Medical School, Chicago; Lafayette B. Mendel, professor of physiological chemistry, Yale University; W. W. Palmer, professor of medicine, Columbia University.

This board met for the first time on April 18, 1922, and in this and subsequent meetings outlined certain regulations that should govern their decisions in connection with the appointment of fellows and the method and place of their work. Since that time two additional meetings of the board have been held for the purpose of appointing fellows from the list of applications that have been received. The most essential points decided upon by the board are the following:

(1) The fellowships are designed primarily for research as fundamental to a teaching career in one of the medical sciences. For this latter reason it is prescribed that the fellow must work where facilities for, but not obligations in, teaching are afforded.

(2) The fellowships are for full time and basal salaries of $1,800 for unmarried men and $2,300 for married men have been determined. Salaries in either of these grades may be larger than the minimum, depending upon the number of dependents and the locality chosen by the candidate for work.

(3) The place of work and the subject chosen for investigation are determined by the candidate with due consideration for the feasibility of the plan proposed. It has been decided that the work may be carried out either in this country or abroad.

The first fellows have been appointed and are now at work. In spite of the fact that the funds for these fellowships generously donated by the Rockefeller Foundation and General Education Board were not available and that announcements concerning the fellowships could not be made until relatively late in the year numerous applications have been received and twenty-six candidates have already been accepted.

The fellows so far appointed cover the whole group of the specialities of medicine and are divided as follows:

Pathology and bacteriology	5
Medicine	5
Surgery	6
Physiology	4
Biochemistry	2
Anatomy	1
Medical specialties	1
Pharmacology	1
Physical chemistry	1

The work is now being carried out in various medical centers as follows:

Harvard	7
Columbia	3
Chicago	3
Hopkins	3
Cincinnati	2
Ohio	1
California	1
Iowa	1
Northwestern	1
Cornell	1
Yale	1
Leipzig	1
New York Post Graduate Hospital	1

F. P. GAY,
Chairman, Division of Medical Sciences, National Research Council

LIST OF FELLOWS

The following is a complete list of fellows so far appointed:

Albritton, Errett C., A.B. Missouri, M.D. Johns Hopkins, Mayfield, Ky. Ohio State University; endocrine physiology.

Andrus, William D., A.B., M.A. Oberlin, M.D. Johns Hopkins, Oberlin, Ohio. University of Cincinnati; surgery.

Anson, Barry J., A.B. Wisconsin (has equivalent of Ph.D. degree), Muscatine, Iowa. Harvard Medical School; embryology and histology.

Bent, Michael J., M.D. Meharry, San Andres, Republic of Colombia. College of Physicians and Surgeons, New York City; bacteriology and hygiene.

Cone, William V., B.Sc., M.D. Iowa, Iowa City, Iowa. Iowa State University; neuropathology.

Connor, Charles L., M.D. Baylor College of Medicine, Forsyth, Montana. Harvard Medical School; the etiology of Rocky Mountain fever.

Curtis, George M., A.B., M.A., Ph.D. Michigan, M.D. Rush Medical School, Ann Arbor, Michigan. The University of Chicago; surgery of the hypophysis.

Davis, Loyal E., M.S., M.D. Northwestern, Chicago, Ill. Northwestern University; neuorolgical surgery.

Derick, Clifford L., A.B. Lachute Academy, M.D. McGill, Noyan, Quebec, Canada. Harvard Medical School; medicine.

Ferry, Ronald M., A.B. Harvard, M.D. College of Physicians and Surgeons, Columbia, Concord, Mass. Harvard Medical School; biochemistry.

Josephs, Hugh W., A.B. Harvard, M.D. Johns Hopkins, Baltimore, Md. The University of Chicago; physical chemistry.

Leiter, Louis, B.S., M.S. Chicago, M.D. Rush Medical School, Los Angeles, California. The University of Chicago; pathology.

Lennox, William G., A.B. Colorado College, M.D. Harvard, M.A. Denver, Colorado Springs, Colorado. Harvard Medical School; medicine, especially epilepsy.

MacCready, Paul B., B.S. Princeton, M.D. Johns Hopkins, New York. Johns Hopkins University; laryngology.

McIver, Monroe A., A.B. North Carolina, M.D. Harvard Medical School, Gulf, N. C. Harvard Medical School; pathology.

McLean, Jay, B.S. California, A.M., M.D., M.S. Pennsylvania, Baltimore, Md. The University of Leipzig; surgery.

Mills, Clarence A., A.B. South Dakota, Ph.D. Cincinnati, Cincinnati, Ohio. The University of Cincinnati Medical School; experimental medicine.

Rapport, David, A.B., M.D. Harvard, Cornell Medical College, New York, physiology.

Reznikoff, Paul, B.Sc. New York University, M.D. Cornell Medical College, Brooklyn, N. Y. Harvard Medical School; experimental medicine.

Robinson, Elliott S., A.B., M.D. Yale, New Haven, Conn. Yale School of Medicine; bacteriology and immunology.

Rosenthal, Sanford M., M.D. Vanderbilt Medical School, Nashville, Tenn. Johns Hopkins Medical School; clinical medicine.

Schmitz, Herbert W., B.S. Wisconsin, M.D. Harvard, Manitowoc, Wis. New York Post Graduate Hospital; biochemistry.

Shibley, Gerald S., A.B., M.D. Columbia, Maplewood, N. J. Columbia University; medicine, especially infectious diseases.

Smith, Beverly C., A.B., M.D. Virginia, Franklin, La. Columbia University; toxemia in intestinal obstruction.

Stieglitz, Edward J., B.S. Chicago, M.D. Rush Medical School, Chicago, Ill. Johns Hopkins Hospital; a clinical study of nephritis.

Locke, Charles Edward, Jr., A.B., M.D. California, Special Docteur en Chururgie, Brussels, University of California Hospital, San Francisco. University of California Hospital; neurological surgery.

SCIENTIFIC EVENTS

THE INTERNATIONAL COMMISSION OF EUGENICS

As has been noted in Science, the International Commission of Eugenics met at Brussels on Saturday, October 7, and Monday, October 9. According to the report in *Eugenical News,* there were present Major Leonard Darwin, *chairman;* Dr. Almert Govaerts, *secretary;* Dr. Van Herwerden of Utrecht, Holland; Dr. Winner, Professor of psychiatry, Copenhagen; Dr. Jon Alfred Mjoen of the Winderen Laboratorium, near Christiania; M. Lucien March of "Statistique générale de la France," and Dr. Pinard, President of the Société Française d'Eugénique, Paris; and Dr. C. B. Davenport, of Cold Spring Harbor.

It was voted unanimously to invite German delegates to the commission. It was decided provisionally to hold the next meeting of the commission at Lund, Sweden, and the next meetings of the Eugenics Congress in 1924 at Prague. These decisions are contingent upon the possibility of making appropriate arrangements for the meetings.

The occasion of the meeting of the International Commission of Eugenics at Bruxelles was taken advantage of for a meeting of the Ligue nationale Belge contre le Péril vénérien at the same place, and an extensive social program was arranged.

On October 7, a lecture was given by Dr. Apert, physician of the hospitals of Paris, entitled, "L'Hérédité Morbide." On October 8, in the morning a joint congress of the Ligue contre le Péril vénérien and Fédérations of Anti-Alcoholic Societies of Belgium was held in collaboration with the Belgian Eugenics Society. In the afternoon there was an excursion to Waterloo, where an address was given by M. Gheude, député permanent, entitled, "Les buts Eugéniques de la Ferme-École." This was followed by visits to the battlefield and to the Ferme-école Provinciale, the new home for the feeble-minded which it is hoped will be ready for occupancy in the spring. On Monday, there was held the second meeting of the commission, and, at 4 o'clock, a visit to the Solvay Institute of Sociology where Major Darwin gave an address entitled "L'Eugénique" and Professor Wimmer of Copenhagen one on "Mental Heredity." At 5 o'clock, the Prison de Forêst and its laboratory of anthropology were visited. On Tuesday, addresses were given by Dr. Daisy M. Robinson, by M. Lucien March, of Paris, and Dr. Berthollet, of Lausanne, on matters partly of anti-veneral and partly of eugenical interest. At half past two in the afternoon, a meeting was held in the large hall of the Solvay Institute of Sociology, at which was inaugurated the eugenics room of the institute. Two lectures were given on the practical organizations of eugenics, "in the United States" by Dr. Davenport; "in Belgium" by Dr. Govaerts. On Wednesday a visit was made by the Congress to the city of Antwerp.

THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

The 1922 annual meeting of the federation will be held on Wednesday, Thursday and Friday, December 27, 28 and 29, at Toronto, Canada, under the auspices of the University of Toronto. The program will be sent out about December 14. An effort to secure special railroad rates is being made. In case these are secured members will be notified. The hotel headquarters are the King Edward. About 100 men can be accommodated, in either single rooms or in suites each with two bedrooms, in the men's residences of the university. About 12 women can be accommodated in one of the women's residences. Breakfast for those living in the residences can be obtained at Hart House. The charge for these rooms will be $3.00 for 3 nights, or $2.00 for 2 or 1 night. Luncheons will be provided on the 27, 28, and 29. Dinners will be followed by a smoker on the evenings of the 27 and 28. All these will be given in Hart House, the student's club, near the residences and the medical building.

The Local Committee is anxious to arrange a large series of demonstrations. As the departments of physiology, biochemistry and pharmacology are all in the one building, facilities of all kinds can readily be arranged. All communications in regard to the same should be addressed to Professor J. M. Olmsted, Medical Building, University of Toronto.

The general meetings will be held in the Physics Building of the university. Meetings of the Constituent Societies will be held in the Medical and Anatomy Buildings of the university, which intercommunicate. The lecture rooms are not distant from each other and it is hoped to have a notice board system, so that the papers to be read in each section will be posted in each other section. Professor Andrew Hunter is chairman and Professor V. E. Henderson is secretary of the local committee.

THE AMERICAN PHYSICAL SOCIETY

The 24th annual meeting (the 118th regular meeting) of the American Physical Society will be held in Boston on December 26-30, 1922, in affiliation with Section B—Physics—of the American Association for the Advancement of Science. The meetings will be held at the Massachusetts Institute of Technology.

At the session in charge of Section B, Professor G. W. Stewart, the retiring vice-president and chairman of Section B, will give the annual address. This will be followed by a symposium on "Ionization Potentials and Atomic Radiation," and the invited speakers are to be Dr. Paul D. Foote, of the Bureau of Standards, and Professors K. T. Compton and Henry Norris Russell, of Princeton.

Members wishing to present papers at the Boston meeting are requested to send abstracts ready for publication to the secretary before December 9. The secretary expects to send the program to all members before the meeting, but the delays in the mails are so great at present that members should not depend upon the program to determine their attendance.

Other meetings for the current season are as follows:

119. February 27, 1923. New York.
120. April 21, 1923. Washington.
121. Time not determined. Pacific Coast Section.

Dayton C. Miller
Secretary

Case School of Applied Science,
Cleveland, Ohio

THE MATHEMATICAL ASSOCIATION OF AMERICA

The seventh annual meeting of the Mathematical Association of America will be held at Room 11, Sever Hall, Harvard University, December 28-29, 1922, in conjunction with the American Mathematical Society and Section A of the American Association. At a joint session of these three bodies the following papers will be read:

Reduction of singularities of plane curves by birational transformation: Professor G. A. Bliss, University of Chicago, retiring president of the society.

The grafting of the theory of limits on the calculus of Leibniz: Professor Florian Cajori, University of California, representing the association.

Geometry and physics: Professor Oswald Veblen, Princeton University, retiring vice-president of Section A of the American Association.

At the Friday morning session the following papers will be given:

Period of the bifilar pendulum for finite amplitudes: Professor H. S. Uhler, Yale University.

Skew squares: Professor W. H. Echols, University of Virginia.

On the averaging of grades: Professor C. F. Gummer, Queen's University.

Mathematics at Oxford and the Ph.D. degree: Professor W. R. Burwell, Brown University.

Some unsolved problems in the theory of sampling: Professor B. H. Camp, Wesleyan University.

Some unsolved problems in solid geometry: Professor J. L. Coolidge, Harvard University.

It is of special note that the session on Friday afternoon will be devoted to a "Symposium on Mathematical Statistics," for the purpose of strengthening the existing entente cordiale between mathematicians on the one hand and practicing statisticians on the other. It is hoped that this symposium will be of real service, not only to those who are giving courses in statistics in departments of mathematics, but also to others who may be interested in the application of mathematics to statistical problems. The following papers will be read:

The subject matter of a course in mathematical statistics: Professor H. L. Rietz, head of the department of mathematics at the State University of Iowa, and chairman of the National Research Council's Committee on the Mathematical Analysis of Statistics.

Time series of economic statistics: their fluctuation and correlation: Warren M. Persons, professor of economics at Harvard University, and editor of the *Review of Economic Statistics*, published by the Harvard Committee on Economic Research.

The fundamental concepts of the calculus of mass variation: Arne Fisher, statistician of the American Telephone and Telegraph Company, and author of "The mathematical theory of probabilities and its application to frequency curves and statistical methods." The discussion will be opened by Raymond Pearl, professor of biometry and vital statistics in the School of Hygiene and Public Health, Johns Hopkins University, and statistician of the Johns Hopkins Hospital.

CHEMISTRY AT THE BOSTON MEETING OF THE AMERICAN ASSOCIATION

The Boston meeting of the American Association for the Advancement of Science will undoubtedly be the most important to chemists of any of its meetings held for years. Papers on research work completed or in progress are now invited from the chemists of the country. In addition to such papers as may be submitted there will be a symposium on "The Progress of Chemistry," and a second symposium on "Photochemistry and Plant Physiology," in which the leading chemists of the country will discuss these subjects. In addition the American Physical Society will continue the series of symposia begun last year jointly with the Mathematica and Chemical Societies. The subject will be "Ionization Potentials and Atomic Radiation," and the speakers will be Paul D. Foote, K. T. Compton and Henry Norris Russell.

The following list gives the papers already arranged for in connection with the symposium on the progress of chemistry: "Compressibilities and the size of atoms," by Theodore W. Richards, of Harvard University; "Proteins and the theory of colloidal behavior," Jacques Loeb, of the Rockefeller Institute; "X-rays as related to the structure of atoms and of crystals," William Duane and also George L. Clark, both of Harvard University; "Changes in volume during the solution of solids," Gregory P. Baxter, of Harvard University; "The chemistry of the photographic process," C. E. K. Mees, of the Eastman Kodak Company; "The present status of the theory of complete ionization," D. A. MacInnes, of the Massachusetts Institute of Technology; "The present status of the theory of incomplete ionizaion," James Kendall, of Columbia University; "Ionization potentials and chemical action," W. A. Noyes, Jr., and "The separation of isotopes," by R. S. Mulliken, both of the University of Chicago. In addition a number of other topics, not yet fully decided upon, will be discussed by noted chemists.

At the symposium on photochemistry and plant physiology to be held Thursday, December 28, at 2 p. m., H. A. Spoehr, of the Desert Laboratory, will discuss "Photosynthesis," S. E. Sheppard will speak on "Photochemical reactions," and a third speaker will present the subject "Carbohydrate metabolism."

The address of the retiring vice-president and chairman of Section C will be upon the subject "The nuclei of atoms and the general system of isotopes."

It is expected that one or two of the sessions will be provided with a program by nearby sections of the American Chemical Society as follows: the Northeastern, the New York, the Eastern New York, the Cornell, the New Haven, the Philadelphia, the Washington, and the Delaware sections.

Speakers have been invited to present papers on atomic structure, the electron theory of valence, the nature of metals, the work of various great laboratories, and various other topics of interest to professional chemists. It should be noted that no specific invitations have been sent out for papers on the research work of individuals, but it is hoped that the chemists of the United States and Canada will respond in considerable numbers to the general invitation given in the present notice. The titles of such papers should be sent as soon as possible either to the retiring chairman, Professor W. D. Harkins, of the University of Chicago, to the secretary of the Northeastern Section of the American Chemical Society, Professor E. B. Millard, of the Massachusetts Institute of Technology, Cambridge, Mass., or to the vice-president and chairman, Professor W. Lash Miller, of the University of Toronto.

SCIENTIFIC NOTES AND NEWS

At the anniversary meeting of the Royal Society on November 30, its awards are to be conferred as follows: Royal medal to Professor C. T. R. Wilson, for his researches on condensation nuclei and atmospheric electricity, and to Professor J. Barcroft, for his researches in physiology, especially in respiration; the Copley medal to Sir Ernest Rutherford, for his researches in radioactivity and atomic structure; the Rumford medal to Professor Pieter Zeeman, for his researches in optics; the Davy medal to Professor J. F. Thorpe, for his researches in synthetic organic chemistry; the Darwin medal to Professor R. C. Punnett, for his researches in the science of genetics; the Buchanan medal to Sir David Bruce, for his researches and discoveries in tropical medicine; the Sylvester medal to Professor T. Levi-Civita, for his researches in geometry and mechanics; and the Hughes medal to Dr. F. W. Aston, for his discovery of isotopes by the method of positive rays.

At the formal opening of the University of Paris, honorary degrees of doctor of laws were received by Ambassador Herrick on behalf of Elihu Root, Esq., Dr. A. Lawrence Lowell, president of Harvard University, and Professor Albert A. Michelson, of the University of Chicago.

Dr. M. C. Whitaker, chemical engineer of New York City, has been awarded the Perkin medal "for the most important contribution to applied chemistry made by any citizen of the United States," by the Society of Chemical Industry. The presentation will be made by Dr. Charles F. Chandler.

At the meeting of the Ophthalmic Section of the American Medical Association, Dr. Frederick H. Verhoeff, of Boston, was awarded the Knapp Medal for his paper on "Ghoinas of the Optic Nerve." Dr. Verhoeff is president of the New England Ophthalmological Society.

The British Institution of Mining Engineers has awarded its medal to Sir George Beilby, "in recognition of his valuable contributions to science, with special reference to his researches on fuel."

Mr. R. T. A. Innes, the union astronomer at Johannesburg, has received the degree of doctor of science from the University of Leyden.

Dr. Adolph Loewy, professor of physiology at the University of Berlin, has been appointed director of an institute at Davos, Switzerland, for research on the physiologic effects of residence in high altitudes as pertaining to the treatment of tuberculosis.

The November number of the *Journal of Geology* at the University of Chicago will bear the names of father and son as editor and managing editor, the former being Thomas C. Chamberlin, professor emeritus of geology, and the latter Rollin T. Chamberlin, associate professor of geology. From the founding of the journal twenty-nine years ago T. C. Chamberlin and the late R. D. Salisbury were the editors. The other editors are Stuart Weller, invertebrate paleontology; Edson S. Bastin, economic geology; Albert Johannsen, petrology; and J. Harlen Bretz, stratigraphic geology. Associate editors include representatives of Great Britain, France, Germany, Norway, Sweden, Australia, and Canada.

Dr. Wilfred H. Osgood, curator of zoology of the Field Museum of Natural History, and party, including Mr. H. B. Conover and Mr. C. C. Sanborn, of the Field Museum, sailed on November 16 for Valparaiso, Chile. They will proceed to the forested region of southern Chile about Corcovado Gulf and, after making general collections there, will work northward. Dr. Osgood and Mr. Conover will return via Argentine, Uruguay and southern Brazil about the middle of 1923 and Mr. Sanborn will remain in the field until 1924.

We learn from the *Journal* of the American Medical Association that the U. S. Public Health Service has begun a study of the methods used in the United States in the manufacture of biologic products. Passed Assistant Surgeon W. T. Harrison has started a tour of the country to investigate this subject, going to Toronto, Canada; Boston; New York, Otisville and Pearl River, N. Y.; New Brunswick, N. J.; Philadelphia, Swiftwater, Glenolden, Ambler and Mariette, Pa.; Asheville, N. C.; Buffalo, and Baltimore.

Dr. Samuel J. Morris, professor of anatomy at the West Virginia University School of Medicine, has obtained a year's leave of absence to study anatomy at the Harvard Medical School.

Dr. Aleš Hrdlička has returned from an extended trip to Western and Central Europe made for the purpose of visiting the more important recently discovered sites of early man, and of examining the skeletal remains. As the result of a special invitation by the minister of education of the Czechoslovak Republic, he delivered also a series of lectures on "Anthropology and man's evolution" at the Universities of Prague, Brno (Brün) and Bratislava (Pressburg), and at the People's University of Plzeň (Pilsen).

Professor F. Krause, of the University of Berlin, is now in Mexico City giving a course of lectures on nerve surgery.

Professor D. Pahle, of the University of Frankfort, Germany, arrived in Chicago on November 18. Under the auspices of the American Society for the Control of Cancer, he will give a series of demonstrations of the deep-therapy roentgen-ray machine at the Norwegian-American Hospital.

Professor George C. Whipple, of the department of sanitary engineering of Harvard University, will give a series of lectures on "The philosophy of sanitation" at the Wagner Free Institute of Science in Philadelphia on Saturday evenings in January.

The educational committee of the Bureau of Standards has arranged with Professor A. Sommerfeld for a course of lectures on "Quantum Theory" and related subjects. These lectures will be given at the Bureau of Standards, Washington, D. C., early in March, 1923.

Professor A. J. Carlson, as the guest of the University of Nebraska Medical College on November 17, delivered two addresses, one before the student body and the other before the faculty.

The Harben lectures before the Royal Institute of Public Health will be delivered by Professor Theodore Madsen, M. D., director of the State Serum Institute, Copenhagen, on December 1, 4 and 5. The subjects of the lectures are: "Specific and unspecific antitoxin production," "Antitoxic treatment," and "The influence of temperature on antigren and antibodies."

Lord Balfour has arranged to deliver his second course of Gifford lectures on natural theology at Glasgow University. The first will be given on Friday, November 24, the series being continued on November 28 and December 1, 5, 8, 12, and 15 and 19, and January 16 and 19. The lectures, which are open to the public, were begun during the session before the war.

At Lake Forest College there has recently been reorganized a Science Club, which has been dormant since the departure of Dr. James G. Needham in 1901. The departments of chemistry, biology and psychology are sponsors for the club and supervise the bi-weekly programs, the purpose of which is to stimulate interest in the general problems of the three fields. All persons in the vicinity interested in science are invited to attend. The following are the topics and leaders for the first three meetings: "Hypnotism," by Dr. W. R. Wells; "The tropism theory as a basis for the interpretation of human behavior," by Dr. W. H. Cole, and "The constitution of matter," by Dr. F. B. Coffin.

The three concluding addresses in the series of illustrated evening lectures given this autumn by the Carnegie Institution of Washington, are as follows: November 28, "The constitution of the hereditary material and its relation to development," Dr. T. H. Morgan, research associate in biology of the Carni, and professor of experimental zoology at Columbia University; December 5, "The properties of matter as illustrated in the stars," Dr. Henry Norris Russell, research associate of the Mount Wilson Observatory and director of the Princeton University Observatory; December 12, "The motions of the stars," Dr. Walter S. Adams, acting director of the Mount Wilson Observatory.

An Exhibition of Scientific Apparatus and Products will be an important feature of the approaching Boston meeting of the American Association for the Advancement of Science, to be held in the building of the Massachusetts Institute of Technology, in Cambridge, December 26 to 30, 1922. Those desiring to take part by exhibiting apparatus, materials, etc., should communicate at once with Professor R. P. Bigelow, Massachusetts Institute of Technology, Cambridge, Massachusetts. Professor Bigelow is chairman of the subcommittee on exhibits for the Fourth Boston Meeting.

Application has been made for reduced railroad fares, on the certificate plan, for persons attending the annual meetings of the Geological Society of America, the Paleontological Society, the Mineralogical Society of America, the Society of Economic Geologists, the Association of American Geographers and the American Association of State Geologists, in Ann Arbor, Michigan, December 26-31, 1922. When purchasing tickets at the regular one-way fare, certificates of the standard form should be obtained from the railroad ticket agent. The granting of return tickets at one half the regular fare is conditional upon there being 250 persons in attendance upon the meetings who hold certificates showing that they have paid 67 cents or more on the going trip.

For the purpose of commemorating the services of William Thompson Sedgwick to the cause of biology and public health, there has been established a memorial lectureship in the department of the Institute of Technology which he created. The desire of the founders is that the Sedgwick Memorial Lectures shall be given from year to year by men of distinguished eminence in any one of the subjects comprehended within the general scope of biology and public health in order that it may fittingly express the deep and broad sympathy of the man whom the lectureship is designed to honor. The committee in charge of the lectureship consists of Samuel C. Prescott, Massachusetts Institute of Technology; Edwin

O. Jordan, University of Chicago; George C. Whipple, Harvard University; Gary N. Calkins, Columbia University, and Charles-E. A. Winslow, Yale University. The first William Thompson Sedgwick Memorial Lecture will be given in Huntington Hall, 491 Boylston Street, Boston, on Friday, December 29, at five o'clock, by Dr. Edmund Beecher Wilson, Da Costa professor of zoology at Columbia University, on "The physical basis of life." The lecture will form part of the program of the meeting of the American Association for the Advancement of Science, the American Society of Naturalists and other societies during convocation week.

It is announced from Stockholm that since it has been decided not to award the Nobel Prize for Medicnie for 1921, the prize will be added to the Special Medical Fund. The 1922 prize is reserved for next year.

The Méthane Association, organized in 1916 with the object of advancing industrial chemistry in Poland, has been reorganized as an Institute of Research, and Professor Moscicki has been appointed director. The government of Poland has made a grant of land in the neighborhood of Warsaw, where buildings for the institute will be erected.

William Eastman Standow, a graduate of the University of Denver and a graduate student at Columbia University, was killed by an explosion in the chemical laboratory on November 17, through the explosion of a chamber containing aniline hydrochloride.

Professor Jeremiah George Mosier, for twenty years in charge of the work in soil physics at the University of Illinois, died on November 10, 1922, at the age of sixty years. A correspondent writes: Professor Mosier graduated from the University of Illinois in 1893. He then became an assistant in geology in the same institution, in which position he served for three years. After a period spent in high-school teaching he reentered the service of his university in 1902 to take up the work in soil physics, a subject which at that time was largely undeveloped. Professor Mosier was an unusually inspiring teacher and he has won the love and respect of the hundreds of students who have come under his instruction. In his field of investigation his interest was broad; but some of the problems which engaged his especial attention were the prevention of soil washing on hilly land, the effect of cultivation, climatological observations, and the soil survey of Illinois, upon all of which topics he made notable published contributions. Professor Mosier's chief interest lay, perhaps, in the soil survey of Illinois, he having been in direct charge of the mapping since the beginning of the survey. Under his direction about four fifths of the state have been mapped. Through his long experience in this connection, he acquired an expert knowledge of soil types that made of him a widely recognized authority in soil classification.

UNIVERSITY AND EDUCATIONAL NOTES

The $1,600,000 financial development project for Dickinson College and Pennington Seminary has been brought to a successful conclusion. Of this amount, Dickinson, it is reported, will receive $1,250,000 and Pennington $350,000. The money will be used for buildings, betterment, liquidation and endowment.

Ground has been broken for the new laboratory of the department of hygiene and bacteriology of the University of Chicago, which when completed will be devoted to bacteriologic and chemical research. It will be erected at a cost of $50,000.

Under the will of the late Sir William Dunn a further sum of £45,000 now accrues to the School of Biochemistry of the University of Cambridge, making a total gift for the purpose of the school of £210,000.

Paul Martyn Lincoln, of Cleveland, Ohio, has been elected professor of electrical engineering and director of the School of Electrical Engineering in Cornell University. Professor Lincoln, who is a practicing engineer, was professor of electrical engineering at the University of Pittsburgh from 1911 to 1915. He was president of the American Institute of Electrical Engineers in 1914.

Charles Harlan Abbott, Ph. D. has resigned his position at the Massachusetts Agricultural College to accept the professorship of zoology at the University of Redlands, California.

DR. J. R. CURRIE, a senior medical officer of the Scottish Board of Health, has been appointed to the chair of preventive medicine in Queen's University, Kingston, Ontario.

DR. H. STANLEY ALLEN, of the University of Edinburgh, has been appointed to the chair of natural philosophy in the United College, St. Andrews, which has become vacant by the retirement of Professor Butler.

DISCUSSION AND CORRESPONDENCE

FINANCIAL SUPPORT OF TECHNICAL JOURNALS

IT is a not uncommon practice for members of the faculties of our colleges, universities, and other schools to enrich the libraries of these institutions by donating copies of technical journals received by the individual either by subscription or by virtue of membership in some scientific society. This loyalty to the local institution is natural and laudable from the standpoint of the institution, but it may, perhaps, not be realized that if every one of our colleges and universities were to depend upon such gifts for their files of scientific periodicals there would shortly, in the case of many such publications, not be any journal to donate, so inadequate is the financial support of scientific publications.

With the exception of those journals, such, for example, as the chemical journals, which have a large and financially profitable circulation among practical workers outside of libraries and faculties, many of our journals devoted to pure science are barely, or not at all, able to exist except for generous subsidies. Outside of members of societies of which the publications may be the official organ, paid subscriptions may be expected only from a very few individuals not members, from a very small number of public libraries in our larger cities, and from educational institutions.

It is a matter of record that many of our journals devoted to publishing the results of research do not have subscriptions from more than a small fraction of American institutions maintaining a department in the given science, and in many cases this results because some member of the departmental staff contributes his personal copy to the library.

One of our biological journals recently faced the necessity of either securing a generous additional subsidy, or of increasing its subscription rate by one dollar a year, or of suspending publication. The subsidy was not forthcoming and so the subscription price was advanced. Notice to this effect was followed by cancellation of subscription, not by one of our private, struggling, small colleges, but by one of the largest of our state universities. The letter of cancellation stated that the institution would hereafter depend upon a donated copy.

The existence of all of the journals of the class referred to is a matter of vital importance to the colleges and universities. None of them is maintained for its own sake as a business venture. Practically all of them were established because of the impossibility of securing the publication of the results of research with any degree of promptness—often not within a year or eighteen months, or even longer, after the completion of the manuscript.

Our colleges and universities should regard practically all of these journals as established primarily for their advantage, and the journals in turn are justified in expecting support from these institutions to the extent of at least one subscription. The donation of personal copies by professors to the library of their institution may help the library to the extent of a few dollars, but the present extent of this practice is depriving journals, indispensable to donor and benefactor alike, of hundreds of dollars each of support annually.

It is an interesting but regrettable fact that, while it is comparatively easy to obtain money for research, nothing is much more difficult to secure funds for than the publication of the results of research.

C. STUART GAGER

ACOUSTICAL RESEARCH

THE quotation from the London *Times* on the subject of Acoustical Research (November 3, 1922) conveys an impression which seems to need correction.

In justice to the life-long labors of the late Professor W. C. Sabine, now gathered into a volume of Collected Papers on Acoustics (Harvard University Press), it should be said that the practical problem of predicting the acoustics of an ordinary auditorium in advance of its construction, or of correcting one already built, was solved by Professor Sabine some twenty years ago. The essential feature to be considered in such a problem is the reverberation and Sabine's papers on this subject are full and complete. Other acoustic questions are, of course, sometimes involved such as the transmission of sound through walls, the effect of resonance, etc. Several of these had also been the subject of prolonged experimental investigation by Professor Sabine at the Jefferson Physical Laboratory at Harvard but some of the results were withheld until the work could be completed. His untimely death interrupted this program, and since then the work has been continued here and at the Acoustical Laboratories at Riverbank, Illinois, under the direction of Dr. Paul E. Sabine, as described in Mr. Munby's article in *Nature,* October 28, 1922.

Architects in this country have become aware of the importance of Sabine's results and scores of cases could be cited in which the application of the principles worked out by him has led to complete success. The opinion that "Architects are still unable to predict with certainty the acoustic properties of the halls and chambers they design" implies a lack of respect for Sabine's profoundly accurate and thorough work which I am sure no one will maintain who has taken the trouble to acquaint himself with the subject.

Theodore Lyman,
Director

Jefferson Physical Laboratory,
Harvard University

AUSTRIAN SCIENTIFIC PUBLICATIONS

To the Editor of Science: The present financial difficulties of scientific and technical journals have no doubt come to the attention of many readers of Science. I am tempted to call their attention to a specific case by quoting a recent letter from William Ford Upson, American trade commissioner in Vienna:

> On a pathetic appeal of Professor Wilhelm Exner, an eminent Austrian scientist, president of the Technisches Versuchsamt, I am sending to the Bureau of Standards, with my compliments, the *Mitteilungen des Technischen Versuchsamtes* for one year. The publication is in sore straits for lack of funds and its ambition is to get 100 foreign subscriptions at $1.00 per year each, to enable it to continue publication, but its efforts have proved unavailing except that I am sending out a few copies at my own expense. Could you help in the good work in any way?

The Bureau of Standards is already a subscriber to this publication, but I trust that the above appeal will put other research laboratories or libraries on the subscription list.

William F. Meggers

Bureau of Standards

AN APPEAL

One hundred Russian university and professional men, mostly scientists, many of them internationally famous, recently exiled from Russia by the Soviet government, are in Berlin in serious circumstances. Local charity is housing and feeding them, but they lack sufficient clothing, shoes and pocket money to get through the winter without acute distress. An appeal has come to the American Relief Administration for one thousand dollars to provide some relief (averaging only $10 a man) for these exiles. Unfortunately all of the A. R. A. funds must be spent for relief inside of Russia. The appeal has been turned over to me. Will the scientific men of America help these suffering scientific men of Russia?

A generous friend, Princess Cantacuzene, of Washington, has given me one half ($500) of the sum needed. I shall be glad to be one of fifty to give $10 each, or one of one hundred to give $5 each, to make up the other half. I will undertake to receive the gifts and send personal receipts for them, and later obtain and publish in Science a blanket receipt from Berlin for the whole amount received and sent over-seas.

Vernon Kellogg

National Research Council,
Washington, D. C.

SPECIAL ARTICLES

ORGANIZATION OF HETEROTYPIC CHROMOSOMES

In a recent article H. C. Sands[1] gives a preliminary account of his interpretation of chromosome structure in *Tradescantia.* This account seems to differ much in fundamentals from the results of a study conducted by the writer on various species of the South African Liliaceous genus *Gasteria.* To consider only the most interesting feature, the heterotypic chromosomes, we find first that at metaphase there are three pairs of small chromosomes in the center of the plate, with four pairs of much larger ones arranged in radiating fashion around them. In favorable material it is easy to see that the metaphase chromosomes are organized internally into chromomeres, though these are somewhat irregularly arranged. Even before they separate the larger chromosomes each show a cleft at the outer end opposite the fiber attachment, and before anaphase is far advanced they are nearly completely divided longitudinally into two halves. Usually this is entirely completed before telophase sets in, and the halves are widely separated. The smaller chromosomes are slow to split, but finally do so. Consequently there is at telophase a diploid number of separate chromosome-halves and the homotypic division has been prepared for.

As the larger chromosomes separate in anaphase it is clear that in each half-chromosome there is a double row of rounded chromomeres. These are few and apparently quite definite in number, well separated from each other and stain sharply in contrast to the almost colorless matrix. As the membrane first appears around the group of telophase chromosomes (which are well separated in this genus and easily studied) it becomes evident that there are no longer two rows of chromomeres, but that four are now present. When the chromosomes are obliquely placed these can clearly be distinguished, especially in the later stages when the chromosomes begin to broaden at the ends in preparation for a more even distribution of the chromatin in the interkinetic nucleus. The smaller roundish chromosomes show comparable changes, though less clearly because of their size. It would seem that this can only mean that both the gametophyte divisions in the pollen grain have been completely prepared for. The chromomeres which enter the construction of the sperm nuclei seem to be already formed and merely awaiting the mechanical distribution of these mitoses. Unfortunately it has not been possible to trace the history of the chromomeres as such through these two divisions.

By a method based on smear preparations it has been possible to largely confirm the results of sectioned material and to obtain fixations in which synizesis (synapsis) has been almost entirely eliminated. The best results on the anaphase and telophase stages were obtained when the dividing cells were pressed from the anther before fixing and embedding.

The writer would consider, then, that the material worked upon, *Gasteria,* tends to demonstrate a very great precision in the chromomere constitution of the meiotic chromosomes. It is hoped that it will be possible soon to make a full report giving the evidence for the views here expressed.

Wm. Randolph Taylor
University of Pennsylvania

[1] Sands, H. C.: "Perigenesis," Science LVI, 517-518, 1922.

THE INTELLIGENCE OF INDIANS

The accompanying tables show that if we rank mixed bloods of certain heredity with nomadic and sedentary full blood Indians according to intelligence as indicated by Scale A of National Intelligence Tests the sequence proves to be:

I. Mixed Bloods.
II. Mexicans.
III. Plains and South Eastern Full Bloods.
IV. Plateau Indians, Full Bloods.
V. Navajos and Apaches, Full Bloods.

While the number of cases is small the indications of the measures are consistent with this inference. The results will shortly be reported more in detail by the writer who has been giving these tests in United States Indian Schools of the Southwest.

THE RELATIVE INTELLIGENCE OF INDIANS OF NOMADIC AND SEDENTARY TRIBES AND MIXED BLOOD INDIANS

The scores are of the National Intelligence Tests, Scale A, Form 1.

	No. Cases	Score Median	Per cent. attaining Median of Pl. & S.E.
12 and 13 years:			
Mixed Bloods	15	103	80 per cent.
Mexicans	145	85	60 per cent.
Plains & S. E.	8	76	—
Pueblo	46	64	40 per cent.
Navajo & Apache	12	52	10 per cent.
14 and 15 years:			
Mixed Bloods	39	110	80 per cent.
Mexicans	132	92	70 per cent.
Plains & S. E.	55	85	....
Pueblo	82	80	44 per cent.
Navajo & Apache	19	60	20 per cent.
16 and 17 years:			
Mixed Bloods	41	104	71 per cent.
Mexicans	28	91	54 per cent.
Plains & S. E.	60	90	....
Pueblo	95	78	34 per cent.
Navajo & Apache	30	77	23 per cent.
18 and 19 years:			
Mixed Bloods	31	114	60 per cent.
Mexicans	2	....	....
Plains & S. E.	53	88	....
Pueblo	26	71	30 per cent.
Navajo & Apache	24	77	40 per cent.

T. R. Garth

University of Texas
July 8, 1922.

THE OPTICAL SOCIETY OF AMERICA

ABRIDGED MINUTES OF THE SEVENTH ANNUAL MEETING[1]

The seventh annual meeting of the Optical Society of America was held at the National Bureau of Standards, Washington, on October 25, 26, 27 and 28, President Troland presiding.

One hundred and thirteen persons registered as in attendance at the meeting. Eighty-five of these were from outside Washington. The actual number attending at one time or another was probably about 150. The number in attendance at any one time at the sessions for the reading of papers ranged from about thirty to over one hundred.

[1] The complete minutes including abstracts of papers and descriptions of exhibits will appear in the January number of the *Journal of the Optical Society of America.*

An exhibit of optical instruments was held in connection with this meeting; and visitors were also given an opportunity to inspect the optical equipment of the Bureau of Standards.

The condensed program follows:

October 25

Bureau of Standards laboratory exhibits open to informal visits.

Business meeting:

Reports of officers and general committees.

Reports of committees on nomenclature and standards.

October 26

Glass Plant open to informal visits. Pot of optical glass being stirred.

General session:

Address of welcome: Dr. S. W. Stratton, director, Bureau of Standards.

Response: Dr. Leonard T. Troland, president, Optical Society.

Papers on miscellaneous optics.

Session on solar, stellar and planetary radiation:

Invited papers by Dr. C. G. Abbot and Dr. W. W. Coblentz.

Glass Plant open to informal visits.

Moulding, annealing and inspection of optical glass.

Illustrated address (by invitation): Professor W. J. Humphreys, U. S. Weather Bureau, on "The optics of the atmosphere."

Glass Plant open to visitors:

Pot of optical glass removed from furnace.

October 27

First session on physiologic optics.

Second session on physiologic optics.

Special session on physiologic optics for papers by invitation of the committee.

October 28

Session on photometry, colorimetry and optical pyrometry.

The exhibit of optical instruments, October 26, 27 and 28.

A synopsis of the proceedings, papers and special features of the meeting is given below:

1. *Business*

The report of the secretary and membership committee was read in part.

The president communicated an informal report from the treasurer, the formal report to be submitted at the end of the fiscal year.

The following reports of general committees were received informally:

Physiologic optics: F. K. Richtmyer, chairman.

Combination of *Journal* with *Instrument Makers' Journal:* J. P. C. Southall, chairman

Ways and means of preparing and publishing an English translation of Helmholtz's "Physiologic Optics": J. P. C. Southall, chairman.

Brief oral reports were made by the following progress committees (committees on nomenclature and standards):

Reflectometry: A. H. Taylor.
Spectroradiometry: W. W. Coblentz.
Visual refraction: A. Ames, Jr.
Wave-lengths: W. F. Meggers.
Photometry and illumination: E. C. Crittenden.
Optical glass: G. W. Morey.
Photographic materials: R. Davis.
Projection: L. A. Jones.
Pyrometry: C. O. Fairchild.
Refractometry: I. C. Gardner.
Spectrophotometry: K. S. Gibson.

2. *Special Papers*

The following papers were given by special invitation:

Apparatus and results of solar radiation work: C. G. Abbot, Smithsonian Institution.

Thermocouple measurements of stellar and planetary radiation: W. W. Coblentz, Bureau of Standards.

The optics of the atmosphere: W. J. Humphreys, U. S. Weather Bureau.

Photic orientation in organisms: S. O. Mast, Johns Hopkins University.

Electrical response of the retina to stimulation by light: E. L. Chaffee and W. T. Bovie, Harvard University.

On reflex visual sensations: Frank Allen, University of Manitoba.

3. *Contributed Papers*

The following are the titles of papers offered by members and others, and actually presented at this meeting:

Reflection of ultra-violet by flowers: F. K. Richtmyer, Cornell University.

Some unusual halos: W. J. Humphreys, U. S. Weather Bureau.

The excitation of spark spectra of rubidium and cæsium in a low voltage arc: F. L. Mohler, Paul D. Foote, A. E. Ruark and C. C. Kless, Bureau of Standards.

Some observations on the transformation of thermal radiant energy into electric current in molybdenite: W. W. Coblentz, Bureau of Standards.

Extraordinary diffraction of X-rays: L. W. McKeehan, Bell System Laboratories.

Simple equipment for detecting the errors of screws: Wilmer Souder, Bureau of Standards.

Refraction of a thin pencil by any refracting surface; generalized meridional and sagittal formulas: E. D. Roe, Jr., Syracuse University.

The dioptrometer, an apparatus for measuring the power of the commercial lenses: Henry F. Kurtz, Bausch & Lomb.

The measurement and specification of optical characteristics in projector performance: G. W. Moffitt, Frankford Arsenal.

The practical application of parabolic surfaces in lens construction: W. B. Rayton, Bausch & Lomb.

Some recent contributions to psycho-physiological optics: L. T. Troland, Harvard University.

A photo-electric theory of color vision: Janet Howell Clark, Johns Hopkins University.

A theory of color vision: Elliot Q. Adams, Nela Research Laboratory.

The fundamental facts of color-sensation, being the minimal requirements of a color sensation theory, with illustrations in color: Christine Ladd-Franklin, Columbia University.

The visibility of radiant energy: K. S. Gibson and E. P. T. Tyndall, Nela Research Laboratories, Bureau of Standards.

On the luminosity ratios of the spectral complementaries, and the subjective saturation of the spectrum: R. H. Sinden, Johns Hopkins University.

Further studies of the Abney effect: L. T. Troland and C. H. Langford, Harvard University.

A critical study of the Snellen letters and the "illiterate" E tests for the acuteness of vision of school children, and a proposed substitute for these tests: J. M. McCallie, Board of Education, Trenton, N. J.

A comparison of the Fechner and Munsell scales of luminous sensation value: Elliot Q. Adams, Nela Research Laboratories.

The theory of flicker photometry: C. E. Ferree, Bryn Mawr.

Comparative studies of equality of brightness and flicker photometry with special reference to the lag of visual sensation: Gertrude Rand, Bryn Mawr.

Progress on the determination of normal gray light: Irwin G. Priest, Bureau of Standards, Munsell Color Company.

The effect of various conditions upon the determination of the normal stimulus of gray: Irwin G. Priest and Casper L. Cottrell, Munsell Color Company, Bureau of Standards.

New tables and graphs for facilitating the computations of spectral energy distribution by Planck's formula: M. Katherine Frehafer, Bureau of Standards.

Graphical aids to the transformation of color measurements from one system to another: Herbert E. Ives, Western Electric Company.

A color match photometer for illuminants: Herbert E. Ives, Western Electric Company.

Comparative color measurements of illuminants by trichromatic and monochromatic analyses: Herbert E. Ives, Western Electric Company.

The colorimetry and photometry of daylight and incandescent illuminants by the method of rotatory dispersion: Irwin G. Priest, Bureau of Standards, Munsell Color Company.

A hemispherical photometric integrator: Frank Benford, General Electric Company.

Improvements in photometric equipment for integrating spheres: A. H. Taylor, Laboratory of Applied Science, Nela Research Laboratories.

A variable aperture rotating sectored disc: Herbert E. Ives, Western Electric Company.

The registering microphotometer of the Mount Wilson Observatory: Edison Pettit and Seth B. Nicholson, Mt. Wilson Observatory.

Color mixing and comparing apparatus: Hermann Kellner, Bausch & Lomb.

Disappearance of the filament in improved forms of the disappearing-filament optical pyrometer: C. O. Fairchild and W. H. Hoover, Bureau of Standards.

The relation between the hiding-power and reflection coefficients of white pigments and paints: A. H. Pfund, Johns Hopkins University.

On the ratio of intrinsic brightness to illumination: James E. Ives, U. S. Public Health Service.

Preliminary data on the color of daylight at Washington: Irwin G. Priest, Bureau of Standards, Munsell Color Company.

The shrinkage of photographic films during development: H. L. Curtis, Bureau of Standards.

A special sensitometer for the study of the photographic reciprocity law: Loyd A. Jones, Eastman Kodak Company Research Laboratory.

An instrument (densitometer) for the measurement of high photographic densities: Loyd A. Jones, Research Laboratory, Eastman Kodak Company.

An adaptation of the thalofide cell to the measurement of photographic densities: A. L. Schoen, Research Laboratory, Eastman Kodak Company.

On the relation between time and intensity in photographic exposure: Loyd A. Jones and Emory Huse, Research Laboratory, Eastman Kodak Company.

Preliminary note on the spectral energy sensitivity of photographic materials: Loyd A. Jones and A. L. Schoen, Research Laboratory, Eastman Kodak Company.

The following are titles of papers which were on the supplementary program and whose authors did not respond when the papers were called:

The horopter, cyclophoria and apparent vertical meridian (preliminary report): Charles Sheard, American Optical Company.

Aspherical lens systems: L. Silberstein, Eastman Kodak Company.

The paper by Hermann Kellner entitled "Motion analyser" on the advance program was not read. In place of it, Dr. Kellner communicated a paper on stereoscopic vision, abstract of which has not been submitted.

Dr. Frank Benford communicated informally the substance of a paper on the plotting of spectrophotometric data which he had presented at the convention of the Illuminating Engineering Society in September.

4. *Exhibit of Optical Instruments*

The following is a list of exhibitors, together with their exhibits.

1. Munsell Color Company

Munsell color tree.
Atlas of the Munsell color system.
Two enlarged atlas charts.
Neutral value scale, chroma scales.
Munsell daylight photometer.
Munsell crayons.
Munsell water colors.
Color index.
Disc spinning motor for use with Maxwell discs.

2. Keuffel & Esser Company

Holophane lightmeter.
Aerial sextant.
Prismatic gunsight turret telescope.
Expedition plane table.
Engineer's Y level.
Engineer's mountain and mining transit.
Engineer's transit.
Triangulation theodolite.
Spy glass, U. S. Navy pattern.
4-inch ship's telescope.
Anti-aircraft telescope.
Stadimeter.
Color analyzer.

3. Ordnance Department, U. S. Army

Instruments of the fire control systems of mobile artillery, observation and laying.

Instruments used in the observation and tracking of targets for securing data for precision fire of seacoast batteries.

Observation and computing instruments for use with anti-aircraft batteries.

(Frankford Arsenal Optical Laboratory)

Instrument for the examination of optical glass (designed by G. W. Moffitt).

Universal prism testing instrument (designed by G. W. Moffitt).

4. U. S. COAST AND GEODETIC SURVEY

Astronomical transit (Bamberg).
Theodolite (Troughton & Simms).
Repeating theodolite (Berger).
Precise level.
Vertical circle.
Vertical collimator.
Navigating sextant.
Electric signal lamp.
Heliograph (heliotrope).
Theodolite-magnetometer.
Dip circle.
Magnetograph.

5. BAUSCH & LOMB OPTICAL COMPANY

Large constant deviation spectroscope.
Constant deviation spectroscope for chemists.
Pocket spectroscopes.
Monochromator.
Color mixing and comparing apparatus.
Two field monochromator.
Comparison photometer.
Martens photometer.
Photometer stand.
New Abbe refractometer.
Dipping refractometers.
Colorimeter.
Hemoglobinometer.
Aspheric condenser.
Dioptrometer.
Field telemeter.

6. DR. HARRY S. GRADLE

Instrument for the determination of areas of retinal correspondence.

7. BUREAU OF STANDARDS (RADIOMETRY SECTION)

Stellar spectral radiometer (Coblentz).

8. A. AMES, JR., AND BLANCHE AMES

Color standard.

9. SOCIÉTÉ GÉNÉVOISÉ D'INSTRUMENTS DE PHYSIQUE

Constant deviation spectrometer.
Length comparator for measurements in air.
Automatic machine for graduating micrometer heads, drums, cylindrical and conical surfaces.

10. LABORATORY OF APPLIED SCIENCE, NELA RESEARCH LABORATORIES

Diffuse reflectometer—A. H. Taylor type.
Photometer and special window for integrating spheres.

11. CORNING GLASS WORKS

Light filters.

12. HANOVIA CHEMICAL AND MANUFACTURING COMPANY

Kalosat soft focus lens for photographic use with specimens of photographs taken with Kalosat.
Fused quartz optical goods, microscopic slides, cover glasses, prisms, etc.
Special lenses of fused crystalline quartz.

13. COOPER-HEWITT ELECTRIC COMPANY

Graded fused-quartz-to-Pyrex and fused-quartz-to-lead-glass joints.
Quartz-glass apparatus for photophysics and photochemistry.
Uviarc lamps.
Labarc.

14. BUREAU OF STANDARDS (AERONAUTIC INSTRUMENTS SECTION)

Synchronizing type ground speed and drift indicator.
Rate of climb recorder.

15. A. H. PFUND

A precision rotating section, aperture variable and measurable while in motion.

16. CENTRAL SCIENTIFIC COMPANY

Ingersoll glarimeter, new model.

17. J. C. HUBBARD

Gold-leaf electrometer.

18. BUREAU OF ORDNANCE, NAVY DEPARTMENT

Binocular collimator mark III (manufactured by Naval Gun Factory, Navy Yard, Washington, D. C.).

19. C. P. GOERZ AMERICAN OPTICAL COMPANY

Polariscopes and accessories.
Polariscopes for the analysis of sugar solutions and other polarizing fluids.
Various lamps and accessories.
Refractometers and accessories.
Refractometers, system Abbe, but of new and improved design, for testing fats, oils and other fluids.

20. WARREN P. VALENTINE

Refractometer—Modified Abbe type, "Precision" model.
Refractometer—Modified Abbe type.
Refractometer—Improved "Precision" model.
Refractometer—Modified Butyro type, "Fat" model.

21. BUREAU OF STANDARDS (F. J. BATES)

Adjustable sensibility saccharimeter (made by J. & J. Fric).

22. Bureau of Standards (Optical Instruments Section)

A variable power magnifying stereoscope.

23. Christine Ladd-Franklin

Charts illustrating the Ladd-Franklin theory of color vision.

5. *Bureau of Standards Laboratory Exhibits*

On account of the limited space in the exhibition room and the inconvenience of disturbing complicated "built-in" apparatus the Bureau of Standards contributed very little to the exhibits in the exhibition room. The bureau apparatus was, however, open to inspection in the rooms where it is regularly used. Instruments and apparatus thought to be of most interest to the Optical Society were listed and described in the advance program, which thus served as a guide to visitors. This list is given below.

Standard horizontal photometers (in charge of B. S. Willis).

Flicker photometers and colored test solutions for photometric observers (in charge of B. S. Willis).

Photometric distribution apparatus (in charge of B. S. Willis).

Integrating photometric sphere and Taylor reflectometer (in charge of B. S. Willis).

Koenig-Martens Spectrophotometer (in charge of M. Katherine Frehafer).

Photoelectric spectroradiometer (in charge of K. S. Gibson).

Hilger sector photometer with quartz spectrograph for ultra-violet spectroradiometry (in charge of H. J. McNicholas).

Spectrophotometer (color analyzer) for measuring spectral reflection (designed by Keuffel & Esser and the Bureau of Standards) (in charge of R. E. Lofton).

Exponential spectrophotometer for liquids (in charge of Irwin G. Priest).

Micrometer-microphotometer for measuring relative wave-lengths and photographic densities in spectra (in charge of W. F. Meggers).

Commercial (life-test) photometric equipment (in charge of Miss R. M. Collins).

Photometer for measurement of brightness of self-luminous materials (in charge of W. H. Wadleigh).

Apparatus for the determination of hue sensibility (wave length differences perceptible by difference in hue) and the visibility of radiant energy (in charge of Irwin G. Priest).

Rotatory dispersion colorimetric photometer (in charge of Irwin G. Priest).

Standard rotatory dispersion apparatus for the determination of the normal stimulus of gray (in charge of Irwin G. Priest).

Special apparatus for the determination of the normal stimulus of gray with full field illumination (in charge of Irwin G. Priest).

Fizeau expansion apparatus (in charge of C. G. Peters).

Dimensional change apparatus (in charge of C. G. Peters).

Scale ruling machine (in charge of C. G. Peters).

Portable gas interferometer, laboratory gas interferometers (in charge of E. R. Weaver).

Disappearing filament optical pyrometer (in charge of C. O. Fairchild).

Universal polarimeter (in charge of A. Q. Tool).

Crystal growing apparatus and various crystals (in charge of F. P. Phelps).

Photographic sensitometric apparatus (in charge of Raymond Davis).

Metallographic microscopes (in charge of H. S. Rawdon and S. Epstein).

Dalby optical load extension recorder (in charge of John R. Freeman, Jr.).

Photomicrographic apparatus (in charge of R. E. Lofton).

Microprojection of stratified soap films (in charge of P. V. Wells).

Ultramicroscope (Zeiss Slit) (in charge of P. V. Wells).

General Electric oscillograph, Bureau of Standards modifications (in charge of R. A. Webster).

Cathode-ray oscillograph (Braun Tube) (in charge of Miss F. Kenyon).

Projectile camera (in charge of A. H. Sellman).

Optical glass plant (in charge of A. N. Finn).

Optical shops: Highest precision hand work (in charge of J. Clacey); Machine grinding and polishing (in charge of F. C. Weaver).

The president announced the election of Professor A. A. Michelson and Dr. S. W. Stratton to honorary membership in the society.

The meeting was concluded by an informal dinner at the Hotel Ebbitt.

The next meeting will be held at Cleveland, in October, 1923.

Irwin G. Priest,
Washington, *Secretary*

SCIENCE

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THE GIFTED STUDENT AND RESEARCH[1]

LIKE the evolution and development of society, the development of the individual is rapidly coming under more and more consciously and systematically directed control; witness the gigantic educational machinery which is the product of the last twenty years. It is, perhaps, safe to say that the systematic direction of the development of the individual is inversely proportional to his initiative, natural gifts and creative power. Morons are cared for; delinquent students are sorted and served each according to his individual need; the average student follows a routine. But what about the intellectually gifted student? Ordinarily he is held in leash. Let me enter a plea for the emancipation of the gifted student, giving him a realization of his powers and responsibilities, the freedom to soar unhampered above the levels of mediocrity, and to live at his highest level of achievement, weaving early his bonds of friendship with scholars. Instead of whipping him into line, let us whip him out of line.

One of the great contributions from modern psychology is the discovery of the individual and the projection of his profile, here and there in quantitative terms, bringing to us the realization that in a given specific mental capacity one individual may have two, five, ten, twenty-five or a hundredfold the capacity of another with whom he is tied up in the educational mold. Our curriculum and our campus sanctions are so effectively set that very often these individual differences are successfully covered up or smoothed out so that the gifted individual as such is lost to himself as well as to society.

A few years ago, particularly during the

[1] Read before the Association of American Universities at Baltimore, Maryland, November 9-11, 1922.

war, some of us were interested in finding from the senior class in college those who would give the greatest promise of achievement in research work. The rating blank[2] I have placed in your hands was used effectively for the locating of a certain per cent. of these. Personally I can testify that the individual interviews with those selected on the basis of these ratings furnished one of the most delightful and profitable opportunities for personnel work in administration. With the charts before the student and the interviewer, it was possible to enter into the life plans of the individual at a crucial stage in his career and cause him to view the situation in a critical attitude with profound interest. This is a procedure which has amply justified itself. But we soon found that the senior year is too late. At the end of the senior year the student has already chosen his career and, sad to say, often unwisely, being guided largely by temporary emoluments, a shortsighted estimate of what is worth while, or the easiest outlet for activity at his then recognized level. Business, the industries, special interests, and the older professions have plucked from the senior class those who are most promising. Without strong traditions in their favor and without the promise of financial rewards, science and art, with very few exceptions, trusting to luck, get what is left. It has therefore become clear that some selection, to be effective, should be made earlier than in the senior year, first, to give scholarship an opportunity in the competition for talent, and, second, to find the gifted student early enough to give him the advantages of preparation that he may crave and deserve.

For this reason, some of us fall back on the opportunity of using the so-called intelligence tests and various substitutes for these at college entrance. These tests should be as much for the purpose of discovering the gifted student as for the purpose of culling out at the lower end. If I may mention a practice which has gradually found its way into Iowa, I may say that those who rank in the highest 10 per cent. at college entrance are summoned by the Dean of the College of Liberal Arts and told

[2]ANALYZED RATING OF FITNESS FOR GRADUATE STUDY

Directions: Record your judgment on each capacity by placing a check mark (√) at the appropriate point in the dotted line. Grade conservatively, bearing in mind that in the long run, for a class, there should be as many marks below average as above. If in serious doubt, put a question mark above the check. Guard rigorously against giving information to, or receiving from, others who are rating independently, but otherwise consult freely with those who know the student well.

At the bottom, cite (1) notable specific evidences of achievements, distinctions, opinions or other data that may throw light on the character of, ability or fitness for some particular field, if you know of any; and (2) mention marked negative traits which might be an obstacle in a learned career.

	Very poor 10%	Poor 20%	Low average 20%	High average 20%	Excellent 20%	Superior 10%
1. REASONING POWER: capacity for solving problems, both deductive and inductive						
2. ORIGINALITY: creative imagination, brilliancy, planful initiative and fertility of rational ideas						
3. MEMORY: extensive, logical, serviceable, and ready command of facts						
4. ALERTNESS: quick, incisive and responsive observation, thought and feeling						
5. ACCURACY: precise, keen, regular and reliable observation, thought and feeling						
6. APPLICATION: power of concentration, sustained attention, persistence, and well-regulated effort						
7. COOPERATION: capacity for intellectual companionship, team work and leadership						
8. MORAL ATTITUDE: intellectual honesty, wholesome moral standards, ideals and influences						
9. HEALTH: nervous stability, physique, vitality, and endurance						
10. ZEAL FOR INVESTIGATION: deep interest in and craving for original and creative work						

that the institution recognizes individual differences both in regard to quantity and quality; that those having given evidence of unusually high powers will be expected to show unusually high achievement through the college course; that they will be watched with hopeful interest by members of the faculty; that an effort will be made to give them such personal direction and stimulation as they may need; and that eminent leadership is characterized by modesty and service.

At the beginning of the second year, the Dean of the Graduate College summons them. Each one is asked to bring three ratings on the blank you have seen; one by himself, one by a student friend, and one by an instructor. In the light of these analyzed ratings and the achievement of the freshman year, we talk over the situation with them individually in preparation for the selection of their major at the beginning of their junior year. This usually leads to an early introduction to the most inspiring men in the major subjects which they are to elect. The selection of a major is then a distinctive step in the finding process, and the selection of an adviser ceases to be a mere form or a mere tool of administration. This procedure has served also to give members of the faculty, who are interested in research, a fresh interest and a clear point of view in the effort to discover in their classes other persons who show evidence of talent for research; because the gifted students do not necessarily fall in the highest group in mental tests.

But even this approach in the freshman and sophomore years has revealed to us the advantage of beginning still earlier. As was shown by Book in the Indiana survey, dull students are as likely to go to college as bright students. In the interest of scholarship it would be extremely wholesome if those who are interested in college entrance could reach down into the high school and inject into that atmosphere the sentiment that the more gifted a student is in the secondary school work, the more desirable it is that he should go to college. It is only by the cultivation of a personal sentiment of this kind that we can draw into the college those high school students of superior attainment whose education is now curtailed.

What I have attempted to say so far is that it is in the interest of creative scholarship as well as culture in general that we should frankly recognize the enormous magnitude of differences in the individual capacity for achievement and that this principle should be asserted early in the course; first, that students may be found in the adolescent period of enthusiasm and generous aspiration and wisely protected from the machinery which is set automatically to grind high and low to a common grade; and, second, that instincts of curiosity, criticism, collecting and comradeship which blossom in the early adolescent period may be fostered in an atmosphere of freedom, encouragement and opportunity for achievement.

Having thus entered upon a program of doing what we can to discover the gifted student, what can we do to follow up this discovery in the undergraduate course? This question has been answered by a very elaborate report prepared for the Association of American University Professors by Professor Wilkins pointing out sixty-seven varieties of things that may work to this end. I shall not here attempt even to summarize or classify these as they will undoubtedly appear in a formal report of his committee.

The Division of Educational Relations, with Dr. Vernon Kellogg as chairman, in the National Research Council, has made a special project of this problem of the gifted student. It has various committees at work and aims to collect and disseminate information on this subject. I desire to acknowledge my obligation to this Division for inspiration and facilities in the work, but the suggestions I am now about to make are not official; they are purely personal convictions gained in my own experience and observation.

In the proposals I am about to make, I shall scrupulously avoid the recommending of any procedure which shall in the slightest detract from the present actual privileges and opportunities that the non-gifted student enjoys. Indeed, the whole appeal for the recognition of the individual in education is as much for the good of the non-gifted as for the gifted student. I am speaking here from the point of view of the intellectually gifted; but we all know that these have many weaknesses and that there are many other gifts or talents which supplement intellect and in many instances outweigh it. I shall therefore not tolerate any odious comparisons in terms of superior and inferior, and my appeal for the gifted shall not convey the slightest slur or disparagement of the non-gifted; but the fact is that, in education as in charity, there has been a constant tendency to give the first and most ardent care to the comparatively helpless. To this I would add some thoughtful equalization of interest.

The discovery of the individual and the study of his talents in modern psychology has brought forth a maxim which may well be our educational slogan: *"Keep each student busy at his highest level of achievement in order that he may be successful, happy and good."*

This maxim is so pithy and cogent that we can afford to read it and reread it, accenting in turn each individual word, as every word of it stands for a principle. Thus, we may emphasize in reading, *each, his, highest, achievement, successful, happy* and *good.*

Keep the moron busy at his highest level of achievement and he will be happy, useful and good; institutions have demonstrated that fact. Keep the gifted student in music or art busy at his highest level of achievement and he may become an artist; that has been demonstrated. But science is slow in applying science to its own procedures. The challenge of educational psychology to-day is this: "Keep the gifted student busy at his highest level of achievement and you may find him a delightful comrade, a contributor to the world's store of knowledge, and a vastly greater man than he could ever have been but for your thoughtful consideration."

To act on the application of this principle, I would urge the extension of the following procedures which have all been tried to some extent in various institutions but need to be promoted.

1. *Sectioning classes on the basis of ability.* We may say in very rough and conservative terms that, if we think of a hundred college freshmen, chosen at random, and match the extremes against each other, 5 at one end can do more than 5 times as much as 5 at the other end. The next 5 at one end can do more than 4 times as much as the next 5 at the other end. The next 6 at one end can do more than 3 times as much as the next 6 at the other end. The next 9 at one end can do more than 2 times as much as the next 9 at the other end. This accounts for the highest and lowest quartiles. The differences at the extreme are much larger than here represented because one or two at the upper end may be capable of rendering more than ten times the *average* output for the class, while the one or two at the other extremes are quite certain to fail. If, then, we seek for a practical basis for the sectioning of classes, we shall do well to recognize three levels which we may call the *high,* the *middle,* and the *low,* the middle being as large as the other two together.

All too often our educational system is based upon the assumption that, where the great Creator failed to make all human beings equal, it is the business of the school to make them equal. To justify this procedure, the school men have found cover in the argument that this task works toward a democratic ideal; that it represents the rights of individuals; that it is necessary for the successful operation of educational machinery; that it is good for the lowly individual; that the procedure is justified by results. Each of these defenses represents a fundamental error and misconception of fact in educational procedure.

The democratic ideal in education, as everywhere else in life, is not identical opportunity for all, but equal opportunity in proportion to capacity. The genius and the moron do not have quantitatively the same rights to knowledge; they have equal rights in proportion to their relevant capacities (quantitative and qualitative), and one should be as insistent upon his rights as the other.

Among the advantages of such sectioning we may note the following: it becomes possible to apply in teaching the pedagogical maxim, "Keep each student at his highest level of achievement." This will result in the setting up of fair standards for quantity, quality, content, and method of work adapted to a fairly homogeneous group. This in turn will establish a fair basis for praise and blame. The introduction of fair standards of achievement creates morale in a class. There will therefore be a larger output at all three levels; for such grouping is as advantageous to the untalented student as to the talented. Such progressive segregation is one of the best means of discovering and motivating the gifted student; because he is thrown into vital and effective competition, works at his highest level of achievement, and enjoys freedom for initiative in self-expression, and these associations are likely to awaken in him desire for progress, a sense of joy in achievement, and a feeling of fellowship. The introduction of this method, if properly managed, will not increase the cost of instruction, but may reduce it.[2] I have pointed out in two articles on this topic[3] that there is no insuperable difficulty in the way of conflict of hours and cooperation of staff and that every institution that has given the method a fair trial is continuing it.

2. *Honor courses.* Let each department in which there are progressive teachers set out one or more courses to which admission may be gained only upon evidence of fitness. The principal factor to take into account should be high scholarship, or creative achievement, or both together with health. The standard for passing should be much higher than in an ordinary course. The class may well be socialized and the work so arranged as to challenge the individual to wide reading, verification and defense of his findings, experiment, independent thinking and self-expression. Under no circumstances should the course be limited to lecture or textbook; nor should formal essays or papers be read by the student. It should not furnish an opportunity for the instructor to recite the findings of his researches, although the subject of study will most profitably lie within or around his field of research.

Admission to these courses should be in the hands of a scholarship committee to which recommendation for admission and reports of achievement should be made by teachers. Assuming as a unit of credit three year hours; *i.e.,* six semester hours, the exceptional student might be permitted to take one course in the sophomore year, two in the junior year and three in the senior year, but not more than one course of this kind each year in a given department. Thus the amount of credit in such courses might furnish a better basis for designing honor students for graduation than the present basis of mere credits in ordinary courses. The existence of such courses would act as a stimulus to the gifted student who might otherwise be disposed to loaf. Dozens of varieties of honor courses are being tried in different institutions. This plan has the advantage of flexibility, simplicity of administration and a salable proposition to the student.

3. *Individual work.* Shall the freshman who has read current literature and history extensively and lives in it be forced to ruminate the cud of predigested pellets which form the diet of freshman general history? Shall the gifted student, who, given the freedom of the library, can read up in one half to one fifth the time what is doped out in lectures on special topics, be forced to acquire a specialized knowledge in that specific form and at that set pace? Shall the student who, if given free hands, could pass all college examinations required in a year or two be required to mark time for four years? Or, granted that it is good for him to be in college for four years, shall his horizon be limited to the scope of course units? Shall the gifted student who can learn the two hour assignments in science or history or language in fifteen minutes be encouraged to loaf or play the rest of the time? Or shall he be given a different assignment? Shall the gifted student who can do independent work in li-

[2] I am, of course, speaking of the larger institutions; indeed, the very necessity for differentiating students may prove to be a decided disadvantage to the small college.

[3] In *School and Society.*

brary, laboratory, field, or creative work have his progress restricted by course units?

Such questions are all the more pertinent here to-day because American institutions have answered them in a different way from that in which they have been answered by the older institutions in Europe. The American college coddles the student; laces him into a strait-jacket of forms, and spanks or rewards him somewhat in proportion to his conformity to this corset. Professors talk about academic freedom. Perhaps it is time that we heard from the student about academic freedom.

One wholesome practice is to excuse students from too elementary courses and give them more advanced work. But in many cases there should be another outlet. Students who, on admission or later, give evidence of high capacity for achievement should, on recommendation to the department and approval by the scholarship committee, be permitted to register for individual work as a substitute for required courses, work to be counted for credit as in the course. But the standard of passing should be much higher than for the class work (1) to prevent rush to this privilege, (2) to call for high achievement on the part of a gifted student, and (3) to allow for the effect of cramming. The test should, however, be more plastic and personal than the formal tests on course content. In addition to scholarship, admission to such registration should be based upon evidence of fitness for such independent work. The principle of this type of registration once approved by the faculty, the administration of it should be left largely to the departments, so as to make it simple and flexible.

Departments might find it possible to have syllabi, bibliographies and study hints available as an invitation to individual work. Occasional interviews should be granted, but not for the purpose of telling or teaching. In certain subjects each individual's work might be so motivated and organized as to carry a considerable number of students in this way rather than in class, and thereby lighten the burden of teaching. Departments might also go so far as to recognize voluntary groups of two or more students for cooperative study in preparation for such tests as the department might set. In every case, the student would have the advantage of working at the highest level of achievement, would be free from the lock-step of the class room, free from the burden of being bombarded with matters which he already knows. Mathematics, history, government and psychology would be good examples of subjects to pursue in this manner. Mathematics is peculiarly a personal affair; it is a skill which the teacher can not impart. In foreign language there is no reason why a gifted student should spend two years in the class room in learning to read French and German; but if he is given time and realizes what it is for, he can read French or German literature and science and live in it and use it to best advantage and thereby lay a better foundation than he could by merely taking a course. Even laboratory courses might well be mastered in this way. Only gifted students can profit by this privilege. Inferior, mediocre or average students need to be nursed and coddled by the methods we now employ for all. The privilege is merely an honest recognition of the fact that there are some who can learn for themselves, without tutor, lecturer or class whip.

4. *Early contact with mature teachers.* Recently, a faculty committee in a university brought in a report representing essentially this: (1) that elementary students should be taught in sections not to exceed twenty-five; (2) that elementary students should be taught by the mature men in the department; (3) that the teaching schedule for these men should be reduced in order that they may have time for research; and (4) that salaries should be raised. One member of that committee, representing a very large department, was asked to prepare a budget for his department embodying these recommendations. Nothing more has been heard of the report. It simply can't be done.

With the present influx of students, there is a tendency to reserve the most inspiring men for the most advanced courses and leave lower courses in the hands of cheap labor. This is especially demoralizing to the gifted student. When a department has from two to fifty sections in the elementary subject it can afford to so organize the course that the academically mature and successful man is made responsible for the content and method and meets every student in that course at least once a week. This will probably of necessity involve the combination of the meeting of the class in large divisions for lectures, demonstrations, or formal exercises under mature men and personal work with the students in small sections under younger men.

Let me hasten to say that this must not be confounded with the old-fashioned lecture plan with quiz sections; that plan is dead, or should be. But that should not condemn the meeting of the class part of the time in large divisions and part of the time in small sections. Harvard was one of the worst sinners under the old lecture and quiz systems. But to-day Harvard is in some departments setting a model for this type of organization which insures inspiration and thoroughness in the work. The sophomore in economics, *e.g.*, may work under such men as Taussig, Carver, Burbank, Ripley and Day in a single course and carries away something which stays by him through life. The professor in charge of the course himself carries one section made up of the most gifted students.

The plan I commend on the basis of my own experience is to recognize three needs of instruction: (1) inspiration, motivation, and organization of the work; (2) systematic reading, practical exercises, or experiments; (3) self-expression. The first can be achieved in divisions of from one to five hundred by capable men; the third must be done in small sections; and the second may be directed either from the large division or the small section. The first can be done only by a relatively mature teacher who has marked ability in leadership and the power of address. The third may be done by well-selected, young teachers; the second should represent the ingenuity of the mature teacher and the capacity for routine and detail of the young man.

The organization and conduct of the large division work may be in the hands of one man. But where there are distinct divisions in a department, as in economics, sociology, botany, or psychology, the first year course should be a cooperative affair. There is no need or justification for electives toward a first year course in a department. There should be only one economics 1, one American history 1, one botany 1; for the majority of students take only one course in the department and a course of the second level may well be built upon the general orientation gained in a general survey course. The finest and most extreme embodiment of this principle is perhaps the course in contemporary civilization—a five-hour course required of freshmen in Columbia University.[4]

5. *Time.* There are a number of things that may be done for the gifted student which can not be prescribed but may be included in the general faculty policy of liberality toward the few students who give unmistakable evidence of exceptional achievement. One of these factors is time.

In discussing the gifted student problem, a professor who spoke with a German brogue said, "Vot do ve professors vant? Ve vant time. Vot does the gifted student vant? He vants time." And he was right. The gifted student wants time to pursue his ideal; and he can best get that by some generous policy of exemption from formal training. This comes hard. I well remember what precious hours our faculty wasted in trying to keep Mr. Steffanson, the now famous explorer, from submitting the evidence showing that he could acquire on short notice those units of learning which we have so logically prescribed in our four year course, all of which he could have met in a year or two while he was doing some creative work on the side. (As a matter of fact he did get permission to do that very thing and succeeded.).

This sounds like iconoclasm. It disturbs the dean and the registrar and the professor. As a practical administrator I am not calling for any great or sudden revolutionary procedure;

[4] The October number of the *Bulletin* of the Association of American University Professors contains valuable material on "Initiatory Courses for Freshmen."

but I should like to enter a plea for the recognition of opportunity for reasonable treatment of the gifted student commensurate with his exceptional powers; and one of the conditions for achievement is leisure and the privilege of working at your own pace.

To the now traditional practice of allowing excess registration in proportion to quality of credit should be added the proviso that an excess schedule must include an honor course each year, and general health and social orientation should be taken into account. If this is done, the student may combine the saving of time with the winning of distinction—a type of distinction which has real value. A flexible scale of excess registration may then safely have such range that the very gifted student could complete the college course in three years if he so desired.

Comradeship. The first and greatest need of the gifted student is comradeship or fellowship in the late adolescent pursuit of his ideal if it be the search for truth. Each of us who has had any degree of success in original work can look back to little incidents where a teacher or a more advanced fellow student conveyed the sentiment; you are good enough to be in my company; see with me this vision; share with me this harvest; let us seek truth first hand; I want you to fall in love with my problem; over the mountain top there is light. This can not be achieved through any formal academic procedure. Probably less than one fourth of the college teachers in the United States are capable of participating in this privilege, and yet the principle needs to be urged upon the academic community in order that those who have this interest at heart may not trust the machinery to do what it can not do; may not underestimate the great significance of little things in this direction, or may not in the interest of modesty or academic courtesy hesitate to exercise this privilege. It is a personal affair and must therefore take the course of natural, personal values, privileges, and rewards, given freely for the love of it, living for it as a father lives for his son.

For this reason, formal academic privileges and procedures can not be prescribed or even enumerated. Comradeship must be personal and warm, involving privilege. But the outward organizations must not be ignored. Invitation to the home; participation in small groups, clubs, and societies; the enjoyment of special laboratory and library privileges; the exemption from hampering formalities; the encouragement of rewards of all kinds; the stimulation of competition; the organization of rigorous academic wrangling and criticism; the participation in the reading of manuscripts, the conduct of experiments, scientific expeditions, and learned societies. These things are all of very great value to the student who has been taken into comradeship for research as a neophyte. They come to him because he has been admitted to comradeship and in return he gives his best.

He needs counsel to curb his enthusiasms, to acquire fundamental habits and knowledge, to lay good foundations through training in the fundamentals, to fit himself into the social body in which he lives, to care for his health and manners, to seek reasonable outlet for his ingenuity, to keep from being a hermit or a prig, to keep in the humble attitude of a master who is not puffed up over his achievement.

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WHAT SHALL BE TAUGHT IN THE FIRST YEAR OF COLLEGE CHEMISTRY?[1]

THERE is much uncertainty among college chemists as to the proper treatment of freshmen, some of whom had chemistry in high school, while some did not. With a class not exceeding one hundred and a somewhat limited teaching staff, there is no better method than to put them all in the same class with the same text. No apology need be offered for such a procedure. In such small classes the teacher can keep in close touch with the individual student and vary the program to suit individual possibilities. This is especially easy in the laboratory drill where the experiments may be

[1] Paper presented at the Pittsburgh meeting of the American Chemical Society.

selected to fit the student's preparation and ability.

In larger institutions, it is more satisfactory to group those with no previous training in a separate class. It is to be hoped they had high school physics as a scientific foundation. General chemistry for such a class should be just what the name implies—a general treatment including traditional descriptive chemistry, physical, industrial, organic, analytical and something of the historical development. Above all, even above the accumulation of facts, this course should give training in real scientific thinking.

This seems like a large undertaking, but it merely means that we take the student up on a high mountain and show him the promised land. The fact that the majority of this class will never study any more chemistry is added reason for a proper breadth of treatment.

The problem is more difficult for students who may possibly feel satisfied with their knowledge of high school chemistry. They enter college to be stimulated and it is fatal to let them feel that college general chemistry has but little in the way of novelty for them. Hence I counsel against a mere hasty review for one semester by way of transition to some advanced course. Such "rush" courses are deadly, dull and unsatisfactory to teacher and pupil. Nothing short of a full year of rather stiff general chemistry will serve the needs of this class and it can be taught with all the freshness needed to whet jaded intellectual appetites.

The high school course was good discipline. It furnished much useful information and inspired the student with a liking for chemistry. It is no reflection on high school teaching to insist that under no circumstances shall a year of college general chemistry be omitted. The explanation is found in the immaturity of the student, the high school environment and the lack of time given to the course.

The college course must cover again the same ground—and much more. It need not, however, be a dull rehash. The broader general chemistry in college must present more fundamental views. Much more of physical chemistry, more exact quantitative experiments, and a glimpse of the newer developments such as radioactivity, atomic structure and colloids are a proper part of such a course. A very simple but reasonably complete system of qualitative analysis may well be used as the laboratory drill during the second semester. This teaches system, classification and comparison. The student greatly enjoys his quest of the unknown and sees a definite use for a somewhat confusing array of facts he may have accumulated. That majority who never take advanced chemistry have a right to the joys and benefits of qualitative analysis.

During this difficult freshman year the old facts of high school chemistry must be dealt with in an interpretative spirit. When taken behind the scenes, so to speak, the student sees a new meaning in the subject. There is small doubt that unless all that has gone before, more or less loosely held in mind, is worked over into a solid foundation the student is chemically crippled for life. A certain amount of forceful repetition is the essence of good teaching. Even in the second, third and fourth years, we all find it profitable to repeat and expand what was presented in the freshman year of general chemistry. This makes the thorough chemist.

It may be well to mention a number of specific topics to be stressed for the class.

The historical development of the system of molecular and atomic weights is far more convincing to the student than a mere statement of the system as it now is. In fact a little of the historical introduction to many topics interests the class and develops the research attitude of mind. It may seem absolutely ridiculous to talk of research on the part of a freshman, yet clever questioning as the steps of a historical piece of research are discussed will do much in stimulating the student into a research attitude of mind.

Structural formulas appal the class on first sight. Later familiarity breeds, not contempt, but appreciation. The usual confusion of formulas of nitrogen, arsenic, antimony and phosphorus compounds is easily cleared up by constant use of structural formulas. With such practise the study of two chapters of organic chemistry is not appalling.

A library shelf, easily accessible and especially selected for students of general chemistry, pays goods dividends. Other texts, books on the applications and special advertising pamphlets should fill this shelf. Not all will read but those who do are the ones who take advanced chemistry.

Stress must be placed on equilibrium, early and late, on solutions, on that fascinating chapter about the periodic system, on the hydrocarbons and their derivations and such other topics as appeal strongly to the teacher.

* * * * * *

An informal talk with each student or a written test on entrance will indicate that some who have had high school chemistry will do better in the class with those who had none. Since high schools vary widely in quality of instruction in chemistry (as do colleges also) the mere name of preparatory chemistry should not be accepted without some investigation. Usually the record of the school is sufficient evidence.

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ON THE EXISTENCE OF A HITHERTO UNRECOGNIZED DIETARY FACTOR ESSENTIAL FOR REPRODUCTION[1]

The fact has been abundantly demonstrated that rats may be reared on a dietary regime consisting of "purified" protein, fat and carbohydrate to which an appropriate salt mixture and adequate doses of the growth vitamines Fat Soluble A and Water Soluble B have been added. We have employed a ration of casein (18), cornstarch (54) and lard (15) to which butterfat (9) and salts (4) are added, the animals receiving separately and daily .4 gram each of dried whole yeast.

Such animals are sterile. They are chiefly so in the first generation and wholly so in the next succeeding one. The sterility of dietary origin yields a highly characteristic picture. Animals suffering from it do not differ so profoundly from normal ones in their ovarian function as they do in placental behavior. Approximately the same number of Graafian follicles mature and rupture per ovulation and the ova are fertilized and implanted. The placentæ are abnormal. They may persist almost throughout gestation but show as early as the second day of their establishment beginning blood extravasations which increase in extent. Resorption invariably overtakes the products of conception.

Natural foodstuffs contain a substance, *X*, which prevents such a sterility or which cures the disorder occasioned by the purified dietary regime. We have thus been able to witness a comparatively sudden restoration of fertility to animals of proven sterility, and whose controls continued sterile, by the administration of fresh green leaves of lettuce. Even the dried leaves of alfalfa appear to possess a similar potency. The proven efficacy of leaves invites inquiry into the certainty of segregation of the new dietary factor from vitamines A and C. As regards A, it is conceivable that amounts of A adequate for normal growth, freedom from eye disease and, indeed, vigorous health might still be inadequate for the reproductive function. Such a conception is apparently strengthened by the reappearance of fertility which we have discovered to take place when the butterfat quota in the above diet is increased so as to constitute 24 per cent. by weight.[2] A sufficient answer to this conception, however, is afforded by our demonstration that in some dietaries reproduction may be unhindered when the A content is lower than in

[1] University of California, aided by the Dairy Division of the Bureau of Animal Industry of the United States Department of Agriculture, the Committee for Research on Sex Problems of the National Research Council and the California Central Creameries. The writers desire also to express their especial thanks to Mr. C. E. Gray, of San Francisco, and Dr. C. W. Larson, of Washington.

[2] Drummond (*Biochem. Jour.*, xiii, 77) has, for instance, reported two generations of animals reared on 20 per cent. butter in this diet.

our ration. Such a diet is furnished by rolled oats (40), gelatin (10), casein (5), dextrin (40.3), butterfat (1), and salts (3.7) (McCollum). It is perhaps also pertinent to point out that we have detected an invariable sign of inadequacy in the A factor of greater delicacy than those hitherto employed and may thus recognize such inadequacy long before growth impairment, for instance. The sign is constituted by a highly characteristic aberration of the œstrous cycle. And we have been able to demonstrate the persistence of fertility with a wheat-milk ration (Sherman) even in the absence of butterfat and when the A deficiency is heralded by the continuous exhibition of the new sign. The beneficial effect of a very high percentage of butterfat, consequently, seems preferably explained by its possession of a definite though low quota of the fertility conferring substance. Furthermore, a sample of cod liver oil tested by us and proven to possess a much superior A content to butterfat is far less efficacious than butter in curing or preventing the impairment of the reproductive function.

The beneficial dietary factor can not be identical with the antiscorbutic vitamine C, for curative effects have been secured when ground whole wheat was added to our purified ration, and the cereals are, of course, notably deficient in C. Moreover, although some favorable influence on growth has been noted, it has been impossible for us to secure with orange juice the fertility effects so evident with lettuce.

Lastly, we may refer to the suggestions either implied or expressed in the publications of some investigators (Osborne and Mendel, Kennedy and Palmer) that yeast contains some toxic substance inimical to the organs of generation and hence causing sterility or that it simply does not contain enough of the water soluble vitamine B. The curative foods could hardly be assumed to detoxify. Nor do we believe our animals suffered from lack of B, for growth was excellent; and as much as 25 per cent. by weight of yeast (which must have given a great surplus of B) did not change the result. Fertility, when wheat germ is used as a source for B, results not from more B but because wheat germ is also rich in X.

We have undertaken a series of experiments designed to trace further in natural foods the distribution of the substance thus shown to be indispensable for the production of healthy young.

HERBERT M. EVANS
K. SCOTT BISHOP

THE RECENT SCIENTIFIC WORK OF ROBERT WHEELER WILLSON

IT must be of interest to the many friends and former students of Professor Robert W. Willson to know that the last months of his life were actively occupied in the successful solution of certain scientific problems.

Professor Willson died at his home in Cambridge, November 1, 1922, in the seventieth year of his age. He was a graduate of Harvard College in the class of 1873, and took his Ph.D. at Würzburg a few years later, after specializing in physics, a subject which, in conjunction with his astronomical experience, gave just the right equipment for his solution of aerial navigation problems at a much later date.

The main facts of his professional career are available in the biographical reference books, while others can speak more fully than I of his devotion to the building up of a department of astronomy in Harvard College. Following his retirement as professor emeritus in 1919, he devoted an increasing amount of time to his own work in Cambridge along the line of air navigation instruments, and this later work is not perhaps so well known.

His development of the air-craft sextant was a notable achievement successfully demonstrated during the war, and widely adopted since. Anti-aircraft defense, trans-Atlantic flight, and ground speed indicators were only a few of the subjects which claimed his keenest attention and in which definite progress had been made. He was fully aware of all the trying obstacles which must be met in the development of instruments for practical airplane use, and not only had a sound, scientific solution in readiness for each case, but was equally alert to suggest the most economical method of construction.

Some of this material had been prepared for publication in the form of a paper on Air Navigation and sent to press early in October, following which his attention was eagerly concentrated on further problems. So the end came like a ship holding its course accurately, and passing out of sight with all sails set.

M. H. D.

Pittsburgh, Pa.
November 6, 1922

SCIENTIFIC EVENTS

MORTALITY FROM CANCER

The Department of Commerce announces that the returns compiled by the Bureau of the Census show that over 76,000 deaths were due to cancer in the death registration area of the United States in 1921, and assuming that the rest of the United States had as many deaths from this cause in proportion to the population, the total number of deaths from cancer in the entire United States for 1921 was 93,000, while for 1920 the number is estimated as 89,000 or 4,000 less than for 1921.

The trend of the cancer death rate is upward, the rate for 1921 being higher than that for any earlier year in twenty-three of the thirty-four states. The cancer death rate in the registration area in 1921 was 86 per 100,000 population, against 83.4 for 1920. In comparing the death rate from cancer in one state with that in another, the bureau uses "adjusted" rates in order to make allowance for differences in the age and the sex distribution of the population, because, generally speaking, only persons in middle life and old age have cancer, so that a state with many old persons may be expected to have more deaths from cancer than a state with comparatively few old persons.

The highest "adjusted" cancer rate for 1921 is 99.6 per 100,000 population for the state of Massachusetts, and the lowest is 47.6 for the state of South Carolina. For a few states adjusted rates have been calculated separately for the white and colored population. In this group of states the highest adjusted cancer rate for the white population is 95.9 per 100,000 population for New York and the highest rate for the colored population is 90.6, also for New York. The lowest adjusted cancer rate for the white population is 51.5 for Tennessee and the lowest for the colored population is 36.4 for Florida.

The adjusted rates show that the northern states have comparatively high and the southern states comparatively low cancer mortality, while there is little difference between the adjusted cancer rates of the white and colored races of the same states.

COLORS FOR TRAFFIC SIGNALS

Thirty-nine men, representing as many administrative bodies, trade associations, scientific or technical societies, and government departments, make up the sectional committee on colors for traffic signals which was organzed at a meeting in New York City on November 9 under the auspices of the American Engineering Standards Committee. In opening the meeting, P. G. Agnew, secretary of the American Engineering Standards Committee, said that this was unquestionably the most representative group that has ever come together anywhere in the world to discuss this subject.

The committee elected as its officers the following representatives of the three sponsors for the code: *Chairman,* Charles J. Bennett, state highway commissioner of Connecticut, representing the American Association of State Highway Officials; *vice-chairman,* Dr. M. G. Lloyd, representing the United States Bureau of Standards; *secretary,* Walter S. Paine, research engineer, Ætna Insurance Company, Hartford, Conn., representing the National Safety Council.

Because of the difficulty of bringing the entire sectional committee together at frequent intervals an executive committee was appointed with instructions to collect information on the subjects coming within the scope of the code, to digest this information, to appoint subcommittees, to arrange for the necessary research work, and to draft definite recommendations for the consideration of the sectional committee. The executive committee consists of the following:

Bert Lord, New York State Department of Motor Vehicles, Albany, N. Y., representing the group of administrative officials and departments;

T. D. Pratt, Motor Truck Association, New York City, representing the owners and operators of motor vehicles;

G. G. Keleey, American Gas Accumulator Company, Newark, N. J., representing the group of automotive accessory, signs and signal manufacturers;

A. H. Rudd, Safety Section, American Railway Association, representing the railroads;

W. P. Young, general manager, National Automobile Underwriters Conference, representing the group of insurance interests on the sectional committee;

W. P. Eno, of the Eno Foundation, Washington, D. C., representing the group of scientific and technical societies;

Harry Meixell, of the Motor Vehicle Conference Committee, New York City, representing the motor vehicle manufacturers;

and the three officers of the sectional committee.

The sectional committee by resolution invited the Aeronautical Chamber of Commerce of the United States to participate in the work of the committee. It was also decided at the organization meeting of the sectional committee to appoint a sub-committee to investigate the efficiency of all color signals now in use as traffic signals, and where possible to ascertain the reasons for adopting certain colors for specific uses. This committee will investigate the use of various types of semaphores and silent policemen. Another committee will make an original study of specific colors for definite uses as a check upon previous researches and to establish certain colors for traffic signals. A third committee will study non-luminous signs and signals and propose, after thorough research, signs of definite colors and shapes for highways and also for railroad crossings.

THE CHARLES A. COFFIN FOUNDATION

On May 16, 1922, Mr. Charles A. Coffin, in his seventy-eighth year, retired from the active leadership of the General Electric Company. Mr. Coffin has been identified with the development of the electrical industry since 1882. He was the founder and creator of the General Electric Company, of which he has been the inspiration and leader for thirty years. As an expression of appreciation of Mr. Coffin's great work not only for the General Electric Company but also for the entire electrical industry and with the desire to make this appreciation enduring and constructive as Mr. Coffin's life and work have been, the board of directors of the General Electric Company created on his retirement and now desire to announce the "Charles A. Coffin Foundation."

A fund of $400,000, to be known as the "Charles A. Coffin Foundation," has been set aside and the income, amounting to approximately $20,000 per year, will be available for encouraging and rewarding service in the electrical field by giving prizes to its employees, recognition to lighting, power and railway companies for improvement in service to the public and fellowships to graduate students and funds for research work at technical schools and colleges. The foundation will be controlled and administered by a foundation committee appointed by the board. This committee, within the limits of the purposes for which the foundation is created, will have power to change the conditions applicable to the distribution of the fund and the amounts for each particular purpose.

The committee proposes to distribute the income of the foundation as follows:

First. Eleven thousand dollars ($11,000) in prizes for the most signal contributions by employees of the General Electric Company toward the increase of its efficiency or progress in the electrical art. Particularly, the prizes are to further encourage suggestions from workmen. With each prize, the company will give a certificate of award.

Second. A gold medal, to be known as the "Charles A. Coffin Medal," will be awarded annually to the public utility operating company within the United States which, during the year, has made the greatest contribution towards increasing the advantages of the use of electric light and power for the convenience and well-being of the public and the benefit of the industry. The company receiving the medal will also receive one thousand ($1,000) for its employees' benefit or similar fund.

Third. A gold medal, to be known as the "Charles A. Coffin Medal," will be awarded annually to the electric railway company within the United States which, during the year, has made the greatest contribution towards increasing the advantages of electric transportation for the convenience and well-being of the public and the benefit of the industry. The company receiving the medal will also receive one thousand dollars ($1,000) for its employees' benefit or similar fund.

Fourth. Five thousand dollars ($5,000) is to be awarded annually for fellowships to graduates of American colleges and technical schools who, by the character of their work, and on the recommendation of the faculty of the institution where they have studied, could with advantage continue their research work either here or abroad; or some portion or all of the fund may be used to further the research work at any of the colleges or technical schools in the United States. The fields in which these fellowships and funds for research work are to be awarded are: Electricity; physics; physical chemistry.

A committee appointed by the foundation committee will award such fellowships and funds for research work, with the advice and cooperation of a committee of three, one to be appointed by each of the following: The National Academy of Sciences, the American Institute of Electrical Engineers and the Society for the Promotion of Engineering Education. This committee is to be known as the "Charles A. Coffin Fellowship and Research Fund Committee" and the fellowships are to be known as the "Charles A. Coffin Fellowships."

The board of directors of the General Electric Company has appointed as the "Charles A. Coffin Foundation Committee" the following officers of the company: A. W. Burchard, J. R. Lovejoy, E. W. Rice, Jr., Gerard Swope and O. D. Young.

The following committee, to administer the fund and to act with organizations outside the company, have been appointed:

Committee to cooperate with the National Electric Light Association: A. H. Jackson, J. R. Lovejoy, vice-presidents.

Committee to cooperate with the American Electric Railway Association: J. G. Barry and A. H. Jackson, vice-presidents.

Committee to cooperate with the National Academy of Sciences, American Institute of Electrical Engineers and the Society for the Promotion of Engineering Education: E. W. Rice, Jr., honorary chairman, A. H. Jackson, vice-president, and W. R. Whitney, director of research laboratory.

THE SOCIETY OF SIGMA XI

The annual convention of the Society of the Sigma Xi will be held in Cambridge on December 27, at the time of the meetings of the American Association for the Advancement of Science. The program of the convention includes the following:

2:30 P.M. Business session.

6:15 P.M. Annual dinner.

8:45 P.M. Joint meeting with the American Association for the Advancement of Science. Address, "The Nation and its Health," by President Farrand of Cornell University.

The chapters of Sigma Xi are entitled to delegates with the right to vote at the business session. Attendance at the business session or the dinner or the evening address is not limited to delegates. All members of the society are invited to be present and will be welcome at all the meetings. A special desk for the registration of members of Sigma Xi will be provided in the registration bureau of the association, where programs and dinner tickets may be secured. Clerks will be in attendance at this registration desk on December 26 and 27.

The business session of the convention will be one of unusual importance, since a complete revision of the constitution of the society is to be brought up for adoption. The revision has been made necessary by the growth of the society as well as by the expansion of its work. Sigma Xi is no longer a society of a few chapters scattered among the educational institutions of the country, but it is a large organization numbering thirty-eight chapters in universities and in some of the research institutions of the country. In addition to this active membership there are scattered over the country and the world some fifteen thousand members of Sigma Xi, who by the provisions of the new constitution will be brought into closer touch with the work of the society. All members of Sigma Xi, whether delegates from chapters or not, are invited and urged to take this occasion to get acquainted with the new spirit in the organization.

SCIENTIFIC NOTES AND NEWS

THE Lalande Medal of the Paris Academy of Sciences has been awarded to Dr. Henry Norris Russell, director of the Princeton Observatory. The Janssen Medal goes to Dr. Carl Stormer, professor of pure mathematics at the University of Christiana, for his work on the aurora borealis.

DR. SIMON FLEXNER, director of the Rockefeller Institute for Medical Research, New York, was elected an honorary member of the Copenhagen Medical Society at a recent meeting celebrating the one hundred and fiftieth anniversary of that body.

AT a general meeting of the Royal Scottish Geographical Society, held on November 7, the society's gold medal was awarded to Professor J. W. Gregory, University of Glasgow, in recognition of the scientific importance of results obtained by him through explorations in Spitsbergen, Australia, East Africa and southwest China.

DR. J. BORDET, professor of bacteriology at Brussels, has been given an honorary degree by the University of Paris.

DR. H. J. KAMMERLINGH ONNES, of the University of Leiden, celebrated on November 11 the completion of his fortieth year of service as professor of physics.

A BANQUET was tendered Dr. Calleja, professor of histology at the University of Madrid, on the occasion of his fiftieth professional anniversary.

DR. JOHN W. HARSHBERGER, professor of botany at the University of Pennsylvania, has been made a member of the Swedish Linnæan Society and of the Finnish Forestry Society.

DR. F. W. PEABODY, of Boston, professor of medicine at the Medical School of Harvard University, and physician-in-chief of the Boston City Hospital, has been elected a member of the Council on Pharmacy and Chemistry to fill the vacancy caused by the resignation of Dr. C. L. Alsberg, formerly chief of the Bureau of Chemistry, Department of Agriculture, and now director of the Food Research Institute of Stanford University.

DR. KENYON L. BUTTERFIELD, president of the Massachusetts Agricultural College, has been reelected president of the American Country Life Association for 1922-23. C. J. Galpin, of the U. S. Department of Agriculture, is first vice-president.

THE British Institution of Civil Engineers has made the following awards for papers printed in the *Proceedings* for the session 1921-1922: A George Stephenson gold medal to Dr. B. C. Laws (London); Telford premiums to Professor L. Bairstow (London), Dr. A. J. Sutton Pippard (London), Mr. E. A. Cullen (Brisbane), Mr. H. H. Dare (Roseville, N. S. W.), and Mr. F. W. Stephen (Aberdeen). For papers read before meetings of students in London and the provinces the following awards have been made: A Miller prize and the James Forrest medal to Mr. F. H. Bullock (Cardiff); and Miller prizes to Mr. J. G. Mitchell (London), Mr. A. G. M'Donald (London) and Mr. Harry Wolf (Manchester).

PROFESSOR E. W. BROWN, of Yale University, will be absent from New Haven until April, 1923. His address will be care of the Bishop Museum, Honolulu, H. I.

DR. R. S. BREED, chief in research (bacteriology) at the New York State Agricultural Station, has been granted six months' leave of absence beginning on March 1, 1923, for the purpose of special study of bacteriological problems at the Pasteur Institute and of dairy sanitation in France, Denmark and Holland.

DR. LOUIS I. DUBLIN, statistician of the Metropolitan Life Insurance Company, will deliver the third Harvey Society Lecture at the New York Academy of Medicine, on Saturday evening, December 16, 1922. His subject will be "The Possibilities of Human Life."

AT the November meeting of the Society of the Sigma Xi of the University of Wisconsin, Professor Louis Kahlenberg, of the department of chemistry, delivered the address on the subject, "The separation of crystalloids from one another by dialysis."

Professor Cassius J. Keyser delivered an address on the "Mathematical obligations of philosophy and education" at the weekly convocation of Connecticut College on November 14. On December 2 he gave an address on "Mathematics and man" at the meeting of the Association of Teachers of Mathematics of the Middle States and Maryland held at Wilmington, Del.

A statue of Claude Louis Berthollet, the French chemist, has been erected at his birthplace, Annecy, on the occasion of the centenary of his death on November 6, 1822.

Dr. Albert Henry Buck, from 1887 to 1904 professor of otology in Columbia University, a leading aurist in New York City, died on November 16, in his eighty-first year.

Dr. Oscar Hertwig, director of the Institute of Histology at the University of Berlin, died on October 27, aged seventy-three years.

The death is announced of Dr. Lassar-Cohn, since 1894 professor of chemistry at Königsberg.

Mr. James A. Teit, well known for his researches on the ethnology of British Columbia, died on October 30 at Merrit, British Columbia. Mr. Teit carried on researches in connection with the work of the Jesup North Pacific Expedition of the American Museum of Natural History. He contributed to the work of the Bureau of American Ethnology and to the Anthropological Department of the Geological Survey of Canada. During the last years of his life, Mr. Teit succeeded in organizing the Indians of British Columbia for the purpose of acting collectively in necessary negotiations with the Canadian government relating to questions of land holding, fishing rights and other matters concerning the life of the natives.

Professor A. V. Vassiliev, of the University of Petrograd, sends us the following note: "Professor A. A. Markov (1856-1922), emeritus professor of the University of Petrograd, member of the Russian Academy of Science, died at Petrograd on July 27. A mathematician of world-wide reputation, Professor Markov was a graduate of the University of Petrograd, pupil and follower of Chebyshev, Korkin and Zolotarev. The main fields of his investigations were the theory of indefinite binary and ternary quadratic forms and the theory of linear differential equation (hypergeometrical equation). His brilliant achievements brought him at the age of thirty the honor of being elected member of the Russian Academy of Science. His works on the calculus of finite differences and on the theory of probabilities were translated into German and published in 1896 and 1912, respectively."

Professor Vassiliev also writes: "Professor L. A. Chugaev (1873-1922) died of typhoid fever at the city of Griazovtzy in the province of Vologda on September 23. One of the most eminent of Russian chemists, Professor Chugaev was a professor in the University of Petrograd, and director of the Institute for the Investigation of Platinum. His various articles on camphor, platinum, cobalt and nickel were published both in Russia (*The Journal* of the Physico-Chemical Society of Russia) and in western Europe (*Journal of the Chemical Society, Zeitschrift für anorganische Chemie,* etc.)."

The fourteenth annual meeting of the Paleontological Society will be held Thursday to Saturday, December 28 to 30, in the Natural Science Building, University of Michigan. The address of Charles Schuchert, retiring president of the Geological Society of America, will be delivered in the closing hour of the morning session of that society, Thursday, December 28. The address of W. D. Matthew, retiring president of the Paleontological Society, on the subject "Recent progress and trends in vertebrate paleontology" will be given at 2 P.M., Friday, December 29. The members are invited to the annual smoker at 9 P.M. Thursday and the annual dinner at 7 P.M. Friday with the Geological Society of America.

The Eleventh International Physiological Congress will be held in Edinburgh, from July 23 to July 27, 1923, under the presidency of

Sir Edward Sharpey Schafer, M.D., F.R.S. Those who desire to be enrolled as members are requested to forward their names and addresses, together with the amount of their subscription (25 shillings), to Miss Charlton, Department of Physiology, University, Edinburgh, who will send on request particulars of hotels and lodgings, and all other necessary information.

In its issue of October 28 *Nature* says: "In an article on Lord Inchcape's task in the *Sunday Times* of October 22, a former finance member of the government of India, Lord Meston, makes an alarming suggestion. Speaking of things 'useful, but not essential,' he says, "many of the research institutes and the like will come under the shears.' The illiberal spirit which inspired our domestic wielders of the axe may thus be carried by one of them to India—a country which, more than any other, perhaps, has benefited by the application of science to 'useful' purposes. The plant breeders there, alone, have literally added millions to the country's wealth; new wheats and cottons yielding 20 to 30 per cent. more than the indigenous varieties have already been successfully introduced. It must not be forgotten that, in India, the prosperity of agriculture is a fundamental element of the solvency of the government, for there, the state, as owner of the soil, takes one half of the rental value of the land. The sum thus raised approaches a moiety of the whole taxation of the country. It is to be hoped that such a suicidal policy as that indicated by Lord Meston will not be advocated by Lord Inchcape, though as a quondam member of the Geddes Committee he may be inclined to repeat its mistakes."

Dr. H. M. Quanjer, head of the Institute for Phytopathology at Wageningen, Holland, announces that an international phytopathological conference is being organized to meet in Holland in June, 1923. The committee in charge consists of Professor Westerdijk, Mr. v. Poeteren, and Dr. v. Slogteren in addition to Dr. Quanjer. A cordial invitation is extended to Americans. Detailed announcement may be expected later and meanwhile any inquiries may be addressed to Dr. Quanjer.

The program for the second annual meeting of the Science Section of the Association of Colleges and Preparatory Schools of the Middle States and Maryland held at the Tower Hill School, Wilmington, Delaware, on Saturday, December 2, 1922, at 9:45 A.M., was as follows: Address on "Science teaching in schools and colleges," Dr. Charles L. Reese, chemical director, E. I. duPont deNemours and Company. Symposium on "Outstanding Problems of the Science Curriculum" (ten-minute papers): "The present status of science in the high schools of New York City," Rosemary F. Mullen, Washington Irving High School, New York City; "The ideal science curriculum for the high school," J. M. Arthur, Tome School, Port Deposit, Md.; "The elective system and the science curriculum in the secondary school," Henry M. Snyder, Wilmington High School; "Biology in the science curriculum," Winifred J. Robinson, dean of Women's College, University of Delaware, Newark, Delaware; "The status of the American Chemical Society on the correlation of high school and college chemistry," Neil E. Gordon, University of Maryland, secretary of Chemical Education Section, American Chemical Society. Address on "The relation between science and modern religious thought, Dr. S. C. Schmucker, professor of biology, State Normal School, West Chester, Pa.

The University of Paris has published comparative statistics of students matriculated in 1921 and 1922, which are quoted in the *Journal* of the Medical Association. In July, 1921, the total matriculation reached 21,185 (17,993 men and 3,192 women). In 1922 the number had grown to 21,612 (18,066 men and 3,546 women), or an increase of 427 students. The department most strongly represented in 1922 was law. Then came medicine, with 4,639 students (738 women); belles-lettres, with 3,381 students (1,450 women); sciences, with 3,179 students (532 women), and pharmacy, with 743 students (234 women). The department in which the most women are enrolled is that of belles-lettres (1,450 women as against 1,931 men). From 1921 to 1922 the number of

French students at the University of Paris increased by 959, while the number of foreigners decreased by 332.

The annual report of the general progress of the British Museum and of the Natural History Museum during 1921 has been issued. Notes by Sir F. G. Kenyon and Sir Sidney F. Harmer describe the additions made to the collections and the rearrangement of rooms. During the year 901,209 persons visited the British Museum, of whom 159,177 were reading room students. Visitors to the Natural History collections in Cromwell Road numbered 479,476.

Preliminary announcements by the Australian Research Council indicate the scope of the Pan-Pacific Scientific Congress to be held in Australia in August, 1923. The program calls for organized conferences on fundamental topics in anthropology, agriculture, botany, entomology, geography, geology, geodesy and zoology. Among the discussions in geology formulated by E. C. Andrews are "Relation of coral reefs to glaciation," "Structure of the Pacific," "Mountain building and igneous intrusion," "Carboniferous and Permian stratigraphy" and "Mineral resources of the Pacific." Arrangements are being made for excursions to the desert, to the tropical jungles and to living coral reefs. By request of the Australian committee, headed by Sir T. Edgworth David, the National Research Council, which organized the First Pan-Pacific Scientific Conference at Honolulu in 1920, is cooperating to insure a profitable meeting for 1923.

Reports from Commander J. C. Thompson and Hans G. Hornbostel, representing the Bishop Museum, indicate successful outcome of the explorations in Guam and in the southern Marianne Islands. Much information has been obtained regarding the culture of vanished Chamorros, a flourishing race, at the time of Magellan's visit in 1521. Under the direction of M. F. Malcolm, assisted by the governor of Saipan, the remarkable ruins on the Japanese island of Tinian, visited by Anson (1749), Mortimer (1791) and Freycinel (1817), are being studied with a view to enlarging the knowledge of migration routes and inter-relations of Pacific peoples.

Harvard University has come into possession of the Farlow botanical library, one of the most valuable collections of books dealing with cryptogamic botany in the world, quarters having been provided for it which meet satisfactorily the conditions of gift contained in the will of Professor William G. Farlow, who died in 1919. Under Prorfessor Farlow's will, this collection, comprising 11,000 volumes, was given to Harvard on condition that, within three years after the testator's death, suitable arrangements should be made for placing it in fireproof quarters in proximity to the Farlow herbarium of cryptogamic plants, already owned by the university. These conditions have been met by the decision of the Harvard Corporation to house both the Farlow library and the herbarium in the Divinity Library building.

The expedition sent last July by the American Museum of Natural History to the island of Santo Domingo to secure, if possible, specimens of the rhinoceros iguana and the giant tree frog, has returned to New York with a large collection, including over two hundred living specimens in addition to the preserved material. The expedition was financed by the Angelo Heilprin Fund and the materials which it collected will be installed in the museum's new Hall of Reptiles, at present under construction. Under the leadership of Dr. and Mrs. G. Kingsley Noble, both of the museum staff, the party crossed the entire length of the Dominican Republic while pursuing its investigations. After exploring the Quita Espuela, an outlying mountain range in the northeastern part of the island, the expedition crossed to Constanza, in the heart of the central Cordillera. From there it pushed on to Barahona, and finally to Los Lajas on the Haitian border.

The Sigma Xi Club of Southern California held its first regular meeting in Los Angeles on the evening of October 28. About eighty-six persons were present including members from numerous Southern California towns. Dr. W. L. Hardin, president of the club, presided. Professors R. A. Millikan, C. G. Darwin and Paul Epstein, of the California Institute of Technology, were guests of the club and were elected honorary members. Professor Millikan told of the activities of the scientific committee of the League of Nations, of which he is a member, and discussed what is desirable in international cooperation in scientific matters. Professor Darwin addressed the club on "The nucleus of the atom." The following officers were elected for the ensuing year: *President,* W. L. Hardin, Mt. Washington, Los Angeles; *vice-president,* L. S. Weatherby, University of Southern California; *secretary,* P. W. Merrill, Mt. Wilson Observatory; *treasurer,* E. E. Chandler, Occidental College.

Nature notes the assignment to science of the proceeds of the first performance of a great play by a leading dramatist. The play was the tragedy "Judith," by M. Henri Bernstein, produced at the Gymnase Théatre, Paris, on October 12, before a brilliant and distinguished assembly, which comprised ministers of state and the chief social and intellectual leaders of the city. The receipts were for the benefit of the French Confederation of Scientific Societies, and amounted to about $5,000. M. Bernstein gave his royalty as author, and Mme. Simone, who took the title part and is said to have obtained the greatest triumph of her career, devoted her fee to the same purpose.

We learn from the *Journal* of the American Medical Association that the national alliance to promote an increase in population in France is planning a competitive contest with prize awards totaling 120,000 francs for the best essays setting forth the critical demographic situation and the best means of combating the danger. The first prize is 50,000 francs; the second, 10,000 francs; the third, 8,000 francs, while the balance of the 120,000 francs will be distributed in small sums. The essay which is awarded the first prize will be printed by the national alliance and 500,000 copies will be distributed throughout the country. The competitors will deal more especially with the following topics, but they will not be confined to these: (A) The evil as it exists: (1) the decrease of the birth rate in France, during the past century; the inevitable further decrease in the future if the most energetic measures are not adopted, and (2) the dangers that lurk in the fall of the birth rate and the catastrophe that threatens not only the life of the nation but also of the individual. (B) The proposed remedies: (1) the respect due to large families and the advantages that they deserve; (2) the reforms needed to raise the birth rate—at the price of financial sacrifices, if necessary; if by the expenditure of certain sums an increase in the number of births can be brought about, no money could be better expended, and (3) instruction in the matter of the moral, social and patriotic duty of paternity and maternity—their joys and their rewards.

UNIVERSITY AND EDUCATIONAL NOTES

The University of Pennsylvania will receive $200,000 for the establishment of a department of clinical surgery from the estate of Edmund A. W. Hunter. The bequest was made with the provision that the addition to the university be known as "The Agnew and Hunter Department of Clinical Surgery," in memory of Dr. D. Hayes Agnew and Dr. Charles D. Hunter. The latter was the son of the donor.

A fund of $60,000 for establishing a chair at Tulane University of tropical diseases and hygiene, and one amounting to $30,000 for constructing an isolation building for the Charity Hospital will eventually be available to these institutions under the will of the late William G. Vincent.

The trustees of Hamilton College have authorized the erection of a biology-geology and museum building to cost approximately $225,000, and the construction of an addition to the chemistry building the estimated cost of which is $60,000. It may be noted further that the board of trustees, by unanimous vote, with twenty-five of the twenty-eight members of the board present, authorized the fixing of four hundred as the ultimate and maximum number of undergraduates in the college, and directed that all building plans take that number into account as the total for which provision should be made.

Ruth Okey, Ph.D., has resigned from the biochemical laboratory of the University of

Iowa Hospital, Iowa City, to take up the teaching of nutrition at the University of California.

DR. WILLIAM E. BLATZ has been appointed instructor in psychology at the University of Chicago.

LEOPOLDO B. UICHANCO, Sc.D. (Harvard), has resumed his former work in the University of the Philippines, where he has been appointed assistant professor of entomology at the College of Agriculture, Los Baños, P. I. Dr. Uichanco had been on leave for about three years, as a traveling fellow of the University of the Philippines in the United States, spending the larger portion of this period in post-graduate work at the Bussey Institution of Harvard University.

DISCUSSION AND CORRESPONDENCE

WEATHERING UNDER CONSTANT CONDITIONS

DURING the past summer the writer visited a number of the paleolithic caves of southern France and northern Spain, and there had an opportunity to study the effects of weathering upon rocks and upon the works of man where conditions have apparently remained unchanged during a time which is variously estimated at from 18,000 to 30,000 years.

Every geologist from his own observations and reading can give many examples of rapid weathering, such as that on the western front of the Amiens Cathedral probably not an original stone placed there by the builders in the fifteenth century can be found;[1] that the outside stones of Westminster Abbey have been renewed five times over; that the stone of which the British Houses of Parliament are built has crumbled so rapidly that already it has been necessary to replace many of the stone ornaments with cast iron.

On the other hand, so many objects showing almost no evidence of weathering have been taken from tombs in Egypt where they were buried for many centuries that little surprise was evinced when the Metropolitan Museum Expedition of 1919-1920,[2] announced the discovery at Thebes, in the chamber of the tomb of a man of great wealth, of a large number of remarkably preserved small wooden models illustrating the daily life of his household: brewers making beer, cooks making bread, boats with their boatmen, cattle fattening in their stable. These wooden models, which are "practically as perfect as the day they were made," were carved and stored away about 4,000 years ago, but so little have they been affected by the agents of the weather that even the finger and thumb prints of the men who carried the figures up to the tomb are preserved as well as fly specks on the models and spider-webs with dead spiders still in them.

It is perhaps because of the many archeological discoveries in arid countries that we have become accustomed to think of the agents of the weather as working slowly only where there is little or no moisture, but the wonderfully preserved paintings, engravings and clay models which are to be seen in the moist caves of southern France and northern Spain, and which antedate the works of the Egyptians by thousands of years, compel a modification of these views.

When the polychrome paintings on the ceilings of the great chamber of the cave of Altamira, near Santander, Spain, were discovered, careful observers doubted their authenticity because they showed so little evidence of great antiquity: the paint is so fresh that it can easily be rubbed off with the finger, the colors are probably nearly as bright as when first laid on, and there is no conspicuous flaking of the surface. Notwithstanding their modern appearance it is generally agreed that the paintings were made by paleolithic artists thousands of years before the pyramids were built or Babylon founded.

In the cave of Combarrelles and in other caves in the Dordogne region of southern France the same absence of conspicuous weath-

[1] J. W. Gregory, "Geology of To-day," page 91.

[2] *Bull. Metropolitan Museum of Art*, XV, December, 1920, pp. 12-40.

ering is marked: the only obvious change in the engravings made by paleolithic artists is that the incisions have taken on the buff color of the rock and are no longer white as when first made.

In the cavern of Tuc D'Audoubert on the estate of Count de Begouen, near St. Girons, in the Pyrenees, is an even more remarkable example of lack of disintegration. In this cave are the clay models of bison which are in nearly as perfect condition as when made. A clay model is almost a synonym for the ephemeral for the reason that a short exposure to ordinary air causes it to dry and crack, and excessive moisture causes it to collapse. These models of bison are in fact slightly cracked but with this exception are unchanged. It is possible that the cracks were formed within the first few weeks after the figures were modeled and that none has developed in the 18,000 to 30,000 years that have followed. This seems incredible, but the proof of very great age appears to be well established.

The conditions under which the art of paleolithic man has been preserved almost unchanged for thousands of years are to be found in the uniform temperature, lack of sunlight, and absence of circulating ground water. Although the rock in the Altamira cave is saturated there has been slight movement of the ground water and consequently little solution or deposition has been possible. In the cave of Tuc d'Audoubert there is now some solution and the composition of the water which drips from the roof of the cave has changed slightly as is shown in some of the stalagmites which after being built by lime deposited from the water now have crater-like depressions in their summits showing that the water is at present under-saturated. It is probable, however, that the moisture content of the air has remained constant and that, because of this, the clay models have not disintegrated. The remarkable preservation of the Egyptian wooden models to which reference has been made is due to uniform temperature, lack of sunlight and absence of moisture.

The explanation of such remarkable preservation therefore involves no new principle as it is due to uniform temperature, absence of sunlight, and non-circulation of ground water. These are, indeed, the conditions under which, deep down in the rocks, the skeletons of the vertebrates of the past are preserved.

Herdman F. Cleland

Williams College

[3] Comte de Begouen: "Les Statues d'Argile prehistoriques de la Caverne du Tuc D'Audoubert (Ariège). *Comptes rendus des séances de L'Académie des Inscriptions et Belles Lettres*, 1912, p. 532.

[4] Macallister, R. S.: "A Text-book of European Archæology," Vol. 1, 1921, p. 481.

THE BEGINNINGS OF AMERICAN GEOLOGY

To the Editor of Science: In his letter, "The Beginnings of American Geology" (Science, October 27, 1922), Dr. Marcus Benjamin (doubtless quite unintentionally) makes a statement which is not only unsupported by facts but which most unjustly reflects upon the character and career of a distinguished American geologist, a president of the Geological Society of America, and also of the American Association for the Advancement of Science, and, I think, the most unselfish, modest and self-effacing man of science I have ever known.

As in these days whatever appears "in print" is likely to become material for the future historian it seems worth while to correct the erroneous statement.

In his reference to Dr. Newberry's connection with the Geological Survey of Ohio there occurs the phrase "owing to the changes in political administration in Ohio he (Newberry) found himself displaced by a subordinate."

Neither of the two statements incorporated in this sentence is true.

No one who had the good fortune to know Dr. Edward Orton, who was Newberry's successor as director of the survey, will be willing to admit that there is the slightest foundation for what is implied in the last phrase; and those who are familiar with the history of that period of the survey know that Dr. Newberry's failure to continue as its head was not due to a change in political administration in Ohio.

During twelve of the sixteen years covering the entire period in which Dr. Newberry may be supposed to have had any sort of connection with the survey, governors of the state were of the party which was in power when it was inaugurated through the interest and initiation of President Hayes, himself twice governor during those years.

Nor is there any evidence to show an attitude of personal unfriendliness towards Dr. Newberry or the survey on the part of the two governors belonging to the other political faction, each of whom served one term.

The plain truth seems to be that for the discontinuance of appropriations for the support of the survey under his administration and for the final ending of it by legislative enactment in 1882, Dr. Newberry, himself, was largely if not entirely responsible, though the financial crisis through which the whole country was passing during the early 70's doubtless had much to do with the limitations put upon its operations.

The people of Ohio had been led to believe that the economic and especially the mineral resources of the state would be developed by the survey and it is not surprising that there was impatience when after the lapse of ten or fifteen years nothing of great value on this phase of the work had appeared.

Instead there had been published elaborate reports upon paleontology, involving large expense for beautiful (and valuable) plate illustrations, the cost of which for a single volume being as much as $34,000.

After three years the legislature modified the organization by creating a geological board consisting of the governor, school commissioner and the state treasurer, which was charged with the general supervision of the survey, though this had, apparently, little effect upon the program of its operations.

Volume 4 of the series of reports was published in 1882, thirteen years after the beginning of the work and was devoted entirely to vertebrate zoology.

In the meantime Dr. Orton, who had been one of Newberry's principal assistants, had been especially interested in the economic and mineral resources of the state, the extent of which was hardly realized at that time, and material for Volume 5 had been gathered. In April 1882 the legislature made an appropriation for the cost of publishing this volume and at the same time announced that "upon the publication of said Volume 5 the Geological Survey of Ohio is hereby declared to be completed."

It was also provided in the same Act that the publication of this volume should be in charge of a geologist to be appointed by the governor.

The governor, the Hon. Charles Foster, promptly appointed Dr. Orton, who had recently resigned the presidency of the Ohio State University, which he had held from its organization in 1873, in order to devote his entire time to the professorship of geology in that institution.

In 1884 Volume 5 was published, being devoted almost entirely to coal. It has always been the most sought after publication of the survey and the reaction to its appearance was a provision by the legislature "to extend and complete the account of the economic geology of the state that was begun in Volume 5." In 1888 Dr. Orton published a volume on petroleum and natural gas which has been esteemed as equal in value to Volume 5.

The survey became and has continued to be popular with the people of the state and it has ever since been "a going concern." On the death of Dr. Orton in 1899 he was succeeded by his son, Edward Orton, Jr., whose development of the ceramic interests and methods of the state were of nation-wide importance. Desiring to devote most of his time to this special field he resigned in 1906 and was succeeded by the present incumbent, Professor J. A. Bownocker who had served as assistant geologist for several years, and who also fills a chair of geology in the state university.

It is true that the fact of Dr. Newberry's absence during a large part of each year, especially during the winter when the legislature was in session, had a good deal to do with the dissatisfaction which developed a few years after his work began. Although born in Connecticut he was, at the age of two years, brought to Ohio by his parents and the state in which he grew up and was educated always regarded him as one of her illustrious sons.

He was a paleontologist rather than a geologist but if he had been tactful enough to place the emphasis of the earlier years of the survey upon those phases of it in which the people were vitally interested the story of his connection with it might have been different. As it was Ohio saw adjoining states rapidly developing their mineral resources as the result of geological surveys while her own organization seemed to be producing only beautifully illustrated volumes concerning fossils.

There are enough sins legitimately left at the door of state and national legislatures, in connection with their dealings with science, without adding to their number the failures and mistakes which should really be charged to men of science themselves.

T. C. MENDENHALL
RAVENNA, OHIO
NOVEMBER 7, 1922

THE COLLOIDAL STATE

EDITOR OF SCIENCE: It seems that one important basis of the anomalous behavior of matter in the colloidal state of subdivision lies in the fact that, in the colloidal zone, increase in dispersion is accompanied by a disproportionately large increase in kinetic activity of the ultramicrons, which reaches an extreme at atomic or molecular dispersion. The speed of motion of ultramicrons is itself the resultant of several factors (including size, temperature, viscosity of dispersion medium, concentration, free electronic fields, etc.), but it probably exercises a very considerable influence in reactions where colloids are involved, *e.g.*, diffusion, adsorption, enzyme action, etc.

For some time I have been accumulating data bearing on this question, and would be pleased to hear from any readers of SCIENCE who know of pertinent experimental facts. Thus Zsigmondy ("Colloids and the Ultramicroscope") has given the size of certain gold ultramicrons and their relative amplitudes of motion. Ultramicrospic examination indicates that gel formation involves aggregation with cessation of visible kinetic activity, and the zone of maximum degree of colloidality (J. Alexander, *J. Am. Chem. Soc.*, 43, p. 434, 1921) may be that zone where the curve of free surface plotted against particle size, approaches and crosses the curve of kinetic motion plotted against particle size.

An investigation will also be made of the variations in size of ultramicrons and ultramicroscopic activity with changes in free acidity (H-ion cencentration or p_H value).

JEROME ALEXANDER
50 EAST FORTY-FIRST STREET,
NEW YORK CITY,
NOVEMBER 13, 1922

NOTE ON THE FUSARIUM WILT DISEASE OF BANANAS

IN the journal, *Phytopathology*, of September, 1919[1], Dr. E. W. Brandes described in detail his out-door pot inoculation experiment, demonstrating that *Fusarium Cubense*, E. F. Smith is the cause of the very destructive wilt disease of the banana, heretofore generally known as the Panama disease. Since then there has been published in Java a paper by E. Gaumamm on a vascular disease of the banana[2], in which the author attempts to discredit the work of American investigators of this disease, but particularly that of Dr. Brandes. In a statement by Brandes, of which the writer has a typewritten copy, he reviews Gaumamm's paper and points out various errors and confusion of facts. As the writer, while connected with the United Fruit Company, recently conducted an experiment of exactly the same kind as the one by Brandes above mentioned, it may be important to those interested to briefly describe this experiment and the results. The experiment was made just outside the Company laboratory, in Changuinola, state of Bocas del Toro, Panama. In this case the common Gros Michel banana was employed, instead of the variety Chamalucco employed by Brandes. Otherwise the two experiments were almost perfectly parallel except as to locality.

This experiment was begun November 1, 1921. Twenty-five cement pots were employed, set in corresponding holes in the ground, and

[1] Brandes, E. W., Banana Wilt. *Phytopath.* 9. No. 9, pp. 339-389, pl. 22-34, 1919.

[2] Gaumamm, E., Over een bactericele Vatbundelziekte der bananen in Nederlandsch., Indie. Meded. V. H. Instituut V. Plantenziekten, No. 48, Dept. N. Landbouw, Nijverheid en Handel, pp. 135, pl. 8, 1921.

the excavated soil afterward returned. They were square, 3 feet each way at top, 4 feet deep, and open at bottom. Sterilizing the soil was done by a Company railway engine, the soil in each pot being steamed two hours, at 110° C. Fourteen pots were thus sterilized and the remaining six were neither sterilized nor inoculated. All the pots were planted with one "bit" of a banana tuber having two "eyes" and in seven of those sterilized these bits were inoculated with a laboratory culture of *Fusarium Cubense,* while the other seven were not inoculated. The inoculum was a combination of two kinds of culture-mixed at time of application—one in corn meal decoction and the other in Ushchinski's solution, both originating from rice tube cultures, three weeks previously. It was applied in quantity of about one liter to each pot. Already in February, 1922, one of the inoculated plants showed signs of disease. By April 1 every one of the inoculated plants was diseased and most of them were even then bad cases. Up to July 12, when the writer left Panama, no one of the plants in the inoculated pots, either sterilized or unsterilized, gave any indication of disease. Besides the added interest that may be attached to this experiment, with a different variety of banana in a different locality, the writer is glad, and others will be, that it confirms the painstaking work of Dr. Brandes. It should be added that Dr. J. R. Johnston, director of tropical research for the United Fruit Company proposed the experiment, in which the writer was also supported and encouraged by the manager, H. S. Blair, and by H. L. Peck, E. C. Adams, and other men of the Company.

Mark Alfred Carleton

Cuyamel, Honduras

FRESH WATER COELENTERATA IN KENTUCKY

In 1916[1] the writer called attention to an extraordinary appearance of the rare fresh-water medusa, *Craspedacusta sowerbyi,* in a Kentucky creek, when it was present literally by the thousands, and expressed his intention to make a search for the hydroid stage of the jellyfish, since the indications were that where so many of the sexual form occurred there should be a good prospect of finding the asexual stage. With this in view visits have been made from time to time to the place where the medusæ were found. In 1917, a year after they were first observed, they were present again in as great numbers as in the preceding year[2]; still no trace of a hydroid condition could be found. Each year thereafter the place was searched, but they have not been seen since 1917. It may be of interest to record, however, that this year (September 26) when examining the locality, some fine growths of the hydroid *Cordylophora*[3] were obtained in the part of the stream where *Craspedacusta* was discovered. There can be no doubt about this material representing *Cordylophora lacustris,* and this interesting fresh-water hydroid is thus given a new locality in which it is associated in a way with *Craspedacusta.* The growths are attached to living willow twigs that by the drooping of branches have become immersed in the water.

Harrison Garman

University of Kentucky
Lexington, Ky.

1 Science, Vol. XLIV, page 858.

2 Professor Hargitt in commenting on the matter (Science, L. 1919, page 413) was wrong in inferring that they disappeared at once.

3 A medusa stage is believed not to be produced by this hydroid.

AN ANNOUNCEMENT IN SCIENCE

To the Editor of Science: I am glad to be able to inform you that in response to my appeal on behalf of Professor W. Boldyreff, published in Science of October 27 under the heading, "An Opportunity," I received promptly a number of requests for special information concerning Dr. Boldyreff's qualifications, and that as a result of these inquiries he has now received an appointment for a year in a dignified position which will give him excellent opportunity for research work and an income to keep himself and family alive.

Vernon Kellogg

National Research Council,
Washington, D. C.,
November 28, 1922

QUOTATIONS

INSULIN AS A CURE FOR DIABETES

ON another page we print an important communication from the Medical Research Council relating to a promising remedy for diabetes recently discovered at Toronto. Diabetes is one of the more serious afflictions of mankind, insidious in its beginnings, debilitating in its course, and often fatal. At present the treatment is little more than an effort to prolong life by a regimen of habit and diet so arduous as to make it very irksome. Dr. F. B. Banting, a young physician attached to the University of Toronto, acting on the known fact that extirpation of the pancreas in dogs is followed by a diabetic condition, thought it possible that the secretion discharged into the blood by that gland might be the factor inhibiting the onset of the disease, and that its administration in some form might prove a remedy. Experimental work confirmed his theory, which has, in fact, been thought probable for many years. A substance, to which the name "insulin" has been given, extracted from the pancreas of the ox, pig or sheep, when injected into the veins of human diabetic patients has frequently given quick relief, and has appeared to lead towards cure. But the remedy is still in an early stage. The exact constitution of insulin, as, indeed, of many other of the subtler animal essences, is still unknown; its preparation demands high skill and special methods; its administration must be watched by expert physicians. In the opinion of the medical faculty of the University of Toronto, of their American colleagues and of representatives of our own Medical Research Council, any premature exploitation of insulin might gravely disappoint the public, and even prevent the ripening of the hopes of these high authorities. It has therefore been decided to protect and control its manufacture and use in the United States and in Canada. Similar protection and control in this country have been offered to and accepted by the Medical Research Council. To protect the public and to perfect a great boon are objects which command respect. But while recognizing that special circumstances may in this case justify it, we are not entirely reassured about the method—a feeling that seems to have given an apologetic tone to the communication issued by the Medical Research Council. For it is proposed to patent the remedy—a course excluded from the practice of the Pasteur Institute. Pasteur and Metchnikov determined that their discoveries should be offered as a free gift to the world, although the possibilities of fraudulent or foolish exploitation by others, of mistaken use, and even of employing the revenue from patents for further research were present to their minds.—*The London Times.*

JUSTICE FOR THE PUEBLO INDIANS

IN formally protesting against the passage of the Bursum Pueblo Indian Bill the American Ethnological Society took account only of the plain facts. It is a thoroughly vicious measure, designed to put a premium on fraud and to commit the United States government to a sweeping raid on the lands and water rights of the New Mexico Indians. The council of the Peabody Museum of American Archeology and Ethnology of Harvard uses very moderate language when it calls public attention to "the iniquity and hardship" of the bill to the end that it be defeated.

The Bursum bill was put through the Senate on the strength of misleading statements. The scheme could not be worked again. Full publicity would prevent it. For a little publicity has already rallied to the support of the cause of the Pueblo Indians disinterested persons and organizations that will not desert them or be lulled to sleep as the Senate was.

These Indians, living peacefully in some twenty tribal groups, have been steadily crowded off lands confirmed to them by the United States government by outsiders having no valid titles. The government is bound to protect them as its wards, but it has failed to do so.

But as it turns out, the Pueblo Indians, though voteless, are not friendless. It is a wholesome sign that before they had united in voicing their own protest against the Bursum bill, friends from many quarters had volunteered assistance and accepted the burden of the fight in their behalf. Congress and the administration can not afford to be indifferent to the flood of protest pouring in on them against this betrayal of the Pueblo Indians for the sake of a few New Mexico land-grabbers.—*The New York World.*

SPECIAL ARTICLES

SERIES REGULARITIES IN THE ARC SPECTRUM OF CHROMIUM

The detection of two sets of related triplets, by Meggers and Kiess, in the course of their work on the arc spectrum of chromium, induced the present writers to undertake a more thorough examination of the spectrum, to find, if possible, other regularities which might lead to series relationships. While a detailed discussion of the work has not yet been completed, enough has been found to warrant the following statements.

At least three sets of series whose members are triplets, occur in the arc spectrum of chromium. Of these, two sets are composed of wide triplets, and one set of narrow triplets. The wide-triplet series are parallel; that is, there exists a constant difference between the wave numbers of homologous members. Each component of the first member of the diffuse series is itself a narrow triplet. In the table are given data for the first members of the principal, sharp and diffuse series of the two parallel systems:

λ I. A. (Vacuum)	ν	Δν	λ I. A. (Vacuum)	ν	Δν	Separation
p			*p*			
4255.53	23498.84	112.44	3579.69	27935.38	115.10	4436.54
4275.99	23386.40		3594.50	27820.28		4433.88
4290.92	23305.02	81.38	3606.35	27728.86	91.42	4423.84
s			*s*			
7464.39	13396.94	112.45	11160.2	8960.4	115.2	4436.5
7402.26	13509.39		11018.6	9075.6		4433.8
7357.95	13590.74	81.35	10908.8	9166.9	91.3	4423.8
d			*d*			
5331.18	18757.57		6982.79	14320.92		4436.65
5330.58	18759.68		6981.75	14323.06		4436.62
5329.80	18762.43	112.78	6980.23	14326.18	115.16	4436.25
....	....		6927.90	14434.39		....
5299.32	18870.35		6927.09	14436.08		4434.27
5298.81	18872.16		6925.96	14438.43		4433.73
5277.56	18948.15	81.29	6885.00	14524.33	91.54	4423.82
5277.09	18949.84		6884.23	14525.96		4423.88
5276.59	18951.64		6883.40	14527.62		4424.02

The narrow triplets which constitute the third set of series are characterized by the frequency differences $\Delta\nu_1 = 8.80$ and $\Delta\nu_2 = 5.65$. Several doublets in which each of these separations exists and also one with the separation, $\Delta\nu = 81.37$, have likewise been found. These are suggestive of inter-series combinations.

C. C. Kiess
Harriet Knudsen Kiess
Washington, D. C.,
October 10, 1922

THE NATIONAL ACADEMY OF SCIENCES

The autumn meeting was held in New York City on November 14, 15 and 16, on successive days at Columbia University, the Rockefeller Institute for Medical Research and the United Engineering Societies Building. The scientific program was as follows:

Biographical memoir of Harmon Northrup Morse. (By title) Ira Remsen.

A catalogue of bright stars, a compilation of all the known data concerning the 9110 brightest stars: Frank Schlesinger. The requirements for an abstract are perhaps sufficiently complied with by the title itself, but it may be well to say in addition that the catalogue gives the name of each star, its position for 1900, the Durchmusterung number, magnitude, spectrum, proper motion, parallax, radial velocity and notes concerning other points of interest.

The status of research on the perturbations of minor planets with special reference to its ultimate significance: Armin O. Leuschner.

The structure of the Jura Mountains in France. Lantern: Emanuel de Margerie (introduced by J. F. Kemp).

Recently discovered evidence bearing on the age of the Sierra Nevada. Lantern: John C. Merriman, R. W. Chaney and C. Stock.

American jade and its archeological bearing. Lantern: Henry S. Washington. Microscopic study of many jade objects from Chichen Itza, Copan and localities in Mexico shows that the material consists of a jade-like pyroxene and albite in different proportions; varying from pure pyroxene to nearly pure albite. The pyroxene is composed of jadeite and diopside, the combination forming a hitherto unrecognized member of the pyroxene group. Many chemical analyses have been made, and these, as well as the microscopic thin sections, show that the albite is soluble in the diopside-jadeite up to a certain amount, beyond which it crystallizes out separately. In chemical and mineral characters the Middle American jades differ markedly from those of Burma and Tibet, the chief sources of Chinese jade. These differences, the occurrence of a complete series of the rocks, and the original pebble form of many of the American jade objects, indicate that the material of the Mexican and Central American artifacts is of American, and not of Asiatic, provenance; thus being adverse to the theory of southeastern Asiatic origin for Middle American races and culture. This American jade has not yet been found in place, but it is probable that it comes from toward the Pacific coast, and two centers of production are suggested as probable, Oaxaca-Guerrero in Mexico and Guatemala in Central America.

Drowned coral reefs of the Liu Kiu Islands, Johnson (introduced by J. F. Kemp).

A genetic description of some New England-Acadian shorelines. Lantern: Douglas W. Johnson (introduced by J. F. Kemp).

A tentative geological column for central Mongolia: Charles P. Berkey (introduced by J. F. Kemp).

Xenoliths in the Stony Creek granite, Connecticut: James F. Kemp.

A chemical investigation of two typical enzymes: pancreatic and malt amylases: H. C. Sherman. This paper reviews briefly some of the results obtained in an investigation carried out during recent years with the aid of grants from the Carnegie Institution of Washington, and describes unpublished experiments which furnish a new line of evidence that these enzymes, in their chemical nature, either are proteins or contain proteins as essential constituents. While alike in this respect, these two starch-splitting enzymes differ markedly in some of their properties and are undoubtedly different substances. Some of the chief points of resemblance and of difference are briefly summarized and the problem as to the conclusiveness of the evidence regarding the chemical nature of these enzymes is considered.

The hydration of sodium monometaphosphate to orthophosphate in varying concentrations of hydrogen ion: H. T. Beans and S. J. Kiehl. The preparation of sodium monometaphosphate; method of following the hydration; experimental data; formation of pyrophosphate as an intermediate product; discussion of results.

Saturated Bredig gold sols: H. T. Beans and L. B. Miller. Briefly summarized the paper will present the results of the continuation of our work on the study of the influence of electrolytes on the composition and behavior of gold sols made by the Bredig method. We have found that a very definite quantitative relationship exists between the maximum amount of gold which can be dispersed by the Bredig method, and the character and concentration of the electrolyte present. The paper will, therefore, consist in a demonstration of this relationship with curves and data which are in support of the conclusions.

Experimental studies on the hydrogen electrode: H. T. Beans and L. P. Hammett. A study of the practical application of the hydrogen electrode and of theoretical questions involved has shown that the hydrogen electrode must function not only as an inert electrode, but as a catalyst for the hydrogen ion reaction. Comparison of various methods for producing the necessary activity is of interest from the general point of platinum catalysis, and indicates the interesting problem of the potential difference between active and inactive electrodes. These results, together with the results of the study of the effect of oxygen upon the electrode have led to a specification of the necessary conditions for precise measurements in buffered solutions, and investigation of the difficulties inherent in the application of the electrode to unbuffered solutions has led to the determination of the reasons underlying these difficulties, and to a new type of electrode which gives satisfactory results in solutions of potassium chloride.

The interdependence of solvent and solute in ionization phenomena: James Kendall and Malcolm M. Haring. In a previous communication (Kendall, *Proc. Nat. Acad.* Sci. 7, 56, 1921) it was shown that compound formation and ionization in solutions proceed in parallel and that solvent and solute play an equally active part in ionization phenomena. The present article discusses the various possible ionic types which may be produced by the disintegration of compounds formed when two substances RX and R^1Y are mixed. Rules are deduced for predicting the relative amount of each type in any particular case from the character of the radicals concerned, and these rules are demonstrated to be in accordance with experimental results chosen from both aqueous and non-aqueous solutions.

Some unusual freezing-point curves in fused salt mixtures: James Kendall, E. D. Crittenden and H. K. Miller. In the course of a detailed study of the factors influencing compound formation and solubility in fused salt mixtures, by which 49 new double salts were isolated, some rather remarkable freezing-point curves were encountered. Two illustrative examples are here described. In the first—the system $AlBr_3$:NaBr—a two liquid layer region exists between 2.6 and 16.3 per cent. NaBr, and the freezing-point curve on either side of this descends from 95.4° to a eutectic point. The solid phase in equilibrium with the two liquid layers must consequently be a double salt of intermediate composition, unstable at its true melting-point but melting to give two immiscible liquids at 95.4°. In the second type of system, of which $SbCl_3$:$SnCl_4$ is an example, the two liquid layer region is metastable, but approaches so closely to the freezing-point curve as to induce it to become almost horizontal over a very wide range of composition.

Ferric hydroxide hydrosol: Arthur W. Thomas and A. Frieden (introduced by M. T. Bogert).

A citraconic analog of quinophthalone: M. T. Bogert and K. Asano. The well-known dye quinoline yellow (quinophthalone) is prepared by the action of phthalic anhydride upon quinaldine. It is now found that citraconic anhydride does not condense smoothly with quinaldine, but that when the imide is used in place of the anhydride, a dye analogous to quinoline yellow results.

Diaryl thiophenes and diaryl selenophenes: M. T. Bogert and J. P. Herrera. 2,4-Diaryl thiophenes and diaryl selenophenes may be obtained in fair yields from ketone anils, of acetophenone anil type, by fusion with sulfur or selenium. The properties of these new compounds and of various derivatives are described.

Factors governing the distribution of plants in Porto Rico and the Virgin Islands: Nathaniel L. Britton.

Growth and form: Robert A. Harper.

Growth and development of children as influenced by environmental conditions: Franz Boas.

Dating prehistoric man in America by methods of distribution and stratigraphy: Clark Wissler (introduced by F. Boas).

Measurements on the expression of emotion in music: C. E. Seashore. The writer points out that every emotional effect transmitted by the singer or other musician through music is contained in the sound wave. This can be intercepted and recorded with high precision and the musical effects may then be classified in terms of the measurable attributes of the wave; namely, frequency (pitch), duration (time), amplitude (intensity and volume), form (timbre). All musical expression through sound may be expressed in terms of variables in these four factors.

Undernutrition and its influences on the metabolic plane of steers: Francis G. Benedict and Ernest G. Ritzman. Based upon experiences with humans, who voluntarily underwent ration curtailment, and upon the well-known inequalities in the feeding habits of wild animals, a group of 11 steers were subjected to curtailed rations amounting to approximately one half of their normal maintenance requirements, for a period of about 140 days. Measurements of feces and urine and feed, as well as an extensive series of metabolism measurements inside of a specially constructed respiration chamber, made it possible to study these animals intensively. The curtailed rations resulted in a distinct loss of nitrogen and fat from the body, but the steers recovered their initial state by subsequent feeding with hay, concentrates or pasture. Although carried through the winter on an extraordinarily low metabolic plane, they suffered no permanent damage and all were subsequently fattened for market.

The acetonitril test for thyroid and of some alteration of metabolism: Reid Hunt. (1) Toxicity of acetonitril; effects of undernutrition; diet; vitamins. (2) The acetonitril test for thyroid; the relation between iodin content and physiological activity. Thyroxin. (3) The reaction as a test for thyroid secretion. Grave's disease.

Leucocytic secretions: Alexis Carrel (introduced by S. Flexner).

Experiments with an anti-serum for Rocky Mountain spotted fever: Hideyo Noguchi (introduced by S. Flexner).

The protection of the newborn against infection: Theobald Smith.

Experimental herpetic encephalitis: Simon Flexner.

Hydrohepatosis, a condition analogous to hydronephrosis: Peyton Rous (introduced by S. Flexner).

Crystalloidal solutions and colloidal suspensions of proteins: Jacques Loeb.

The ovary in connection with structural and metabolic changes in mammals: Charles R. Stockard. A general description is given of a method of external examination by which the several stages of the ovarian cycle may be definitely located. The moment of discharge of the ovum from the ovarian follicle may also be accurately determined. The several stages of the ovarian cycle may be experimentally modified and ovulation temporarily or permanently suppressed. The type of modification may be recognized by a study of the structural reactions of the uterus and vagina which are indicated by the cellular composition of smears collected from the wall of the vagina. The ovary may be used as a very exact and valuable indicator for determining the general metabolic conditions of the individual.

The mechanism of selective bacteriostasis: John W. Churchman (introduced by S. Flexner).

The reduction division in haploid, diploid, triploid and tetraploid daturas: John Belling and A. F. Blakeslee (introduced by C. B. Davenport).

The consequences of different degrees of intermensual correlation for fecundity in the domestic fowl: J. Arthur Harris (introduced by C. B. Davenport).

Recent studies on the relation of metabolism to sex: Oscar Riddle (introducted by C. B. Davenport).

Sex and sex control in Cladocera: (By title.) Arthur M. Banta (introduced by C. B. Davenport).

The consequences of different degrees of interference, in the crossing-over of the hereditary genes: H. S. Jennings. The paper gives the general results of a mathematical study of the relations exhibited in the socalled crossing-over of the genes, and compares these with those bound to occur if the genes are arranged in series and there is interference between breaks at points near together in the series. The observed ratios fall into a peculiar and complex system; by means of a mathematical formula it is shown that this entire system, even to details, is, in all essentials, a necessary result of the serial arrangement with a certain extent of interference. The marked changes that would result from different extents of interference are likewise shown.

A new type of uroleptus formed by permanent fusion of two conjugating individuals: Gary N. Calkins.

Restoration of fossil human remains its possibilities, value and limitations: J. H. McGregor (introduced by Edmund B. Wilson).

The rôle of the golgi apparatus in the formation of the animal sperm: Robert B. Bowen (introduced by Edmund B. Wilson).

The map of the third chromosome of Drosophila: T. H. Morgan and C. B. Bridges.

Limiting values of the size of the genes of Drosophila: T. H. Morgan.

Ultraviolet flowers and their possible bearing on the problems of pollination by insects: Frank E. Lutz and F. K. Richtmyer (introduced by Frank M. Chapman). The various colors on the petals of flowers and, indeed, the petals themselves are rather generally believed to have arisen in connection with the pollination of flowers by insects. A few experiments, including some made recently, indicate that insects respond definitely to ultraviolet rays. This suggested an investigation of the reflection by flowers of ultraviolet rays. It was found that some flowers show ultraviolet while others do not, just as some show blue while others do not. If flower colors are important in connection with pollination by insects, its seems that not only the visible spectrum but also the ultraviolet should be considered.

Recent discoveries of fossil vertebrates in China and Mongolia: W. D. Matthew (introduced by Frank M. Chapman). Important fossil mammal faunas have been recently discovered in China by the Chinese Geological Survey and American Museum party. The American Museum's Asiatic Expedition has also been extraordinarily successful in Mongolia this summer. Three important mammal faunas, Eocene, Oligocene and Pliocene were discovered, also a rich Cretaceous dinosaur fauna. Large collections were secured, including complete skulls and skeletons and their study is expected to throw much light on the origin and dispersal of the higher vertebrates and of men.

The Whitney South Sea expedition of the American Museum of Natural History: ROBERT CUSHMAN MURPHY (introduced by Frank M. Chapman). For more than two years the Museum has been conducting ornithological investigations in Polynesia. This paper summarizes the purposes and accomplishments of the expedition, and outlines some of the problems involved in studying oceanic and insular zoology.

Mutations among birds in the genus Buarremon: FRANK M. CHAPMAN. From a study of the 160 specimens of *Buarremon brunneinucha* and *B. inornata* in the American Museum of Natural History the following conclusions are reached: (1) That *Buarremon inornata* is a representative of *Buarremon brunneinucha.* (2) That the variations in pattern and color occurring in the underparts of *brunneinucha,* throughout the range of that species, are individual and are not due to age, sex or season, to climate or other observable environmental factors. (3) That isolation, partial or complete, has alone supplied the conditions needful to the development and establishment of these characters as the specific attributes of *Buarremon inornata.*

On the attraction of a central body in the theory of relativity: GEORGE D. BIRKHOFF.

The equiaffine geometry of paths: OSWALD VEBLEN.

The cosmological equation of gravitation: EDWARD KASNER. It is shown that the two sets of equations introduced by Einstein in 1917 and 1919 are exactly equivalent in empty space. The cosmological factor λ can then be proved to be a constant, instead of being so assumed.

A theory of the various transverse effects of the magnetic field in several metals: EDWIN H. HALL.

The photo-luminescence of flames: E. L. NICHOLS and H. L. HOWES. When flames containing salts of Na, Li, Ca, Ba, Sr, etc., are exposed to light the bright bands in their spectra, in general, are enhanced. The effect, although large compared to ordinary fluorescence, forms a small part of the total brightness of the flame and can not be readily detected except by spectro photometric methods. As in ordinary photoluminescence *excitation is by wave-lengths shorter than those of the band itself.* There is a *measurable quenching by exposure to the longer wave-lengths* and specifically to light identical with the band. So far as now known no new bands are developed as the result of excitation. The light sources thus far used as excitants are the tungsten lamp, carbon arc, mercury arc and iron spark.

The reflection of X-rays by crystals: WILLIAM DUANE.

The analysis of certain crystals by the new X-ray method: G. L. CLARK and WILLIAM DUANE.

The use of isophelimatic lines in historical geography; A new theory of population; A new hydrodynamical phenomenon; Further results in interior ballistics: ARTHUR G. WEBSTER.

The Thermal emissivity of water: MILDRED ALLEN.

The determination of ocean depths by acoustical methods: H. C. HAYES (introduced by W. H. Dall and W. M. Davis).

The gyroscope and its practical application in the arts. Lantern: O. B. WHITAKER (introduced by J. J. Carty and F. B. Jewett).

Electronic tubes of high power: H. D. ARNOLD, Ph.D. Recent developments in the construction of high vacuum apparatus have made possible the use of pure electron currents as large as 30 amperes in single tubes which are capable of controlling powers of 100 k. w. or more. This paper discusses some of the problems in physics and in engineering which were solved in the course of this development, particularly those which relate to the construction of glass and metal apparatus suitable for use with these high powers. The paper will be illustrated by samples of the tubes and by slides showing the general features of their construction.

Carrier type multiplex telephony and telegraphy: E. H. COLPITTS. The underlying principles of carrier are discussed particularly as they apply to carrier telephony, first, where a single channel of communication is provided, and secondly, where a number of channels are provided over the same pair of wires. Apparatus is shown illustrating the various physical steps in the process of transmitting speech from one terminal station to the other. Particularly the performance of filters in discriminating against the passage of currents outside of the band which they are designed to transmit is demonstrated. In these demonstrations use is made of a loud speaking telephone.

Spectrum energy curves of the stars: CHARLES G. ABBOT.

Affine geometries of paths possessing an invariant integral: LUTHER P. EISENHART.

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THE TREND OF AVIAN POPULATIONS IN CALIFORNIA

THERE is one besetting temptation to which any student fairly advanced in the exploration of his chosen field would seem justified in yielding. This temptation is to hold up to close scrutiny any striking generalization given wide publicity, save it be from the most authoritative source—to see whether it be really founded in fact. A case in point has to do with avian populations.

It has been stated or at least implied with increasing frequency in late years, in various publications, especially in those emanating from organizations concerned with bird protection, that serious decrease is taking place in our bird life, and that this decrease is due to the thoughtlessness or perfidy of man and is preventable. These statements and implications are being expressed not only with regard to the longer and more thickly settled eastern United States, but with regard to the west in general, and to California. Confessedly with some *a priori* doubt, but with a view to testing fairly the truth of these dicta, I have undertaken an inquiry into the situation in our own state, for the purpose of finding out what the facts are—of ascertaining whatever changes in our bird population may, indeed, have become apparent, and the causes therefor.

To begin with, of course, terms must be defined. In using the word "decrease," or its opposite, "increase," in this connection, one of two distinct ideas may be in a person's mind. He may refer to the *number of species,* or he may refer to the aggregate *number of individuals.* Or, both of these ideas may be held, in more or less vague association.

To take up the first concept: There is no question whatsoever that a certain few species of birds have become nearly, or quite, extinct, as far as California is concerned, within the past seventy-five years; as examples, the trumpeter swan and the whooping crane. But, compensating for these losses, there have become newly established within our territory during that same period some species of foreign source; as examples, ring-necked pheasant and English sparrow. Checking up the species of both categories, we can reach but the one conclusion that, as yet, so far as concerns the state as a whole, there has been no real reduction in the total number of species; our known avifauna at the present moment totals 582 species and subspecies; I am aware of no good ground for supposing that it was one unit more or less, seventy-five years ago.

If, however, we narrow our attention to given restricted localities, we are confronted with evidence of real and great reduction in species, up to even forty per cent. of the original number, I figure, in some places. It is this *local* reduction in species, most apparent naturally in centers of human population, that has impressed so strongly the ardent advocates of the various sorts of bird protective measures.

An entirely different phenomenon, as already intimated, is comprised in the fluctuation of aggregate populations, irrespective of the various species, few or many, represented in them. On this point, my impressions are strong that, throughout the country at large, wherever human influence has had any marked effect, there has been *increase* in the bird life. In some localities, as pointed out below, this increase may reach as much as tenfold.

My reader will at once demand something more tangible than "impressions." And I am compelled regretfully to admit that actual figures seem to be wanting. We have no record of censuses taken fifty years ago, or even twenty-five years ago. This is unfortunate; and it is to be hoped that further lapse of time will see an improvement in this situation. Numerical censuses, on either an areal basis or a unit-of-time basis, are now being taken and recorded. The student of the future, let us hope, will have plenty of statistical data upon which to base final conclusions.

It seems, then, that, in this discussion, I must fall back upon less tangible classes of evidence—upon memory and upon inferences from other categories of facts. Before citing this evidence, however, let me introduce some theoretical considerations.

It is a recognized, established principle that the presence in a region of any given bird species is absolutely dependent upon, first, proper food supply, second, the right kind of breeding places, and third, appropriate cover or protection for individuals—each of these conditions as bound up with the inherent structural features of the bird under consideration. Mark that there are *three* of these factors, each and all of them essential; if any one of them in a given region becomes effaced, the bird in question can no longer exist there. There are, of course, other factors essential to avian existence, but they affect all the birds of a given fauna alike. We can deplore, wring our hands, and suffer agonies of regret, but to no avail—except as active steps be taken to restore the critical condition. As a matter of cold circumstance, a bird's disappearance in a given locality may be irretrievable—as happens where man has densely settled a territory and incidentally or purposely destroyed certain of its natural features unnecessary or inimical to his own existence there. Chop down all the trees and there can be no more woodpeckers; drain the lakes, ponds and swamps and there can be no more water birds; remove the chaparral, and wren-tits, bush-tits and thrashers can no longer find proper food and shelter. Cement up all the holes in the campus oaks and there will be no more plain titmouses—for the reason that roosting and brooding places essential to their existence are no longer to be found.

Each bird species native in a given region has a different and very special combination of requirements. Existence of each is really determined by a very slender thread of circumstances which can, in most species, be broken readily. Differences must, of course, be recognized in the degree of hardihood, or of viability, in the various species of birds—some are on the ragged edge of extinction, this condition in part due to inherent reduction in specific vigor—the race is naturally playing out, we say; others are hardy, with a large reserve of specific energy; some can even stand what may aptly be called ecologic punishment.

In any one locality the field observer comes to recognize a few or many rather intangible units which he calls "ecological niches"—separate cubby-holes or dwelling places or habitats (in the narrowest sense), which differ in essential respects from one another. If the topography and vegetation be varied, there are many of these niches; if more uniform, there are few of them. Each niche is separately occupied by a particular kind of bird, and the locality supports just as many species of birds as there are niches; furthermore, the numbers of individuals of each bird are correlated directly with the degree of prevalence or dominance of the niche to which that particular bird is adapted. In other words,—and here is the crux of the idea,—both the number of the species and the number of the individuals of each species, in a locality, are directly dependent upon the resources of the environment, from an avian standpoint. The same notion holds, of course, for all other animals, including *Homo*.

Rate of reproduction in any species has been established down through past time so as to supply the population needed to keep the appropriate niche filled. This rate varies with the natural prevalence of the niche, and with the hazards to which the niche occupant is exposed. Not only that, but a wide margin above the normal need is provided to meet that extreme emergency which may arise but once in a thousand generations; in other words, there is produced a large surplus—an apparent great waste—of individuals over and above what is needed to keep the appropriate territory fully populated, in order to save the species from extinction at some critical moment; for animate nature abhors a vacuum no less than does inanimate nature. A recent writer in Science (LV, May 12, 1922, pp. 497-505), Professor A. F. Shull, has, in another connection, called this fact of over-production the "factor of safety." He says: "The entire struggle for existence is based on the principle that security and advancement are best assured through wasteful over-production." The employment of the factor of safety, I would say, is a manifest device on the part of nature to insure continuity of species, and hence also to make evolution possible.

A British ornithologist, Mr. H. E. Howard, has lately put out a book in which he elaborates exhaustively the idea of the importance of territory to bird life. Kind and availability of territory determine the kind and amount of bird life. In final analysis, when a territory, or, as I would express it, more explicitly, an ecological niche, becomes *full,* and this in normal times comes to pass very quickly, the individuals within the species constitute each other's worst enemies. Continued conflict for space—for a piece of land, for an area of meadow, for a section of tree-trunk, for a given unit of volume of twiggery or foliage—is plain to be seen by any diligent observer of bird life. The resulting pressure for territorial expansion reminds one of the same pressure obtaining among humans; only, among birds, there is no organized warfare. The process is one of struggle as between individuals or pairs of individuals, between neighbors, indirectly, perhaps, as a rule; but also, often, directly, by personal action. The most fit to compete, sometimes the most fortunate, will survive; the less fit will be eliminated. The survival prospects of each single individual are small. Vast numbers of individuals are poured in. The "safety factor" in numbers is there in order to insure the persistence, and continued adaptive improvement, *of the species.*

Let us now return to more matter-of-fact considerations. What have been some of the effects of the settlement of California by the white man, upon the environments of birds? Have any ecological niches been effaced? Have any niches been added? Have some been reduced in prevalence and others increased in prevalence, relatively? What have been the effects upon the niche-occupants?

Perhaps the most conspicuous changes wrought in the appearance of the landscape in the southwest have resulted from irrigation. In substantiation of this statement, many of my readers can doubtless appeal to his own memory. I, myself, recall traversing long stretches of the San Joaquin Valley twenty-five years ago, which were then merely arid plains. The vegetation consisted of xerophilous grasses and herbs, with here and there tracts of lupine or atriplex bushes. The birds observed were scattering horned larks, fewer meadowlarks, and occasional burrowing owls; it being winter, there were more numerous Savannah sparrows and, in rain-dampened places, pipits. Knowing what I do now about censuses, I doubt if there were then more than one bird to the acre, on an average, probably much less than that ratio.

Now, regarding the same territory, it would be hard to exaggerate the amount of change in vegetation which has resulted from the watering of the ground. Orchards, alfalfa fields, green pastures and streams of running water lined with willows, completely occupy the land. Instead of a very uniform type of environment, with only a few niches and correspondingly few species of birds, one finds, upon analysis, a great variety of niches and a much increased number of bird species. What is more, the numbers of *individuals* are vastly larger. To be sure, the horned larks and burrowing owls are gone. But the meadowlarks have multiplied; and, in addition, one sees great numbers of Brewer blackbirds, of mockingbirds, goldfinches, swallows, phœbes and killdeers. I esitmate the mean population over large areas of the San Joaquin in April, when the lowest ebb for the year is reached, at 10 per acre, or over 6,000 per square mile. Here, obviously, the conditions for abundant avian population have been markedly improved by the coming of the white man with his methods of cultivation.

Even more spectacular has been the faunal change wrought by irrigation in Imperial Valley, where luxuriant vegetation with resulting abundance of bird life has replaced the original sparse vegetation of the desert which supported relatively little animal life.

Another biotic modification is brought about by deforestation. Close stands of coniferous trees are replaced by "slashes," by open young growths, or by mixed brush land and trees. Dense forests, it is well known, are sadly lacking in bird population. The removal of the forests has meant, of course, the disappearance of a few, specialized avian tenants. But in their place, occupying the clearings and mixed growths, is a much greater population both as to individuals and species. Kinglets, pileated woodpeckers, and hermit thrushes may have disappeared; but fox sparrows, chipping sparrows, spotted towhees and a host of other birds of like habitat preferences have come in. Certain little niches have been done away with; but the change in the nature of the territory at the hand of the lumberman has resulted in there being many more, new niches; each of these, evidently, of greater amplitude, of greater supporting power.

Very definite change in the other direction has been that made as a result of the draining of swamp lands. Many species thereby have been eliminated, locally, many more species than occupy the reclaimed land; and, furthermore, I feel sure that the numbers of individuals, too, have been reduced, though not in so large proportion. As instances, I would refer to Nigger Slough and Gospel Swamp in southern California, and to the region at the confluence of the Sacramento and San Joaquin Rivers in west-central California. A swamp is really a very complicated type of environment; within it usually may be recognized *many* "niches" and a correspondingly large number of avian occupants. Among these are the herons, rails, gallinules, song sparrows, yellow-throats and tule wrens, and, if there be open water, coots, terns and several species of ducks.

The most serious adverse effect of the human occupancy of California upon bird-life thus far has, I believe, resulted from this reclamation of the swamp lands. But, if you will resort to memory, or examine a topographic map, you will observe that the total area here involved is very small compared with the territory that has been affected oppositely, by irrigation. Irrigated territory, moreover, is subject to continual and much farther spread, while the possibilities of drainage are almost exhausted.

Other modifications of primitive conditions as a result of the white man's occupation of the country are as follows: By the clearing of brushlands, for example, in San Fernando Valley, Los Angeles County; by the planting of trees, afforestation, as exemplified in the groves of trees around the Greek Theater and on the Berkeley hills; by the cultivation of dry grasslands, as on the coastal benches of San Diego County; and by the formation of storage reservoirs and canals, which, irrespective of the lands which they water, bring into existence aquatic and riparian types of vegetation conducive to an abundant bird life. Some of these it will be noted, check against one another, so that *status quo*, in part of the country, tends in some measure to be maintained.

In general, then, my contention is that there has been, on the average, as a result of the settlement of California, a marked increase in our bird population. Bird life at large has benefited—and this in spite of various adverse features which also have been imposed. My message should be, therefore, one of optimism to the bird-lover. It is to be understood that I refer to birds of all groups together; not to any particular group. There are vastly more of the so-called "song birds," numerically, than there are of the "game birds" and "birds-of-prey." The latter two groups have been seriously depleted, unquestionably, from various causes associated with man; but probably not more than ten per cent. of our original bird population consisted of game birds and birds-of-prey combined.

Permit me now to link up with current notions and beliefs in regard to the status of bird life some of the ideas that I have been endeavoring to express. In a large proportion of cases the reduction or disappearance of a cherished species of bird, locally, such as may have been laid to other entirely different causes, has really been due simply and inevitably to the reduction or complete effacement of the kind of habitat the bird must have for its existence; in other words, its ecologic niche has been reduced in volume, or destroyed. No one could help it; nor can any one now stay the process, except by restituting the lost factor; for example, when land is bought or otherwise preserved from human use and devoted to the use of the birds, as in national or state bird or game reserves. Of course, in certain areas, such as national parks and forest reserves, the environments and the birds occupying them are being preserved anyway, incidental to other interests.

The tendency among sentimentalists has usually been to seek out a cause for the disappearance of birds that is directly concerned with their fellow men. The hunter, the boy with the sling shot, the collector, any one of them or all, loom up as *the* "exterminators of birds"; whereas, in truth, I believe, it is only in rare cases and then only very locally, that *these* agencies have had any effect at all. In other words, if my line of reasoning has been correct, legal protection, with ninety per cent. of our bird species, is absolutely unnecessary, save as it applies, and then properly so, to parks, the suburbs of cities, and to logically constituted game and wild-life preserves, where shooting for *any* purpose is out of order.

Recall the geometrical ratio of reproduction, and the consequent powerful potentiality for recovery on the part of bird species. Let me cite here the case of the eastern bluebird as reviewed by Mr. P. A. Taverner in a recent number of the *Canadian Field-Naturalist* (XXXVI, April, 1922, pp. 71-72). In the winter of 1895-96 a cold wave swept the South Atlantic states, the sole wintering ground of the eastern bluebird. As a result, famine and death reduced the total bluebird population almost, but not quite, to the vanishing point. But in five years the species had recovered "from almost nothing to practical normality." After reaching normal, a "saturation point of population" for the species, it ceased to increase; or, as I would express it, its ecologic niche, of fixed amplitude, was then full. The operation of the "factor of safety" not only saved, but very quickly brought back, the species.

Another catastrophe, recorded by Dr. T. S. Roberts (*Auk*, XXIV, 1907, pp. 369-377) happened to a sparrow-like species, the Lapland longspur, in southwestern Minnesota, the middle of March, 1904. It was migration time, and a peculiarly wet and thick snowstorm that occurred during the night of the thirteenth is thought to have overwhelmed the birds when in flight high overhead, soaking their plumage and dazing them. At any rate, great numbers hit the ground with fatal violence. In the morning dead and injured birds were to be seen over a wide stretch of country; on the frozen surfaces of two lakes 750,000 dead longspurs were counted, by the method of laying off sample units of area and checking the birds to be seen on these units. But in spite of this spectacular destruction of individuals the Lapland longspur was not reported the following years in the winter range of the species (Kansas, etc.) as obviously less numerous than usual. Did not the ability of the species to recover from this extraordinary calamity rest in the "factor of safety"?

There is good reason to believe that release of intra-specific pressure on the breeding grounds of a species is accompanied by greater productivity on the part of the remaining population. The survival chances for the young are greater where the safest type of nesting places is available to all the adults seeking to breed, and where congestion of population, and consequent drain on available food supply, has been relieved. Also, towards the end of the year, when the annual pinch of food scarcity comes into play, in the winter range, a larger proportion of maturing individuals than usual will survive. In other words, from one point of view, calamitous reduction of population benefits the immediately oncoming generations.

Let me center attention now upon the significant fact that certain of our birds are, and always have been, totally *un*protected by either law or sentiment—jays, crows, linnets, shrikes and blackbirds. The rate of annual increase in those species is no different, in so far as I am aware, than it is in the vireos, warblers, mockingbirds, tanagers, and purple finches, which latter are looked upon as desirable songbirds. Yet the former are holding their own just as well as the latter, protected, species. Their numbers are always kept up to topnotch commensurately with the prevalence of their niches. They have reached the maximum population possible to them, consistent with the nature of the country, and they hold to it.

We all know of the enmity of orchardists, and agriculturists, and sportsmen toward linnets, blackbirds and blue jays, respectively. Now and then, and there is a case on record as far back as thirty years ago, "blue jay hunts" are held; in one lately recorded instance, at Hollister, San Benito County, 1,531 California jays were killed in one day, in a prize competition for the destruction of so-called "vermin." Incidentally, you will note that sportsmen feel particular animosity toward any competitor or rival in their own field! They are right after anything that can be called "vermin" from their standpoint. As far as we can see, as a result of such campaigns—shooting of blue jays, netting of blackbirds, and poisoning of linnets—there has been only a very temporary and local reduction in the numbers of these birds; two or three seasons bring them back to normal: that is, to the maximum numbers which the amplitude of their respective niches will warrant.

Bird population, in kind and quantity, is controlled primarily by conditions of habitat. It is a matter of food and shelter. The natural history collector, as a factor against birds, is only an exceedingly minor influence, one which like all the others, is allowed for by the "factor of safety." My readers will begin to suspect that I have become sensitive because of the inveighing that certain well-meaning but uninformed people have undertaken against the killing of birds for specimens. I admit the score.

Joseph Grinnell

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ARE PERMANENT DISTURBANCES OF EQUILIBRATION INHERITED?

The writer of this note has just brought to completion a long series of studies upon the mechanics of equilibration in the white rat. During the course of these studies certain facts appeared which, though incidental to the original problem, may be of importance in the field of genetics. The facts were observed under the following conditions. As a part of our method, we found it necessary to rotate white rats day and night in small revolving cages over a period of several months. The cylindrical cages, less than a foot in diameter, were rotated in a horizontal plane, some at sixty and others at ninety times a minute. Several months after this series of continuous rotations began, a part of the subjects were removed from the rotating cylinder (a) in order to make observations on their behavior subsequent to their long continued rotation, and (b) in order to make room for litters which were born from time to time within the cylinders. Several weeks (the time has varied from individual to individual) after these first subjects had been removed from the rotating cylinders, it was discovered that permanent changes in bodily movement and posture had taken place. The most striking changes were (a) circular movements about the nest, usually in the direction of the long continued rotation, and (b) a decided turning or twisting of the head to the right or to the left. It was discovered, moreover, that these changes in posture were occasionally accompanied by swellings and discharges from the region of the ear, and more frequently, by decreasing bodily tonicity and finally by death. Further search revealed the fact that this state of "disequilibration" was accompanied by important changes in the character and in the duration of the ocular movements following short rotation periods (20 turns in 10 seconds).

Before the appearance of this state of "disequilibration," a few of the subjects with a long history of rotation were mated with other rotated and unrotated individuals solely for the purpose of adding to our experimental stock. Curiously enough, however, individuals began to appear in successive generations presenting the same types of disequilibration observed in the parents. That is to say, rotated individuals mated weeks after having been taken from the revolving nests gave offspring a part of which were disequilibrated in the same manner as their parents. Subjects of this kind have continued to appear at various intervals during the past two years. They have even been discovered in the third generation after rotation. Up to this time about sixty disequilibrated individuals have been counted in a total population of approximately five hundred.

Unfortunately, the demands of the experiments upon equilibration made it impossible to investigate adequately the genetic implications involved in these materials. Nevertheless, the facts as such were considered striking enough to warrant their presentation at a meeting of the Society of American Naturalists in 1921. The questions and suggestions received at that time have led to the conclusion that the biological aspects of the problem should be established and that definite attempts should be made to discover (a) whether the stock in our laboratory may not have given one or more mutations or segregates which, in turn, became the progenitors of the curious individuals still apparent; (b) whether an experimental method of modifying the function of an important organ has been accidentally discovered; and (c) whether actual inheritance of such an acquired bodily change can be demonstrated. The first suggestion seems improbable because no similar rats have appeared in a large related control stock running along with the experimental stock. Furthermore, the character of the disequilibration has appeared to be regularly dependent upon the direction in which the ancestors were rotated. With respect to the third problem, namely, a possible demonstration of the inheritance of acquired vestibular changes, a number of biologists have offered the suggestion that long continued rotation may have induced the production of toxins or of other substances which, in turn, operate after the fashion of the lens anti-bodies, recently described by Guyer and Smith.

It seems desirable, then, to institute a new series of rotations with a new stock and to use, as well, other means of inducing disturbances in the semicircular canals so that more reliable evidence for or against the apparent cases of inheritance in our own stock may be discovered. It is also desirable to know what morphological and structural changes have taken place in the vestibular areas subsequent to long-continued excitation. Fortunately, Professor J. A. Detlefsen, who has cooperated with the writer ever since the first cases of disequilibration appeared, is able to devote a sabbatical year at the Wistar Institute to the further investigation of the facts above described.

C. R. Griffith
Department of Psychology,
University of Illinois

THE USEFULNESS OF ANALYTIC ABSTRACTS

The various ways in which preliminary abstracts should be of service to scientific readers were pointed out about a year ago[1], but whether such abstracts as actually prepared and published would be worth while could be determined only by experiment. This has been done. After analytic abstracts had been appearing in the *Astrophysical Journal* and the *Physical Review*[2] for over two years the following return post-card questionnaire was sent by the chairman of the Division of Physical Sciences of the National Research Council to each reader, with the request that he underscore in each parenthesis the word or words which represent his answer to the question implied:

I look through (the *Astrophysical Journal*, the *Physical Review*) regularly. Before reading the articles, I read the abstracts (always, usually, sometimes, seldom, never). Instead of reading the articles, I read the abstracts in (many, some, few, no) cases. The abstracts have helped me understand the articles in (some, few, no) cases. The abstracts have proved useful in locating information in (some, few, no) cases. I read the subtitles in the abstracts first (sometimes, never). I find the subtitles of value as an index of the abstract (sometimes, never). The abstracts in general give (too much, too little, about enough) information. I think they should be continued (yes, no).

I have the following suggestions to make:

[1] "Scientific Abstracting" by G. S. Fulcher, Science 54, 291, September 30, 1921.

[2] The preliminary abstracts in the *Physical Review* are called "Synopses" to distinguish them from the abstracts of papers presented at meetings which are printed in connection with the proceedings of the Society.

Replies were received from 805 readers, including 83 readers of the *Astrophysical Journal*, 502 readers of the *Physical Review*, and 220 readers of both. Although the answers from the three groups have been tabulated separately, the results are so nearly the same for each that only the results for all readers, that is, the percentages of all readers answering each question in each alternative way, will be given here. Since some replies are incomplete, the sum of the percentages is usually less than 100.

1. How frequently are the abstracts read before the articles?

always	by	41.9	per cent. of readers.
usually	by	45.9	per cent. of readers.
sometimes	by	9.9	per cent. of readers.
seldom	by	2.1	per cent. of readers.
never	by	0.2	per cent. of readers.
		100.0	per cent.

2. How many abstracts are read instead of the articles?

many	by	44.5	per cent. of readers.
some	by	39.7	per cent. of readers.
few	by	9.5	per cent. of readers.
none	by	2.6	per cent. of readers.
		96.3	per cent.

3. How many abstracts helped in understanding the articles?

some helped	58.1	per cent. of readers.
few helped	17.7	per cent. of readers.
none helped	11.8	per cent. of readers.
	87.6	per cent.

4. How many abstracts have proved useful in locating information?

some useful to	59.3	per cent. of readers.
few useful to	16.6	per cent. of readers.
none useful to	11.4	per cent. of readers.
	87.3	per cent.

5. Should the abstracts be continued?

yes	92.8	per cent. of readers.
no	4.0	per cent. of readers.
	96.8	per cent.

Since the abstracts are read, always or usually, by 88 per cent. of the readers; are read instead of many of the articles by 45 per cent.; and have been found helpful in other ways by 59 per cent., they have evidently proved of decided value. In what ways? According to the testimony of the readers: "They are great time savers"; "They frequently give all information necessary about the articles"; "They double a man's range of reading." Moreover, the abstracts have been copied verbatim in *Science Abstracts* and have thus reduced the labor of preparing that abstract journal by ten per cent. The abstracts have therefore to some extent fulfilled their purpose of saving the time of scientific men.

How about other sciences? Are astronomy and physics essentially different from chemistry, botany, zoology, geology, physiology, etc., in their methods of disseminating scientific information? If 93 per cent. of the readers of these astronomical and physical journals find that preliminary abstracts are useful to them, would not the great majority of other scientific readers also find such abstracts useful? The responsibility resting upon the editors of other scientific journals is clear.

Now as to the nature of the abstracts which should be provided. The abstracts which have been appearing in the *Astrophysical Journal* and *Physical Review* are of the analytic type developed by the National Research Council.[3] They aim to give a complete description and adequate summary of the results reported in each article. The replies to the question:

6. Is the amount of information given, in general, about enough, too little, or too much?

about enough	79.8 per cent. of readers.
too little	6.7 per cent. of readers.
too much	4.8 per cent. of readers.
	91.3 per cent.

these replies indicate that the abstracts, averaging from 5 to 6 per cent. of the articles, have been of about the right length, and it is not believed they could be made much shorter without considerably decreasing their value.

A distinctive feature of the abstracts is that they contain italicized subtitles which give the various subjects involved more completely and precisely than in general it is possible for the author's titles to do. One purpose of these subtitles is to enable a reader who is not interested in the subject indicated by the author's title to determine by glancing through the subtitles whether something of interest to him has not been incidentally included. Until readers became accustomed to these subtitles, however, it was to be expected that most readers would consider them more of an annoyance than a help; but the following replies show that a surprising percentage of the readers have already found the subtitles useful:

7. Do you ever read the subtitles in the abstracts first?

sometimes	64.1 per cent. of readers.
never	17.5 per cent. of readers.
	81.6 per cent.

8. Do you ever find the subtitles of value as an index of the abstract?

sometimes	63.0 per cent. of readers.
never	12.7 per cent. of readers.
	75.7 per cent.

Since the subtitles also serve the purpose of assisting in the compilation of a complete subject index and tend to insure more complete abstracts, it is believed this feature should be retained. Only three readers definitely objected to the form of the analytic abstracts.

It is the practice of both these journals to submit all authors' abstracts to an abstract editor to be revised or if necessary rewritten, in conformity with the standards adopted. While a few authors have objected to having their abstracts "robbed of individuality," a number of readers specially called attention to the importance of having the abstracts edited so that a uniform standard might be maintained. It can safely be affirmed that since most authors are inexperienced in writing abstracts and also differ widely in their ideas of the function of the abstract, authors' abstracts if not thoroughly edited are sure to fall far short of rendering the service which preliminary abstracts should render, even if detailed instructions are furnished. But after the edited abstracts begin to appear regularly, they

[3] Described in "Scientific Abstracting" referred to above.

gradually establish a standard to which authors will conform more and more closely as time goes on, and therefore the amount of editing required will become less and less.

Finally, mention should be made of the suggestion of several readers that larger type be used for the abstracts than has been the custom. Since more people read the abstracts than read the articles, it would seem obvious that the type of the abstracts should be at least as large as that of the articles.

It should not be long before all scientific journals, in fulfilment of their duty toward their readers, provide carefully prepared preliminary abstracts of their scientific articles. There can no longer be any doubt of the value of such abstracts. It remains only to overcome the practical obstacles to the introduction of the new policy.

In conclusion we desire to express our thanks to the 805 readers whose cooperation gave us the information herewith reported.

Gordon S. Fulcher
Corning Glass Works

SCIENTIFIC EVENTS

CONSERVATION OF THE RESOURCES OF THE PACIFIC

The following resolutions were unanimously adopted by the Pan-Pacific Union Commercial Conference, meeting at Honolulu on November 7, 1922:

Whereas, It is known that many valuable species of marine mammals such as fur seal, sea otters, elephant seals and whale, and many species of important food fishes such as salmon and halibut, formerly occurred in the Pacific in such vast numbers as to constitute the objects of fisheries whose annual products were worth more than one hundred million dollars, and

Whereas, Nearly all of those great natural resources have been seriously depleted, many of them even to commercial extinction, through greed and short-sightedness and ill-considered fishery methods, and

Whereas, It is known that small remnants of fur-seal and sea-otter herds and small numbers of whales and of other commercially valuable species still remain in certain places, and

Whereas, The rapid recovery of the Alaska fur-seal herd in the short period of ten years from complete commercial ruin to an annual production of more than one million five hundred thousand dollars, as a result of the international fur-seal treaty of 1911, demonstrates conclusively the wonderful recuperative power of such depleted natural resources of the sea under international cooperation, and justifies the belief that other depleted fisheries can be rehabilitated through similar cooperation among the nations concerned, and

Whereas, It is conservatively estimated that these resources when rehabilitated will yield to the world a regular annual product of more than one half billion dollars in value, therefore be it

Resolved, That the Pan-Pacific Commercial Conference strongly recommends that the various countries bordering on, or interested in, the Pacific, take such steps as may be necessary to bring about an international treaty for the restoration of the vanishing resources of the Pacific to their former abundance, that they may be maintained for all time as the objects of great commercial fisheries of which they are easily capable, and be it further

Resolved, That this Commercial Conference recommends that the governments of the countries bordering on the Pacific enter into correspondence for the purpose of establishing an international commission for the scientific study of the biology, physics and chemistry of the Pacific in the interest of the restoration, proper utilization and conservation of its vanishing natural resources.

THE UNIVERSITY OF WYOMING AND DR. NELSON

The trustees of the University of Wyoming have passed the following resolutions:

Whereas, Dr. Aven Nelson, after five years as president of the University of Wyoming, resigned at the June meeting of the board of trustees, and

Whereas, His activities as president ceased October 2, upon the arrival of his successor, Dr. Arthur G. Crane, of Edinboro, Pennsylvania, and

Whereas, Dr. Nelson has served this university in various capacities from the infancy of the institution, in all of which he has succeeded to a high degree, and

Whereas, His industry, his patience and his scholarship were controlling factors in carrying the University of Wyoming through the world war and the reconstruction period thereafter to its present success.

Be it resolved, By the board of trustees of the University of Wyoming that we appreciate more fully than we can express his splendid loyalty and labors; that we extend to him our sincere wishes for a continued pleasant relationship upon his return to his former position as professor of botany; that we bespeak for him and Mrs. Nelson a long and happy life and all the joy and satisfaction which come from real service and the knowledge of a duty well done.

Resolved, That this expression of our good will be made a part of the permanent records of this board, and a copy thereof be transmitted to Dr. Nelson.

W. C. Deming,
President, the Board of Trustees

THE INDUSTRIAL DIVISION OF THE AMERICAN CHEMICAL SOCIETY

In order that more time can be given to the presentation and discussion of papers delivered before the Industrial Division, American Chemical Society, it has been decided to ask all who plan to give papers before this division to submit completed manuscripts not later than March first to the secretary of the division. The manuscripts will then be sent to reviewers in a similar manner as contributed articles now submitted to any of the journals of the American Chemical Society. Upon favorable recommendation of the reviewers and the officers of the division, the papers will be included in the final program of the division.

It has been keenly felt for some time that something must be done to raise the standard of some of the papers which have been given before the division. No doubt the new method will reduce the number of papers to be presented at any one meeting, but it is felt that a few genuinely good papers followed by a sufficient time for discussion will be what most chemists desire. At Pittsburgh there were so many papers on the program that a time limit of seven minutes was allotted with three minutes for discussion. This time proved to be so short that a speaker could not present the paper in the best manner possible, and the period for discussion was so short that there was practically no attempt on the part of members to discuss the subject.

Since the spring meeting occurs at New Haven from April 3 to 7, inclusive, it is necessary for members of the American Chemical Society who are planning to present papers before the industrial division to send their papers on or before March 1 to the secretary of the division.

Erle M. Billings,
Secretary
Industrial Division,
American Chemical Society,
Kodak Park, Rochester, N. Y.

THE UNION OF AMERICAN BIOLOGICAL SOCIETIES

The most important business before many of the societies concerned at the Christmas meetings is the consideration of the proposed organization of the Union of American Biological Societies.[1]

That there is strength in union has long been believed. The practical questions before the biologists of the country are two: first, is it possible to achieve effective union in the diversity of biological interests; second, is the proposed Union of American Biological Societies a sufficiently well thought out plan of organization to give fair promise of effectiveness?

The answer to the first question would seem to be a clear and obvious "Yes." More diverse groups have already shown that they can by union achieve cohesiveness and power. The unbroken record of history, from the time when Benjamin Franklin said, "We must hang together or we will hang separately," to the present, from the first pooling of the common interests of unlike individuals to the Standard Oil Company and the American Chemical Society gives testimony to the real effectiveness and power of united effort.

As to the second question, that can only be answered after a study of the plan of organiza-

[1] The original name was the Federation of American Biologial Societies. The word *Federation* in the Constitution has been changed by vote of the temporary executive committee to *Union* because of the confusion that some have thought would be caused by the similarity of the first provisional name to that of a small group of societies already organized.

tion as published in Science of September 29. The plan has evolved after long discussion as a matured expression of opinion of the representatives of some twenty-five organized groups of biologists. If this plan fails it seems likely that we will wait a very long time for any improvement to come to biology from the concerted efforts of its scattered votaries.

I. F. Lewis,
Chairman Temporary Executive Committee

HOTELS FOR THE BOSTON MEETING

The local committee for the Boston meeting has supplied the permanent secretary's office with a list of the Boston hotels and their rates, which is given below. The hotels are conveniently considered in five groups, according to their locations. The following grouping is employed in the tabular arrangement:

Group 1, north end of Boston Common: Bellevue Parker House, Quincy House, Young's.

Group 2, south end of Boston Common: Adams House, Touraine, Avery.

Group 3, Copley Square and vicinity: Copley Square, Copley Plaza, Garrison Hall, Brunswick, Vendome, Victoria, Westminster, Lenox.

Group 4, Upper Back Bay: Buckminster, Puritan, Somerset.

Group 5, other hotels, each within a ten-minute walk of one of the above groups (They furnish excellent accommodations for those not requiring a headquarters hotel): Essex (opposite South Station), Arlington, Savoy (Columbus Avenue, near West Newton Street), United States (Beach Street, near South Station).

SCIENTIFIC NOTES AND NEWS

Biographies of members of the National Academy of Sciences who died during the year 1922 will be prepared as follows: A. Graham Bell, by Dr. John J. Carty; J. C. Branner, by Professor Bailey Willis; Wm. S. Halsted, by Dr. Wm. H. Welch; Henry M. Howe, by Dr. Edwin H. Hall; Alfred G. Mayor, by Dr. Charles B. Davenport; Alexander Smith, by Professor W. A. Noyes.

To Dr. Fridtjof Nansen, the Norwegian Arctic explorer and zoologist, has been awarded the Nobel Peace Prize for his work in relieving the starving populations of Russia and Asia Minor and for his endeavors to promote the brotherhood of nations.

At the anniversary meeting of the Royal Society on November 30, the following members of the council were elected: *President,* Sir Charles Sherrington; *treasurer,* Sir David Prain; *secretaries,* Mr. W. B. Hardy and Dr.

BOSTON HOTELS

Name of Hotel	Group No.	Rates			
		Without Bath		With Bath	
		Single	Double	Single	Double
Adams House	2	$2.00-$2.50-$3.00	$3.50-$4.00-$5.00	$4.00-$4.50-$5.00	$6.00 and up
Copley Square	3	$2.50	$3.50	$3.50	$5.00-$6.00 up
Copley Plaza	3	-------	-------	$4.50-$6.00 up	$8.00 and up
Garrison Hall	3	$2.50 and up. Several suites for 2 to 6 persons.			
Arlington	5	-------	-------	$2.50-$3.00-$3.50	$3.50-$4.00
Bellevue	1	$3.00 and up	$4.00-$5.00	$4.00-$5.00	$6.00-$10.00
Brunswick	3	$2.50-$3.50	$4.50-$6.00	$4.00-$5.00	$6.00-$7.00
Buckminster	4	Residence hotel—Limited accommodations—singly and en suite.			
Essex	5	$2.00-$2.50	-------	$3.00-$4.00	$6.00-$7.00
Puritan	4	-------	-------	$5.00-$7.00	$6.00-$8.00
Savoy	5	-------	-------	$2.00-$2.50-$3.00	$2.50-$3.00-$4.00
Somerset	4	$4.00	$5.00	$5.00-$6.00-$7.00	$6.00-$7.00-$8.00
Touraine	2	$3.00-$4.00-$5.00	$5.50-$7.00	$5.00-$7.00	$7.50-$10.00
Vendome	3	$7.00-$13.00—American plan.			
Victoria	3	$3.00	$5.00	$4.00	$6.00
Westminster	3	$2.50	$5.00	$3.50	$6.00-$7.00
Parker House	1	$2.50-$3.50	$4.00-$5.00	$3.50-$5.00	$5.50-$8.00
Quincy House	1	$2.00-$2.50	-------	$3.00 and up	-------
Young's Hotel	1	-------	-------	$4.50 and up	$5.50 and up
United Staes	5	$2.50	$4.00	$3.50-$4.00	$4.50-$5.50
Avery	2	-------	-------	-------	$5.00-$6.00
Lenox	3	$3.00-$3.50	$4.00-$5.00	$3.50-$6.00	$5.00-$8.00

J. H. Jeans; *foreign secretary,* Sir Arthur Schuster; *other members,* Professor V. H. Blackman, Professor H. C. H. Carpenter, Professor T. R. Elliott, Professor A. Harden, Sir Sidney Harmer, Professor W. M. Hicks, Professor H. F. Newall, Professor G. H. F. Nuttall, Professor D. Noel Paton, Lord Rayleigh, Professor O. W. Richardson, Sir Ernest Rutherford, Dr. Alexander Scott, Mr. F. E. Smith, Sir Aubrey Strahan and Professor J. T. Wilson.

Dr. Walter B. Cannon, professor of physiology in the Harvard Medical School, colonel of the Medical Officers' Reserve Corps, has been awarded a distinguished service medal citation by the War Department. The citation reads: "For exceptionally meritorious and distinguished services as director of physiological research for the American Expeditionary Forces in France. His activities in connection with the development of a standard method for the resuscitation of the wounded and in organizing, instructing and directing the work of shock teams in hospitals at the front reflected professional skill and judgment of the highest order, and resulted in saving many lives."

Ernst G. Fisher, chief mechanical engineer in the U. S. Coast and Geodetic Survey, has retired from the service, after over thirty-five years of active work for the government.

Miss Eleanor Philbrook Cushing has been appointed professor emeritus of mathematics of Smith College.

Joseph W. Grieg, recently assistant in the department of mineralogy at Columbia University, has been added to the staff of the Geophysical Laboratory, Carnegie Institution of Washington, as a petrologist.

Dr. J. S. Joffe has been appointed associate in research (bacteriology) in the New York State Agricultural Station, beginning January 1, 1923, *vice* G. J. Hucker, who has been granted leave of absence for the academic year 1922-23.

The official canvass of the vote in New York State shows that Dr. Charles P. Steinmetz, of the General Electric Company, who was a candidate for state engineer on the socialist and labor tickets, received 291,763 votes.

Dr. Jan Šránek has been appointed minister of health of Czechoslovakia, to succeed Dr. Bohumil Vrbensky.

Dr. Rupert Blue, former surgeon-general of the U. S. Public Health Service, is attending the Near East Conference at Lausanne, Switzerland, as technical adviser to the American observers on the question of the control of maritime quarantine in the Near East.

C. P. Lounsbury, entomologist of the Union of South Africa, who has been in official entomological work for twenty-six years at Cape Town, is visiting the United States.

Dr. Louis Cantor, chief sanitary officer to the British administration in Palestine, is in the United States, studying sanitation methods in the larger cities for use in Palestine. He states that modern sanitary systems are rapidly eliminating malaria and trachoma in that country.

Dr. W. J. Humphreys, meteorological physicist of the U. S. Weather Bureau, lectured on "Fogs and clouds" to the Pittsfield, Mass., section of the American Institute of Electrical Engineers on November 9. During the following week he gave four lectures on the properties and movements of the atmosphere to the aviation officers at Langley Field, and on December 13 he spoke on "Fogs and clouds" to the department of physics of the Brooklyn Institute of Arts and Sciences.

Dr. C. E. Kenneth Mees, director of the research laboratories of the Eastman Kodak Company, lectured before the Franklin Institute of Philadelphia on December 7 on "Recent advances in photographic theory."

Professor Victor Lenher, of the University of Wisconsin, addressed the state branch of the American Chemical Society during the last week of November on the subject of "Selenium oxychloride," the new solvent which he has discovered.

A series of lectures by John Dewey will be delivered in part (and later published complete) in Union Theological Seminary before the coming joint meeting of the eastern and western divisions of the American Philosophical Association on December 27, 28 and 29. Under the general caption of "Experience and Philosophy," but subject to alteration, Professor Dewey proposes the following tentative outline: (1) Experience and philosophical method; (2) Experience and reason; (3) Experience and selves; (4) Experience and the psychical; (5) Experience and values; (6) Experience and metaphysics.

DR. EDGAR F. SMITH, former provost of the university and president of the American Chemical Society, gave a lecture recently, in the Harrison Laboratory of the University of Pennsylvania, on Joseph Priestley. The lecture was under the auspices of the Priestley Club. Dr. Smith, author of a biography of Priestley, showed for the first time many exhibits of Priestley and his work.

SIR CHARLES A. PARSONS delivered the second Joule memorial lecture at the Manchester Literary and Philosophical Society's house on Tuesday, December 5, his subject being "The rise of motive power and the work of Joule."

THE Henry Sidgwick memorial lecture at Newnham College, Cambridge, was delivered by Lord Rayleigh on December 2, the subject being "The iridescent colors of natural objects."

DR. VICTOR C. VAUGHAN, of the School of Medicine of the University of Michigan, gave a public address on December 6 under the auspices of the chapter of Sigma Xi of the University of Wisconsin, in commemoration of the hundredth anniversary of the birth of Pasteur.

AT the ceremonies to be held, December 26, under the auspices of the Academy of Medicine to commemorate the centenary of Pasteur, papers dealing with the development of Pasteur's work in the various branches of medical science will be read by Delezenne, for general biology; Widal, for medicine; Delbet, for surgery; Wallich, for obstetrics; Barrier, for veterinary medicine, and Calmette, for hygiene.

CHARLES FRANKLIN EMERSON, dean emeritus of Dartmouth College, and formerly professor of astronomy and physics, who was at the college from 1865, when he entered, until 1913, when he retired as dean at the age of seventy years, died on December 1.

CHARLES ALBERT FISCHER, professor of mathematics and astronomy at Trinity College, died at the Hartford Hospital, following an operation for appendicitis on December 9, aged forty-eight years.

DR. EMIL HOLMGREN, professor of histology at Stockholm, has died at the age of fifty-six years.

DR. JOHANNES PETRUS KUENEN, professor of physics in the University of Leyden, died on September 25, aged fifty-eight years.

THE death is announced of M. Barbier, correspondent of the Section of Chemistry of the Paris Academy of Sciences, at the age of seventy-five years.

IN honor of the late Lieutenant Colonel E. F. Harrison, who shortly before his death on November 4, 1918, became head of the British Chemical Warfare Department, a fund amounting to £1,640 has been collected. A memorial to Colonel Harrison and other members of the Chemical Society of London who lost their lives during the war has been erected, and a prize has been established for the chemist under thirty years of age who has carried out the most meritorious researches in chemistry.

THE executive committee of the Australian National Research Council has fixed the date of the Second Pan-Pacific Scientific Congress as August 13 to September 3, 1923. It is proposed to hold the first session at the University of Melbourne, and the second session (August 21 to September 3, at the University of Sydney. From Melbourne and Sydney as centers, excursions are planned as part of the congress program and, after the adjournment of the formal meeting, opportunities will be provided for visits to more remote parts of the continent.

THE tenth annual meeting of the Indian Science Congress, under the auspices of the

Asiatic Society of Bengal, will be held at Lucknow on January 8 to 13, 1923. The congress will be opened by Sir Spencer Harcourt Butler, governor of the United Provinces, who has consented to be patron. The president of the congress is Sir M. Visesvaraya, and the presidents of the sections are as follows: *Agriculture:* Dr. Kunjan Pillai, Trivandrum; *physics:* Dr. S. K. Banerji, director of the Observatory, Colaba, Bombay; *chemistry:* Dr. A. N. Meldrum, Royal Institute, Bombay; *botany:* Mrs. Howard, Pusa; *zoology:* Professor G. Matthai, Government College, Lahore; *geology:* Dr. Pascoe, Indian Museum, Calcutta; *medical research:* Lieutenant Colonel Sprawson, Lucknow; *anthropology:* Dr. J. J. Modi, Bombay. In addition to the regular program of the meetings of the scientific sections, a series of general scientific discussions has been organized, beginning with one on colloids by Dr. S. S. Bhatnagar, of Benares. A series of illustrated public lectures on subjects of popular scientific interest has also been arranged, details of which will be announced later. Further particulars regarding the congress may be obtained from Dr. C. V. Raman, general secretary, Indian Science Congress, 210 Bowbazaar Street, Calcutta.

The Colorado College science departments have for two years maintained an undergraduate honorary society, Delta Epsilon. The purpose of the organization is to stimulate interest in scientific research and achievement. Members are elected on the basis of promise of research ability. At the first meeting of this academic year R. J. Gilmore, professor of biology, discussed "Hormones and heredity."

Under the will of the late Dr. Carl von Ruck, Asheville, N. C., approximately $700,000 has been bequeathed for scientific research work on the prevention and cure of tuberculosis. The von Ruck Research Laboratory will have charge of the fund, and the earnings are to be expended by the corporation for "scientific research, study and experiment in tuberculosis and for the aid of tuberculous patients who are unable to procure adequate and satisfactory treatment."

At the annual dinner of the London School of Tropical Medicine, held on November 1, it was announced by Sir Arthur Robinson of the ministry of health that a scheme was under consideration whereby the London School of Tropical Medicine would be incorporated with the new Institute of Hygiene, which was made possible by a gift from the Rockefeller Foundation of New York. Sir Havelock Charles said that, if the aspirations of the school were met, the support of the staff and students would be freely given the new arrangements.

Through the president, M. Appell, the Marquise of Arconati-Visconti has given the sum of 100,000 francs to the French National Committee to Aid Scientific Research.

The Paris correspondent of the *Journal* of the American Medical Association writes that French laboratories "are lacking in financial resources, and that they find it difficult to supply what is indispensable in the way of instruments and to secure the new men needed. This state of affairs, so profoundly regrettable, was clearly brought out at a recent meeting of a group of scientists held under the auspices of the *Bienvenue française,* to which representatives of the lay press had been invited. Two ways are open to remedy the situation. Professor Appell, rector of the University of Paris, has announced that a national committee for the aid of scientific research has been founded. It is also planned to address an appeal to M. Poincaré, president of the council of ministers, to authorize, in connection with the centenary of Pasteur, a *journée nationale* in favor of our laboratories."

In the course of a field trip the past summer with a class from the University of Chicago, Dr. Adolph C. Noé, assistant professor of paleobotany, secured from Mr. C. D. Young, of Morris, Illinois, a valuable collection of fossil plants and animals from the Mazon Creek. Mr. Young, who is master in chancery of Grundy County, presented the collection to the University of Chicago. It consists of 900 choice specimens selected from a great number which Mr. Young has been collecting through nearly forty years, and is the last great private collection of Illinois fossils available. The collection, which represents a value of several thousand dollars and was given to the university without any conditions or reservations, will be housed in the Walker Museum of the university.

The Liquid Carbonic Division of the Compressed Gas Manufacturers' Association announces the establishment of an industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, for the purpose of classifying, studying and developing the uses for liquid carbon dioxide. The founding of this fellowship is in accord with the desire of the members of the association to cooperate with users and prospective users of liquid carbon dioxide, with the object of developing efficient means of applying the gas and of obtaining fundamental data bearing on its use in various industries. In addition to conducting research work, the fellowship will be made a clearing-house of information regarding various uses of liquid carbon dioxide, and data will be kept on file for the accommodation of prospective users of this product. The present incumbent of the fellowship is Charles L. Jones, who will be glad to correspond with any one interested in the use of liquid carbon dioxide in industry.

UNIVERSITY AND EDUCATIONAL NOTES

Sir William Dunn's trustees have provided the sum of £100,000 for the establishment of a school of pathology at Oxford. They have also endowed with £10,000 a readership in biochemistry at Cambridge.

The French government has offered a number of scholarships to Canadian universities, including the universities of Toronto, McGill, Laval and Ottawa. The winner of a scholarship will spend the next academic year in France. The scholarship has a value of 6,000 francs, with an additional 1,000 francs for traveling expenses.

Major General Leonard Wood has resigned the office of provost of the University of Pennsylvania in order to remain as governor general of the Philippine Islands.

Dr. Stephen S. Colvin, professor of educational psychology at Brown University, has been elected professor of education at Teachers College, Columbia University. Dr. George A. Coe and Dr. Albert Shiels have also been elected professors of education.

Dr. Albert Salathe, of the College of Pharmacy at Albany, has been appointed head of the department of chemistry of Sweet Briar College, and Dr. Frederick William Stacy, formerly of the Florida State College for Women, has been appointed head of the department of psychology.

A course of lectures on "Animal Psychology" will be delivered at Harvard University during the second half of the current college year by Dr. Wallace Craig, formerly professor of philosophy at the University of Maine.

M. Auger has been appointed director of the laboratory of analytical chemistry at the University of Paris, to succeed the late M. Ouvrard.

Professor Max Bodenstein has been invited to succeed Professor Nernst as head of the Physical-Chemical Institute of the University of Berlin.

DISCUSSION AND CORRESPONDENCE

GLACIATION IN THE CORDILLERAN REGION[1]

To the Editor of Science: Communications on the above subject by Thomas Large and Frank Leverett have appeared, respectively, in the September 22 and October 6 issues of Science. To these the writer wishes to add that during May and June, 1922, he found glacial drift including till with striated stones similar to that mentioned by Leverett at many other places on the Columbia Plateau west and southwest of Spokane. The writer expects to study the region further and to publish the results later on, but the information now at hand is sufficient to warrant the statement that

[1] Published by permission of the Director of the U. S. Geological Survey.

during one or more comparatively early stages of the Pleistocene ice from the north advanced over the Columbia Plateau in a southwesterly direction far beyond what heretofore has been regarded as the southern limit of glaciation. The evidence at hand tends to show that the ice extended at least over large parts of Spokane, Lincoln and Adams counties, and less complete information suggests the possibility that the glaciation extended much farther.

Concerning the glacial drift, which by the way is not the only evidence the region affords that land ice was formerly present, the alternative ideas that it was brought to place by floating ice or running water have been considered and rejected. Large patches of the drift may be seen southwest of Cheney, west of Lantz, and in the neighborhoods of Winona, Lacrosse and Kahlotus, these occurrences being selected for mention at random and not because they are more typical than scores of others scattered throughout the region.

The writer wishes to point out that he does not herein attempt to correlate or otherwise define the relations between the glaciation described and the glaciation already known to have covered the plateau west of the Grand Coulee or an ice stream which, as shown by recent observations, traversed the coulee itself.

J. T. PARDEE
U. S. GEOLOGICAL SURVEY

EFFECTS OF COPPER WIRE ON TREES

IN 1918 the writer heard it stated that shade trees were being killed by driving one or two pieces of copper wire into each. To test the effects of copper wire six young trees from two to four inches in diameter were selected, and on March 21, 1919, there were driven into each tree five pieces of large copper wire 1.5 inches long. The end of each wire was left flush with the outer surface of bark. All wires were within six feet of the base of the tree. The trees comprised two hemlocks, two alders, one cedar, one willow.

On July 3, 1922 the trees were examined and found to be perfectly healthy. In all cases they had completely healed over the wires, and their growth was equal to that of other similar trees in the immediate vicinity. On cutting into the trees, it was found that there was very little injury to the wood, merely a brown color showing for about 1.5 inches above and below the wire, and about 0.25 inch to each side.

GEORGE B. RIGG
UNIVERSITY OF WASHINGTON

TANGENT LINES

OSGOOD and Graustein state in their *Analytic Geometry,* page 176: "A tangent to a conic might then be defined as the limiting position of a line having two points of intersection with the conic, when these points approach coincidence in a single point." This accords with the ancient idea of a tangent as touching a conic at only one point. That idea is given in a paragraph on page 163 of my *History of Mathematics,* from which Professor G. A. Miller quotes[1] part of a sentence and then criticizes that part. I illustrate this mode of criticizing by quoting from Professor Miller's review the following: "Students can usually prove a large number of theorems which they do not understand." Serious-minded readers would deny this statement, but when they read the whole sentence and the paragraph from which this fragment is taken, they will acquiesce.

FLORIAN CAJORI

SCIENTIFIC BOOKS

A Treatise on the Analysis of Spectra. By W. M. Hicks, Sc.D., F.R.S., emeritus professor of physics in the University of Sheffield, formerly fellow of St. John's College, Cambridge. Cambridge University Press, 1922, 231 pp. of text, 92 pp. of tables and 25 figures.

The purpose of the book is twofold, to serve as an introduction and handbook and to present the mature results of the author's extensive investigations. The treatise is based on an Adams prize essay presented in 1921. For the first purpose the appendix contains the Meggers and Peters tables for corrections to be added to the wave-lengths in air to reduce

[1] This Journal, October 13, page 421.

to vacuum, Rydberg's values of $N/(m + \mu)^2$, data for wave-lengths and wave-numbers of lines allocated to series, and the Hicks formula constants, in Chapter V in which he considers the effects of physical conditions, the various Zeeman patterns so far determined, illustrative of Preston's law, are collected for convenient reference and also the Stark data, and a table of radiation and ionization potentials is included.

Chapters II and III give a clear introduction to types of series and to the series systems now recognized in the different groups of the periodic table. In the following chapter Rydberg's rules are discussed in the light of the series systems now determined and of the available spectroscopic data. With the exception of the constancy of N, he considers that all the values are valid; as to N he concludes that we can not hope to determine exact values of N in the various series and elements from determination of formulæ constants alone, that it is practically certain that the value in general is larger than Rydberg's value and nearer Bohr's limit and that changes in N in the different sequences should not be unexpected.

A distinctive contribution by Hicks to the study of series is his modification of the Rydberg formula which he writes $n = A - N/(m + \mu + \alpha/m)^2$ where A is the limit, $\mu + \alpha/m$ the "mantissa," and N 109675 R. U. In his notation the separations from the limit in a series of lines form a "sequence" of values and a particular value is the mth "sequent." Separation is the difference in the wave-numbers of two lines, ν = doublet separation, Δ = the difference in the mantissæ of doublet sequences and is shown to be an integral multiple of the "oun."

The mantissæ play an important rôle in the author's development of the idea of the oun and "linkages." He writes $\Delta = m\ q\ w^2$ where m is an integer, q a universal constant, and w the atomic weight, which for convenience he divides by 100. From a consideration of the doublets of Ag he finds that q is 361.78.

The oun is considered to be a fundamental constituent in spectra and is written oun $= \delta_1 = \frac{1}{4}\delta$ where $\delta = 361w^2$. The evidence given for the dependence of the oun on the square of the atomic weight is very strong, but the existence of isotopes introduces difficulties which the author recognizes but does not succeed in disposing of completely.

When a multiple of the oun is added to the limit mantissa, the modification is called displacement and a displaced line a "collateral." This leads to his theory of linkages, "that in certain elements the spark spectra consist almost wholly of long sets of lines differing from one another in succession by certain special separations which can be calculated from the ordinary series limits and Δ, these separations may be called links, and a complete set a linkage. These linkages appear to start from ordinary series lines." The subject of linkages is too complicated for presentation in a review; it aims to relate the lines which do not belong to the regular series to lines occurring in the ordinary series by a set of links. These links may occur in any order forming chains and meshes of lines. That "linkage spectra" represent realities and form a category coordinate with series and band spectra would seem to be a matter for further investigation.

The reviewer's impression is that the author over-estimates the accuracy of the spectroscopic data and one wonders whether with more accurate data the evidence for linkages would be increased or lessened. Professor Hicks is convinced that links occur with much greater frequency than a chance arrangement would suggest, but considers the most conclusive evidence to be furnished by the large number of regularities, repetitions, collocations of links and meshes. It is, however, somewhat surprising that lines in spark spectra should be related to each other by separations calculated from the limits and the Δ of the ordinary series inasmuch as spark spectra are characterized by their special types of series.

Chapters VIII and IX are devoted to a discussion of the distinguishing properties of the p and s and of the d and f sequences. For the p sequence the march of the mantissæ and atomic volumes is so close that he concludes that the p sequence depends directly on a quantity equivalent to the volume of the atom. On the other hand the *d* and *f* sequents have as mantissæ multiples of the oun. The last two chapters are given to the monatomic gases and to the consideration of miscellaneous questions.

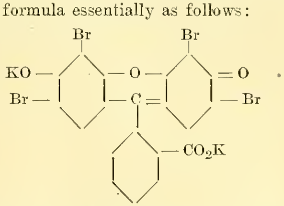
This book by Professor Hicks representing extensive researches for data and extended calculations based on the material collected and giving the views of one who has studied the subject so long and thoroughly will prove a welcome addition to a working library. It presents a general and connected view, provides a means of ready reference and suggests lines of investigation. It is well indexed and replete with references to original sources.

CHARLES E. ST. JOHN

AMERICAN EOSINS

IN a recent report of this committee[1] it was mentioned that a number of satisfactory samples of eosin had been obtained from American sources. At the time this early report was published no very definite data were at hand to show how these samples compared with samples of Grübler's eosin. At the present time, however, data have begun to accumulate giving a more satisfactory survey of the whole situation and it seems time to publish them.

Eosin is a compound of the phthalein series with a formula essentially as follows:



There are an almost innumerable number of different eosins on the market, differing slightly in chemical composition and having quite different staining properties and solubilities. They are usually classed in three or four groups denoted in Schultz's Farbstofftabellen, fifth edition, under the numbers 587, 588, 589 and 590.

Eosin 587 is the stain best known to the biologist. It is typically the same as the formula given above, namely the potassium salt of tetrabromfluorescein; but the monobrom and dibrom derivatives are also known, and as they sometimes occur mixed with the tetrabrom compound, the composition of this dye varies somewhat. Its color varies accordingly, because the more bromine atoms the bluer the shade. This dye is specified in the trade by such terms as eosin, yellowish eosin, eosin Y, and eosin G, water-soluble eosin, eosin W, eosin Y extra, cosin S extra.

Eosin 588 and 589 are both known as alcohol-soluble eosin, being only slightly soluble in water, but differ from each other in that 588 contains a methyl group in the place of one of the potassium atoms in the above formula while 589 contains an ethyl group in this same position. Number 588 is more correctly called methyl eosin while 589 is called eosin S or primrose.

Eosin 590 is a compound in which two of the bromine atoms have been replaced by NO_2-groups. This compound, like 587, is readily soluble in water but differs from it in its bluish color. It is known as bluish eosin, eosin B or eosin BN.

It must be understood that with such great variation in the possible composition, every manufacturer puts on the market a product slightly different from that of any other and as these compounds differ in shade each different product is generally known by its own trade designation. This gives the very confusing list of designations applied to eosin, of which those mentioned above are merely the commoner ones. It simplifies matters, however, if it is remembered that the terms eosin, yellowish eosin or water-soluble eosin refer to 587, while alcohol-soluble eosin refers to 588 or 589 and bluish eosin to 590.

No attempt was made in this work to get uniformity in the technic that was used, each collaborator being asked to use the samples for any purpose and according to any technic with which he was familiar. One of the investigators, in fact, reports five different tests to which he submitted the samples. As a result, these samples have been tested in a great

[1] Committee on Standardization of Stains: "Preliminary Report on American Biological Stains," SCIENCE, N. S., LVI, 156-160.

variety of ways and although it is hardly to be expected that the reports would be uniform under such conditions, it is felt, nevertheless that they have considerable value on account of the number of different methods by which the samples were tested. One of the collaborators tested the samples by the simple staining of bacteria; two used them for counterstaining in the Gram technic for staining bacteria. In three cases they have been tested in blood stains, in one case with hæmatoxylin, in another with methylen blue in the well-known Wright method, and in the third without combination with any other dye. Three of the investigators used the samples in tissue staining as a counter-stain against hæmatoxylin. One of the investigators, besides using the eosin in blood work and as a counterstain in the Gram technic, reports results obtained in staining cultures of *Penicillium*. These cultures after being killed and fixed were stained in mass, then mounted and examined. Lastly, another collaborator reports using the samples in two indicator media, one with brilliant green and the other with methylen blue.

The variety of these methods is sufficient so that there is good reason to feel that any sample which gave good results in all cases can be safely recommended. It was very clearly demonstrated that in the great variety of purposes for which these samples of eosin have been used, the American samples almost without exception are the best. Some may be slightly better than others for certain special purposes but there seems to be no reason for condemning any of them.

Satisfactory samples were obtained from the following American concerns: Eimer and Amend, Harmer Laboratories Company, Heller and Merz Company, N. Y. Color and Chemical Company, Providence Chemical Company, Darwin Chemical Company, Campbell and Company, Geigy Chemical Laboratory, Coleman and Bell Company, H. S. Laboratories, E. Leitz, National Aniline and Chemical Company Company and D. H. Pond.

The chairman of the committee is ready upon request to furnish investigators with information as to the apparent merits of each of these samples for particular purposes and as to how any particular one of these lots of eosin may be obtained.

Committee on Standardization of Biological Stains, National Research Council,

S. I. Kornhauser
F. W. Mallory
F. G. Novy
L. W. Sharp
H. J. Conn, *Chairman*

ZOOLOGICAL NOMENCLATURE

In accordance with the provisions respecting the use of "plenary power" by the International Commission on Zoological Nomenclature, to suspend the rules in cases in which the application of the rules will produce more confusion than uniformity, the secretary has the honor herewith to notify the zoological profession that a proposition by Commissioner David Starr Jordan is now before the commission to suspend the rules in the following cases and to "definitely reject the works named below from consideration under the law of priority," namely:

Gronow, 1763, Museum Ichthyologicum.

Commerson (as footnotes in Lacépède Hist. nat. des Poissons, 1803 mostly).

Gesellschaft Schauplatz, 1775 to 1781. An anonymous dictionary accepting the pre-Linnæan genera of Klein.

Catesby, 1771, Natural History of Carolina, Florida and the Bahamas (1731 to 1750), revised reprint by Edwards, 1771.

Browne, 1789, revised reprint of Civil and Natural History of Jamaica (1766).

Valmont de Bomare, 1768-1775, Dict. Raisionnée Universelle d'Hist. nat. (several names accidentally binomial).

In connection with these works, attention is invited to Opinions Nos. 13, 20, 21, 23, 24, issued by the commission.

The effect of the foregoing proposition is to reject as unavailable (as of the dates in ques-

[1] Notice to zoologists (especially to ichthyologists) of Consideration of Suspension of Rules of Nomenclature in cases of Gronow (1763), Commerson (MS. names—quoted in footnotes in Lacépède, 1803 mostly), Gesellschaft Schauplatz (1775 to 1781), Catesby (1771 reprint by Edwards), Browne (1789), and Valmont de Bomare (1768 to 1775).

tion) all systematic (chiefly generic) names published as new in the foregoing works, but to leave them as *available* as of the dates when they were later adopted by authors whose nomenclatorial status is unqnestioned by zoologists; thus, a *modus operandi* is suggested to solve in a practical way the impasse which has existed for abont twenty years in the views respecting the use of the words "binary" and "binomial" and while neither side concedes the principle it supports, both sides unite on another principle, namely, that the important end in view is to obtain, not to delay, results, and that the "plenary power," used judiciously and discreetly, offers us a practical method to solve the problems upon which there is such conscientious difference of opinion as to interpretation that concensus of opinion seems hopeless.

The secretary is fully persuaded that the application of the rules to the foregoing publications will continue to result in greater confusion than uniformity and he proposes at the expiration of the proper time (one year) to recommend to the commission the adoption of Commissioner Jordan's proposition.

Zoologists interested in this proposition, *pro* or *con,* are cordially invited to present their views in writing to any member of the commission so that they can be given due consideration when this proposition comes to vote (approximately October 1, 1923). Views, *pro* or *con,* which reach the secretary prior to September 1, 1923, will be manifolded and submitted to the commission prior to the final vote.

C. W. Stiles,
Secretary to Commission

SPECIAL ARTICLES

THE ORGANIZATION OF THE NERVOUS MECHANISM OF RESPIRATION

We have been accumulating experimental data on the nervous mechanism of respiration for some years past, but these results have been for the most part presented in preliminary notes only.[1] Circumstances have arisen which make it seem probable that the publication of the full experimental data must be still further delayed. We wish, therefore, to present a brief summary of our general conclusions at this time.

Gad stated that the nervous mechanism of respiration extended from the facial nerve to the lumbar plexus. We must, in all probability, enlarge the field to include the fifth cranial nerve. Any statement of the organization of this mechanism must take account of all the pertinent elements found in this rather extensive region.

The primitive nervous mechanism for the control of respiratory movements in vertebrates has its central representation in the medulla oblongata. Against Trevan and Boock's view[2] of a primitive respiratory center in the region of the corpora quadrigemina we would say, (1) that we have no evidence of any cells in this region which are sensitive to carbon dioxide in the same sense that the central cells in the medulla oblongata are sensitive to it; and (2) since the corpora quadrigemina themselves are not primitive, it is difficult to see how such a primitive mechanism could be located there.

The activity of the central respiratory mechanism in the medulla is conditioned by (1) the concentration of substances dissolved in the blood, *e.g.,* carbon dioxide; (2) the temperature of the blood flowing through the medulla; (3) the volume of blood flowing through the medulla in unit time, and (4) afferent nerve impulses from various peripheral sensory fields. All these various conditions are summed algebraically in the central respiratory mechanism. This view implies an important extension of our common idea of the summation of stimuli.

The afferent nerve impulses arise, in higher mammals, *e.g.,* the cat, from the lungs and the

[1] Pike, F. H. and Coombs, H. C., *Soc. Ex. Biol. and Med.,* 1917, xv, 55; *Am. Journ. Physiol.,* 1918, xlv, 569; Coombs, H. C., *Am. Journ. Physiol.,* 1918, xlvi, 459; Pike, F. H., Coombs, H. C., and Hastings, A. B., *Soc. Ex. Biol. and Med.,* 1919, xvi, 49; *Am. Journ. Physiol.,* 1921, xlvii, 104; Pike, F. H. and Coombs, H. C., *Am. Journ. Physiol.,* 1922, lix, 472.

[2] Trevan, J. and Boock, E., *Journal of Physiology,* 1922, lv, 331-339.

respiratory epithelium generally, parts of the alimentary epithelium, the pleura, and the muscles of the thoracic wall, the diaphragm, and the abdominal muscles.

The afferent paths are (1) the vagus (tenth cranial nerve) from the lungs and trachea, the fifth cranial from the mucous membrane of the nose, the glossopharyngeal (ninth cranial) from the pharynx and the portions of the soft palate, the phrenic[3] from the diaphragm, the sympathetic[4] from the thoracic wall, and the dorsal roots of the spinal nerves from the thoracic and abdominal muscles.

The central connections of the vagus do not necessarily extend beyond the medulla oblongata. The central connection of the spinal tracts arising from dorsal root fibers are primarily with the mid-brain (region of the corpora quadrigemina) and only secondarily with the medulla oblongata.

We have no evidence of any true respiratory mechanisms of an accessory sort in the spinal cord. The efferent root cells in the spinal cord have no special sensitiveness to carbon dioxide.

The respiratory rate becomes slower after division of both vagi for the reason that afferent impulses over the vagi, which are normally summed with the carbon dioxide in the blood to produce an excitation of the cells of the medulla, are no longer present, and the excitation of the central cells is now dependent in large part upon the carbon dioxide alone. The form of the respiratory movements changes for the same reason that the movements of a limb undergo a change in character when the afferent nerves from the limb are divided, *i.e.*, both types of movements become ataxic.

A further fall in the respiratory rate ensues when, in addition to division of the vagi, there is section of the dorsal roots of the spinal nerves or transection at the lower border of the midbrain because there is a still greater loss of afferent nerve impulses, and excitation of the efferent cells in the medulla oblongata becomes almost wholly dependent upon the carbon dioxide of the blood. The respiratory movements also become correspondingly more ataxic.

Costal movements of respiration fail after section of the dorsal roots alone for the reason that the efferent root cells of the intercostal nerves, which are normally excited by impulses from at least two sources—the descending respiratory motor fibers and the dorsal roots of the intercostal nerves—now receive impulses from the descending fibers only. There is no actual paralysis of the efferent root cells, since costal movements are immediately resumed when contraction of the diaphragm is prevented. This indicates that von Monakow's diaschisis effect is due to loss of some nervous impulses normally entering into the process of excitation of a motor cell.

Our idea of the manner of action of the nervous mechanism for respiration may be briefly stated as follows. Afferent impulses passing into the central mechanism in the medulla oblongata reach the efferent cells through connections which do not pass outside of the medulla itself. The central pathways of afferent impulses over the sympathetic fibers and the phrenics are at present unknown. Afferent impulses coming in over the dorsal roots of the spinal nerves reach the efferent root cells through intra-spinal connections, but the discharge of these cells is withheld until the arrival of impulses over the descending tracts in the spinal cord. Impulses from these two sources are summed in the excitation of the efferent root cells. Other impulses from the dorsal root fibers pass up the spinal cord to the region of the corpora quadrigemina, but whether over the ventral spino-thalamic fibers[5] or over fibers in the spino-cerebellar tracts is uncertain. From the midbrain, these impulses are relayed to the cells of the respiratory center in the medulla oblongata. The excitation of these cells is dependent upon the summation of stimuli arising from (1) the concentration of carbon dioxide in the blood flowing through these cells, and (2) the nervous impulses coming in over the various afferent pathways. The

3 Mathison, G. C., *Review of Neurol. and Psychiatry*, 1912, x, 553.

4 Barry, D. T., *Journ. Physiol.*, 1912, xlv, 473.

5 Ransom, The Anatomy of the Nervous System, Philadelphia, 1920, p. 104.

afferent nerves thus have the double function of (1) contributing to the excitation of the cells in the respiratory center, and (2) of controlling the movements of the muscles arising from this excitation. While it is undoubtedly true that the respiratory center may act automatically under conditions which preclude the effect of afferent impulses[6] it is our opinion that its normal activity is not wholly automatic but partly reflex.

F. H. PIKE
HELEN C. COOMBS
COLUMBIA UNIVERSITY

[6] Stewart, G. N., and Pike, F. H., *Am. Journ. Physiol.*, 1907, xix, 328.

THE AMERICAN CHEMICAL SOCIETY

(Continued)

DIVISION OF AGRICULTURAL AND FOOD CHEMISTRY. II

The application of certain commercial dyes to the reductase test on milk: MINNIE F. DRESSLAR and H. A. WEBB. The decolorization of methylene blue by the reductases in milk furnishes a rapid approximate determination of its bacterial age. In order to make the test more convenient for bakers, grocers, restaurant keepers, cooking classes or housewives, who might wish to test milk claimed to be fresh on delivery, eighty-four dyestuffs sold under trade names for household use were tested. By a series of eliminations, the most satisfactory ones were determined, eight in number. They are: "Diamond Dyes" (wool and silk), cardinal, garnet, orange, turkey red; "Rit" dyes, blue, flesh, lavender, red. The decolorization times, which vary for each, but are reasonable, and the effect on various types of milk-whole, skimmer, cream, pasteurized, boiled, malted, condensed, evaporated, were determined. Suggestions for the use of the test by non-technical people are given.

Data on the thickening of condensed milk: ALAN LEIGHTON and COURTLAND S. MUDGE.

Use of frozen eggs in mayonnaise: S. K. ROBINSON. Comparisons between the fresh and frozen eggs were made on batches of mayonnaise. No difference in the product was noticeable, immediately after preparation. Both products were well emulsified and had good body. The following physical tests were then applied: microscopical examination, freezing test, incubation, shaking test and effect of air and light. Not any of these tests put the frozen egg product at a disadvantage. Mayonnaise made from frozen eggs held well in a warm room for thirty days.

Changes in hens' eggs stored in water glass and in lime solutions: F. C. COOK and J. B. WILSON. Strictly fresh and commercial eggs, which were preserved in water glass (1-10, 1-13 and 1-20) and saturated lime solutions. Separate jars of each were stored in the laboratory and in a cellar. At the beginning of the experiment and after various periods samples of the eggs were examined physically, bacteriologically and chemically. Best results were obtained by holding strictly fresh eggs in a 1-10 water glass solution at cellar temperature. Changes of considerable magnitude were found in water, ash and nitrogen contents of both whites and yolks. Bacteria were not found to be a factor in deterioration. Ammonia nitrogen and acidity of fat proved to be the best indices of decomposition.

Manganese, aluminium and iron ratio as related to soil toxicity: R. H. CARR and P. H. BREWER. Much emphasis has been given in the past to the isolation of organic toxins which were thought to be the cause of soil toxicity, while in more recent times the trend of investigation has been turned more specifically to soil acidity as the reason for poor crop yield. Investigations which have been conducted on a large variety of soils using the potassium thiocyanate method for soil acidity and toxicity, described by one of the writers, indicates that the cause of infertility of many soils, supplied with sufficient plant food, is due to the presence of soluble manganese compounds in some cases, to aluminum compounds in other instances and sometimes to a combination of the two. The toxicity of soluble iron is not so apparent, as it is usually associated with a considerable quantity of soluble aluminum in an acid soil. The potassium thiocyanate method has been found helpful in this study, because of the color changes taking place when these elements are present in the soil in easily soluble form. If the soil is more acid than p_H 5.5 a red color of ferric thiocyanate is produced in the presence of soluble ferric iron and if this soil solution containing manganese is made slightly more basic, a green color will develop in the liquor. The depth of the color will be proportional to the amount of manganese in the soil solution. This color begins to form when the soil contains about 0.008 per cent. of soluble manganese. The green color will be found associated with nonproductive acid soils, and since it is shown that manganese does not precipitate as a hydroxide until a p_H of about 7.9 is reached, a large amount of limestone (8 to 10 tons in addition to that required to remove the red color) will be required. In some instances the cost of this large amount may be prohibitive.

The effect of selenium compounds upon the growth and germination of plants: VICTOR E. LEVINE. The findings of Gassmann (*zs. Physiol-Chem.*, 1917, 100, 209) that selenium is a constituent of plants has led to the inquiry as to the effect of selenium compounds upon germination and growth. White lupine and timothy seedlings were used in the experiments. Concentrations of 0.001 per cent. to 0.0001 per cent. show no injurious effect; in some experiments these concentrations favor growth. Concentrations of 0.01 per cent. and over are exceedingly inimical to germination and to growth. The compounds may be arranged as follows in the order of diminishing toxicity: selenious acid, selenic acid, sodium selenite, sodium selenate and potassium selenocyanate. This order agrees well with that obtained with animal experiments testing the relative toxicity of these compounds. It is evident from the results obtained that selenium can not replace sulfur in the nutrition of plants.

The determination of nitric nitrogen in the soil solution: WALTER THOMAS. The determination of nitric nitrogen is the *bête noir* of the soils chemist. Inasmuch as the phenoldisulfonic acid method is the one that is the simplest and most rapid, and therefore more generally used by soil chemists than any other, the author has carried out some experiments on the effect of various flocculating and clarifying agents under carefully controlled conditions by this method and compared the results with the Devarda reduction method, which is the only one that has escaped serious criticism. The results obtained by different investigators have been very conflicting, but the results of the present investigation indicate that: (1) The use of either potash alum or alumina cream (even if neutral) results in large losses of NO_3; (2) CaO if freshly ignited is the most satisfactory flocculating and clarifying agent; (3) The Devarda alloy method gives excellent results on the soil solution, but is not applicable to rapid routine work.

DIVISION OF FERTILIZER CHEMISTRY

F. B. Carpenter, *chairman*

H. C. Moore, *secretary*

Water-soluble nitrogen in mixed fertilizers: R. N. BRACKETT.

Studies on the availability of organic nitrogenous compounds: C. S. ROBINSON.

Review of methods of determining nitrogen in fertilizer: E. W. MAGRUDER.

Possibilities in the use and preparation of concentrated fertilizers: WILLIAM H. ROSS. The Haber and other processes for fixing nitrogen and the volatilization method of preparing phosphoric acid all yield materials, directly or by combination, of different composition and higher concentration than those ordinarily used in the manufacture of fertilizers. Some of these materials, as ammonium phosphate, have chemical and physical properties which make them admirably suited for mixing with ordinary fertilizer materials, or for making mixed fertilizers of higher concentration than any now in use. Others, as ammonium nitrate, can not be satisfactorily used in present fertilizer mixtures unless means can be devised for eliminating or neutralizing properties which interfere with their use in this way. The work of the Bureau of Soils on concentrated fertilizers and fertilizer materials was therefore undertaken not with a view to replacing the ordinary fertilizer materials, nor of providing high quality fertilizers which would command higher prices per unit, but rather with the double purpose of devising means of utilizing new sources of fertilizer materials and of decreasing the cost of handling and transporting fertilizers by increasing the concentration of mixtures which require shipment to a distance. The advantages and disadvantages of low-grade fertilizer mixtures are discussed and a review given of progress made in the preparation of concentrated fertilizer materials.

Recent investigations on the oxidation of sulfur by micro-organisms: J. G. LIPMAN. There has been isolated at the New Jersey Agricultural Experiment Station a new sulfur-oxidizing organism which has been named *Thiobacillus thioxidans*. This organism grows readily in purely inorganic media containing, aside from the usual mineral salts, elementary sulfur. It derives its energy from the oxidation of sulfur and obtains its carbon from carbon dioxide. It will grow readily in a medium having a hydrogen-ion concentration of 4.0 to 5.0 and will continue to multiply when the hydrogen-ion concentration exponent is below 1.0. The sulfur is oxidized by this organism to sulfuric acid. The acid so produced may be utilized for a variety of purposes. Mixtures of mineral phosphates and sulfur, properly inoculated with *Thiobacillus thioxidans*, will be converted into acid phosphate. Inoculated sulfur added to the soil will increase its acidity to a point where certain objectionable fungi, like those producing scab of potatoes and scurf of sweet potatoes, may be largely if not entirely suppressed. The transformation of sodium carbonate, present in excessive amounts in so-called black alkali soils, into sodium sulfate may be similarly accomplished. The direct use of inoculated sulfur for the purpose of supplying sulfates where these may be present in inadequate amounts, or the use of the same material for the production of potassium sulfate from greensand marl is indicated. The elimination of soil-infesting insects, or nematodes and of undesirable vegetation may also be accomplished by means of sulfur inoculated with cultures of *Thiobacillus thioxidans.*

Trend of modern fertilizer plant construction: Peter S. Gilchrist. This paper will deal with the construction features of up-to-date fertilizer plants, including types of buildings, materials for building construction, equipment for plants and the relation of equipment to the building. Especial attention will be given to the design of plants with the necessary equipment for the economical handling of materials, silos or storage bins for storing phosphate rock, air separation for ground rock, the development of mechanical dens for making acid phosphate and economical methods of manipulating and bagging finished goods.

Modern trend in fertilizer plant operation: E. H. Armstrong. The manufacture of sulfuric acid as the basis of the fertilizer industry. A brief résumé of this subject, giving developments from its inception to the present time. A brief discussion of the present methods pursued in operating a modern sulfuric acid plant. A short discussion of the developments in acid phosphate manufacture, together with a review of the more modern methods and the trend toward finer grinding, emphasizing the necessity for close chemical control. A comparison of the old and new ways of mixing fertilizer, showing the tendency towards larger mixing units and a better conception of the necessity for more methodical sampling and for coordination between operating and analytical departments to insure closer analyses.

Modern trend of chemical control in the fertilizer industry: H. C. Moore. Chemical control involves the practical application of chemical phenomena and laws to the manufacturing operation, thereby directing or restraining influences as conditions require. Chemical control is not chemical analyses alone, but is the sum total of chemical analyses, chemical knowledge and practical experience and the correlation and application of these with the problems at hand. Chemical control has pointed the way to remarkable economy in the manufacture of sulfuric acid; to economic progress and a greatly improved product in the manufacture of acid phosphate; and to the cost, mechanical condition and quality in the manufacture of mixed fertilizers. The modern trend of chemical control in the fertilizer industry is to substitute knowing for guessing; to learn the best working conditions for each type of plant, and the materials and mixtures it is required to use or make; to determine the best and most economical combinations of materials to be used in the manufacture of fertilizer; to determine the best methods of formulating and using the materials so selected; to determine the general crop needs and materials most suitable for supplying it; to determine the combination of materials which must be avoided or if possible to see how this may best be done; to determine the best means of avoiding large unit losses of materials, of preventing analytical discrepancies and of sampling all products to insure reliable analytical results. Thus chemical control properly becomes both the governor and safety valve on the whole machinery of the fertilizer industry.

Modern trend in state fertilizer control: Andrew J. Patten.

Modern trend in fertilizer legislation: J. E. Breckenridge.

Modern trend in fertilizer experimentation: Dr. H. J. Wheeler. Fertilizer experiments at Rothamsted on permanent meadows, at Rhode Island on limed and unlimed soils and with different phosphates and potash salts, coupled with similar experience elsewhere, and the studies of lime-magnesia ratios, of the different effects of iron, magnesia and of manganese, boron, strontium, barium, lithium and other elements not usually considered plant foods have shown the necessity for intensive study of the physical, chemical and biological conditions best adapted to each kind of plant. At the same time, the relation of soil colloids to problems of fertilization and plant nutrition has been especially emphasized. Future investigators will study thoroughly physical and biological soil properties as related to fertilization, correlating them more closely than before with individual plant requirements and adaptations.

The determination of potash in mixed fertilizers: F. B. Carpenter. A brief review of the methods for the determination of potash in mixed fertilizers prior to the adoption of the Lindo-

Gladding method as official by the Association of Official Agricultural Chemists, with modifications which have been made since. The official method, although popular with analysts, gives low results and suggestions are made as to modifications, which may be used to recover all the available potash. It is recommended that the fertilizer division take up the matter and work out an accurate method, which will be acceptable to the Association of Official Agricultural Chemists.

Some sources of error in the determination of insoluble phosphoric acid in acid phosphate and fertilizers: W. R. Austin.

Some sources of error in the determination of total phosphoric acid in acid phosphate and fertilizers: W. R. Austin.

A qualitative scheme for the detection of cyanamide and related compounds: G. H. Buchanan. Quantitative methods for the determination of cyanamide and its transformation products are only of value when preceded by a reliable qualitative examination. A qualitative scheme is presented, modeled after the ordinary schemes of inorganic analysis, whereby ten forms of nitrogen which are commercially related to cyanamide may be detected. Provision is made for the interference of the more common inorganic radicles. The ten forms included in the scheme are as follows: (1) Ammonia and its salts; (2) Cyanamide; (3) Hydrocyanic acid and its salts; (4) Dicyandiamide; (5) Guanidine and its salts; (6) Quanylurea and its salts; (7) Nitric acid and its salts; (8) Thiocyanic acid and its salts; (9) Thiourea; (10) Urea. Comments relating to the behavior of several other less common nitrogenous forms are also made.

The importance of correct methods of applying fertilizer: E. J. Pranke. Faulty methods of applying fertilizer in the seed row in direct contact with the seed frequently causes visible damage to the crops, for which the grower often seeks to recover compensation from the fertilizer manufacturers. There is probably also a great deal of invisible damage caused by improper method of applying fertilizer. The effect of the relative position of seed and fertilizer on the efficiency of the latter, as developed in extensive researches conducted during the past three or four years, is discussed.

Fertilization in relation to plant composition: H. A. Noyes. Mention was made of different methods of testing the fertilizer requirements of soils. A study of these methods showed that the users of fertilizers measure results, almost entirely, on the increases in the marketable portions of the crop grown. There are many reports of increased crops resulting from fertilization but very little information of the character and composition of the plants. Industries which manufacture food-stuffs from grains and fruits find the control of their finished products difficult, due *to immense variations in the composition of the grains and fruits which serve as their raw materials.* Data was presented showing that large variations exist in the composition of two economic plants. A plea was made for a study of the optimum analyses for each economic agricultural crop. Such a study would cause fertilizer results to be judged in terms of variations toward or away from the optimum analyses. As a result of a long series of investigations of one crop under field conditions the following hypothesis was evolved. *When the optimum composition for any two parts of a plant is worked out it will be possible to determine how to fertilize the soil by studying the ratio that exists between the analysis of the different portions of the plant.*

Replacement of plant food adsorbed by the hydrogels of ferric oxide and alumina: A. L. Flenner, A. L. Lichtenwalner and N. E. Gordon. The hydrogels of ferric oxide and alumina were allowed to suffer their maximum adsorption of salts. When this equilibrium had been reached the gels were subjected to successive washings with distilled water, and when 50 cc. of the filtrate failed to give more than a very slight test for the adsorbed salt, the gel was subjected to washings with various acid, base and salt solutions, and the resulting filtrates analyzed for the respective salts. Analysis of the gel was made at each change of the leaching solution.

Can plants use salts adsorbed by soil colloids: R. C. Wiley and N. E. Gordon. Experimental work was started in order to find if plants were able to use salts which had been adsorbed by soil colloids. The soil colloids were artificially prepared, and after they had suffered a maximum adsorption of the various salts used in plant nutrition work, the plants were allowed to root and grow in the colloids. After a certain period of growth the plants were analyzed for the quantity of different elements which the plants had been able to take up from the colloids.

Utilization of waste products for organic nitrogen: E. H. Armstrong. The comparative abundance of materials carrying organic nitrogen in available form which were to be had in the early stages of the fertilizer industry; the gradual withdrawal of these from the fertilizer materials market to the feed market; the use of part mineral ammoniates and part organic ammoniates to offset this shortage; the necessity of conserving all waste materials carrying organic nitrogen and of developing methods to render available the nitrogen in such inert materials as leather, hair, etc.; a description of the manufacture of leather meal, its undesirability and a comparison of the European and American products; a refutation of the general understanding that the nitrogen in the inert materials can not be made soluble without loss of ammonia, and the reference to a high class product which can be used in any quantity; a discussion of garbage tankage and other waste.

DIVISION OF PETROLEUM CHEMISTRY

T. G. Delbridge, *chairman*

W. A. Gruse, *secretary*

The vapor pressure of solutions of benzol, hexane and cyclohexane in lubricating, gas absorbent and vegetable oils, with molecular weight data: Robert B. Wilson and Edward P. Wylde. A knowledge of the vapor pressure of volatile solvents, such as benzol and hexane, dissolved in various types of relatively non-volatile oils, is of commercial importance in a considerable number of applications. Of these the three most important are (*a*) the dilution of crank-case oils with fuels in internal combustion engines; (*b*) the complete removal of volatile solvents from oils and fats obtained by the solvent extraction processes; and (*c*) the recovery of solvents by scrubbing with cold absorbent oils, as in benzol recovery from coal gas. It was the object of the work described in this paper to make possible such generalizations and approximate calculations for the three general types of volatile hydrocarbons—paraffin, napthene, and aromatic—dissolved in most ordinary types of oils. Molecular weights were determined on all of the oils used, and the amount of vapor pressure lowering for different combinations was compared with the theoretical as predicted by Raoult's law. It appears that the amount of lowering produced by different types of combinations is fairly definitely predictable and that the results for any combination met with in practice can be calculated with quite satisfactory accuracy for any ordinary temperature if the vapor pressure of the pure volatile constituent is accurately known, together with the molecular weight and type of hydrocarbons present in the oil. Molecular weight data included in the article is also of interest in being the first published data on a fairly wide range of the higher mineral oil fractions, the results having been obtained by measuring the freezing point lowering in benzol.

Further data on the measurement of the effective volatility of motor fuels: Robert E. Wilson and Daniel P. Barnard, 4th. This paper is an extension of the work presented at the Rochester Section where some new methods of determining the effective volatility were described and the results on three typical fuels presented in some detail. This work has been extended to more than a dozen fuels in this laboratory and this, combined with data obtained in other laboratories, makes it possible to draw certain generalizations as to the effect of the shape of the distillation curve on the effective volatility of the fuel in so far as it affects the completeness of vaporization and proper distribution in the manifold. In the light of these investigations, the writers believe that a single specification for the 85 per cent. point should replace all the present limitations at 50, 90 and 96 per cent., and, similarly, that the effective starting volatility can best be measured as a routine proposition by a specification at the 25 per cent. point rather than at the 5 per cent. or initial point.

Some applications of vapor pressure measurements: Harold S. Davis. An improved differential-pressure apparatus for measuring vapor pressure is described. The apparatus can be successfully applied to the control of light oil recovery plants. Actual data from plant tests are given. It has been suggested that oils could be standardized for efficiency in gas absorption by preparing solutions containing the same concentration of benzene and measuring their vapor tensions. Experiments on seven representative absorbent oils have shown no appreciable differences between them in this respect, and practical variations in their efficiencies must be attributed to other factors rather than to their ability to lower the vapor tensions of dissolved benzene. Some applications of vapor pressure measurements in gasoline recovery are discussed.

A rapid test for the decolorizing efficiency of fuller's earth: Leon W. Parsons and Leonard R. Churchill. The paper covers the development of a rapid test for determining the relative efficiencies of various samples of fuller's earth for decolorizing purposes. This test was desired to avoid the necessity for resorting to tedious filtration processes in the laboratory to determine the quality of the clay, and it serves two purposes: first, to compare the decolorizing power of various clays used in experimental investigations; and second, to serve as a rapid control test for plant operation. A survey of the properties of fuller's earth which would parallel its power to decolorize oils is given and the development of several different tests is indicated. The most satisfactory test, however, is based on the reaction between fuller's earth and pinene. Fuller's earth reacts vigorously with pinene to form polymerized products with the development of a very large amount of heat. The amount of temperature rise is used as a measure of the efficiency of the clays and data is given to show the relation between this pinene efficiency and the decolorizing power of such clays. A discussion of the mechanism of the reaction, the materials used and the application of the test for laboratory and plant use is indicated.

Effect of certain physical and chemical properties of emulsifying agents on the stability of oil-water emulsions: LEON W. PARSONS and BRIAN MEAD. This paper embodies further studies on Nujol-water emulsions and a comparison of these systems and commercial mineral oil emulsions. The technique of investigating these emulsions, making use of microphotographic apparatus and the ultra-microscope, is given. A study has been made of the following factors of extreme importance in connection with the stability of emulsions: Physical characteristics of emulsifying agents; effect of opposing emulsifying agents in the same system; action of oil soluble colloids on the emulsifying agents; and similarity between behavior of soaps and of finely divided solids. The importance of relative wetting of the different phases by the emulsifying agent is emphasized and it has been found that several common emulsifying agents give abnormal results with regard to type of emulsions produced. This latter observation has important bearing on the mechanism of the behavior of soaps and finely divided solids as emulsifying agents. Certain parallelisms have been observed between the behavior of the emulsifying agents used for Nujol-water systems and those present in commercial oil emulsions.

Engine experiment with high sulfur fuels: CARL O. JOHNS. These experiments were conducted by Professor George Winchester, formerly in charge of the Engine Research Laboratory of the Standard Oil Company of New Jersey. A Hvid type of Diesel engine ("Thermoil") was used. Several fuels were tested to ascertain the effect of both free and organic sulfur. The runs were continued for 384 hours. The fuels included high sulfur Mexican crude and gas oil, and mixtures of these with a polymer oil containing about 19 per cent. of combined sulfur, or 10 per cent. of sulfur in the mixed fuel. The running time for these fuels was 180 hours. The compression in the engine reached 500 pounds. A run of 204 hours duration was made with kerosene containing 0.85 per cent. of free sulfur in solution. Frequent examinations of the dismantled engine disclosed no evidences of corrosion, nor was the copper tubing affected appreciably. Trouble was encountered by the excessive formation of carbon which deposited on the exhaust valve and clogged the spray holes to the cylinders.

Gasoline saved on government trucks due to adjusting the carburetors by gas analysis: G. W. JONES and A. O. FIELDNER. Carburetor adjustments by exhaust gas analysis on 15 trucks, varying from 2½ to 7½ tons capacity, showed that all but one were too richly adjusted for maximum power and economy. The adjustments made gave an increase of over 20 per cent. in mileage for the first month after testing and 16 per cent. increase for the second month. The CO_2 indicator used for making the adjustments while the trucks were operated was found to be practical and easily operated by the laymen inexperienced in the handling of chemical apparatus. An analysis of the exhaust gas under the conditions which the truck is operated gives an absolute indication of the carburetor adjustment and removes all guess-work. By adjustment for maximum power and economy is meant the leanest adjustment without reduction of power.

Some factors affecting the accuracy of Saybolt viscosity measurement and their control: P. E. KLOPSTEG and W. H. STANNARD. Without a suitable form of automatic temperature control, it is impossible to secure experimental conditions which conform to A. S. T. M. specifications, namely, that "the bath shall be held constant within 0.25° F. (0.14° C) at such a temperature as will maintain the desired temperature in the standard oil tube." At any rate, the requirements can not be met with the form of bath described in the specifications. In this paper, the development is described of an electric heating and regulating device which at a temperature of 212° F. (100° C.) will hold the bath temperature constant within 0.1° F. (.05° C.) throughout an entire day's run without attention. Conditions within the oil tube are also considered, and it is shown that when the A. S. T. M. method of stirring is followed, even with the bath temperature very constant at 212° F., variations of 0.5° F. are observable on a sufficiently sensitive stirring thermometer. A method of stirring is then described by means of which it was found possible to hold the temperature of the sample under test constant to 0.01° F. over a period of many minutes. Tabulated data show the Saybolt readings at different temperatures, for samples tested under "standard" conditions, and with the new apparatus.

Cracking of unsaturated hydrocarbons by heat to give saturated hydrocarbons: Ralph H. McKee and Ralph T. Goodwin. The real liquid fuel reserve of America is in its oil shale deposits. In a study of oil shale we have found that distillation in vacuum gives an intermediate product which on heating gives over into petroleum. A study of this intermediate from various oil shales shows it always to be highly unsaturated (dissolved by 66° Be sulfuric), sometimes 100 per cent. unsaturated. If this waxy intermediate is distilled at atmospheric pressure, there is obtained a petroleum containing 48 per cent. saturated hydrocarbons. Redistillation brings about additional cracking with a further increase of the percentage of saturated hydrocarbons. Ordinarily we expect the cracking of hydrocarbons to proceed with increase of unsaturated constituents but here we have the reverse, the unsaturated constituents decreased 48 per cent. on the first distillation and still more on redistillation.

The refining of gasoline and kerosene by hypochlorite solutions: A. E. Dunstan and B. T. Brooks. The present paper is a description of the process developed and perfected by A. E. Dunstan and his associates in the Anglo-Persian Oil Company. It is the first successful industrial utilization of hypochlorite solution for refining of petroleum oils. Gasoline and kerosene may be refined in this way with treating losses of less than one half of one per cent. Malodorous compounds, including sulfur derivatives, are removed. The treated oil is free from chlorine, is free from substances which develop acidity, gummy substances or discolorations on standing, and it eliminates obnoxious waste products, such as acid tar, eliminates acid recovery and the process can be carried out in the usual form of treating apparatus. The new method, therefore, is cleaner and easier to operate, gives a much better refined product, and the refining costs are markedly lower, particularly when the losses incidental to sulfuric acid refining are included in the comparison. The process is particularly adapted to light distillates from high sulfur crudes and the savings are greatest in the case of cracked gasolines.

Refining of cracked hydrocarbon oils: Jacque C. Morrell and Gustav Egloff. The various methods of refining light petroleum distillates are discussed. The general methods involved are (*a*) physical and (*b*) chemical. The physical method of refining involving the use of various adsorbent earths, though giving good results, can not compete commercially with the chemical methods of refining. The chief chemical method in use to-day is the sulfuric acid method of refining, and it is the use of various modifications of this method upon which the authors lay the greatest stress. Applying various modifications of this method with regard to subsequent treatment as well as concentration and amounts of reagents, the authors have successfully refined cracked distillates from the following raw materials and have produced water white gasoline of sweet odor, as well as a product which will pass the corrosion and doctor test: (*a*) California gas oil, (*b*) Midcontinent fuel oil, (*c*) Midcontinent gas oil, (*d*) Mexican gas oil, (*e*) Texas fuel oil. The raw oils were cracked on a commercial scale in the gas-liquid phase. The authors describe in detail the methods used with full discussion of the theories involved, especial stress being laid upon the treatment of hydrocarbons containing sulfur compounds. The effect of the sulfuric acid treatment upon the unsaturate per cent. is also discussed. It is concluded that following the methods and principles laid down by the authors, all types of cracked hydrocarbons, regardless of the type of raw oil used to produce them, can be successfully treated to produce water-white products of sweet odor.

Fractional distillation of various petroleums under reduced pressure with new type receiver: Jacque C. Morrell and Gustav Egloff. A new type of receiver for fractional distillation under reduced pressure is described. The general principles and elements of the receiver are as follows: The receiver is made up of two graduated chambers, the whole being arranged so that it can be properly mounted. These chambers are connected by a stop-cock. The arrangement is such that one fraction may be drawn off from the lower chamber, while the next fraction is being distilled in the upper chamber. The rate of distillation is always under perfect control. With regard to the fractional distillation of petroleums under reduced pressure, following a general discussion of the theory and experimental method, comparative distillation of the following crude oils, under atmospheric distillation and vacuum distillation, are shown: Kentucky crude, Arkansas crude, Colorado crude, Ohio crude, California crude, Texas crude and Mexican crude. A discussion of the results from the viewpoint of unsaturate content, percentage of paraffin and viscosity of lubricating stock for both types of distillation follows the experimental results.

Sulfo-acid bodies in lubricating oils: G. L. Oliensis. When lubricating oils are overtreated or prematurely neutralized in the agitator, some sulfo-acid compounds from the sludge are re-incorporated in the oil. The breaking of the resultant emulsion or blowing of the oil to brightness causes some of these compounds to go into perfect solution in the oil. The Conradson Demulsibility and Vacuum Company steam tests then cause these bodies to precipitate as a soapy layer below the oil, thus constituting qualitative tests for such material. Evidence indicates that a foamy layer differs from a homogeneous layer only in concentration. It is indicated that this layer is caused by salts of inorganic acids, etc. The significance of the presence of such material and the usefulness of the Conradson test for its recognition are discussed.

Calculations of flash points: Edward Mack, Cecil E. Boord and Harold N. Barham.

SYMPOSIUM ON "LUBRICATION FROM THE CHEMISTS' VIEWPOINT"

Lubricant and asphaltic hydrocarbons in petroleum: C. F. Mabery. The work of this paper is a continuation and expansion of the preliminary notice presented at the Rochester meeting, in which it was stated that an investigation had been begun to ascertain the composition of the part of petroleum that can not be distilled without decomposition. This work is now well advanced and a large number of hydrocarbons have been identified in typical West Virginia, Pennsylvania, Mecca, Texas and Baku oils. The more soluble lubricant hydrocarbons, at least those of lower molecular weight, collect for the greater part in the D series (more soluble) and the heavier asphalts in the H series (less soluble). The two series differ widely in viscosity and in lubricant quality. Tested on a fractional machine, the D's are superior in wearing quality to the H's. The highest viscosity is shown by the Mecca D No. 8, the last one of the series, $C_{78}H_{138}$, 5461 seconds, in an Ostwald tube, water standard 0.25 S. at 38 C., 100° F., 2780 Saybolt. This paper also gives tables of viscosity, iodine numbers, showing unsaturated hydrocarbons and values by the formolite reaction showing internal cyclic unsaturation.

Viscosity temperature curves of fractions of typical American crude oils (Second paper): F. W. Lane and E. W. Dean.

Low speed-high pressure friction tests with a Kingsbury machine: W. F. Faracher and Ronald Reamer. A discussion is given of data on frictional coefficients obtained with a Kingsbury oil-testing machine in which speed was maintained at 7.4 feet per minute and pressure was varied over the range of 2,000-4,000 pounds per square inch. A number of mineral oils and several compounded lubricants were studied.

A graphical study of journal lubrication: H. A. S. Howarth. This study is based on W. J. Harrison's paper, "The hydrodynamic theory of lubrication." The oil pressures and friction are represented quantitatively by simple diagrams showing the effects of varying the speed, oil viscosity, eccentricity and clearance. A few examples are given showing the practical application of this study to the case of a journal surrounded by the bearing.

The mechanism of partial lubrication: R. E. Wilson. This subject is presented from the standpoint of the author's recently published papers on the subject, and some additional material is brought forward.

Notes on the chemical composition of mineral lubricating oils: A. Duston and Thole.

The origin of petroleum—origin, migration and accumulation of oil and gas: R. E. Somers. The inorganic theories of origin, such as that of Mendeleef, are geologically impossible for large amounts of oil and gas. The organic theories better account for the commercial pools. Effects of geologic alteration continue beyond the first formation of oil and gas and, according to White's laws, lighter fractions are added with increasing pressure and longer time. The geologically older oils are lighter in weight and the younger are heavier. Oil passes from the source bed shales into the reservoirs because of compacting of the shales, and perhaps because of a differential capillarity. Accumulation into pools starts when the reservoirs are loose and uncemented, and is then due principally to differences in specific gravity between oil, gas and water. It continues as the reservoirs become cemented, but gravitation is either assisted by other influences, such as gas pressure, or else replaced by capillarity.

The probable mother substance of petroleum: Reinhardt Thiessen.

Charles L. Parsons,
Secretary

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THE WHITNEY SOUTH SEA EXPEDITION OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THROUGH the personal influence of Dr. Leonard C. Sanford, a trustee and honorary fellow of the American Museum of Natural History, Mr. Harry Payne Whitney agreed in 1920 to finance a zoological expedition in Polynesia. The main object of the expedition is to collect birds at the various islands of the South Sea and on the intervening ocean areas. The sum generously contributed by Mr. Whitney was considered sufficient for five years' work, including provision for the purchase of a vessel which would assure the field workers of the Museum an opportunity to visit a large number of islets which are far from the trade routes or ordinary lines of communication. The expedition is perhaps the most comprehensive that has ever been planned and equipped for ornithological science.

The Whitney South Sea Expedition is under the direct administration of a committee appointed by the Trustees of the Museum and consisting of Doctors Leonard C. Sanford, Frank M. Chapman and Robert Cushman Murphy. As field representative, the Museum has been fortunate in securing the services of Mr. Rollo H. Beck of San José, California, a veteran naturalist and collector of marine birds who had previously rendered the institution years of noteworthy service, particularly while he was in charge of the Brewster-Sanford South American Expedition of 1912-1916. Mr. Beck is accompanied in the field by Mrs. Beck, who was his constant companion during the South American littoral work, and by an assistant, Mr. Ernest H. Quayle, whose training at Stanford University has admirably fitted him for the responsibility. In September, 1920, the members of the party sailed from San Francisco to Tahiti and from the latter base they have since been engaged uninterruptedly in field work.

An appeal by Professor Henry Fairfield Osborn, president of The American Museum of Natural History, to Ambassador Jusserand for the good offices of the French Government in the Society Islands, met with a generous reponse, and since the initiation of the work, the Whitney Expedition has received every courtesy both from the government and from individuals at the French Islands.

When Messrs. Beck and Quayle arrived in Tahiti, they began at once an ornithological reconnaissance of this classic isle. As opportunity offered, trips were made to neighboring islands either upon trading vessels or by the use of sloops carrying copra or other cargoes. Early in 1921 an invitation from Père Rougier, the proprietor of Christmas Island, north of the Equator, was accepted, and the ornithologists made a notable journey to this interesting station, stopping en route for collecting at three different islands of the Marquesas group. Subsequently voyages were made to the southward, when the northern islands of the Austral group were visited, as well as Rapa, the southernmost of the eastern Polynesian islands. In September, 1921, a second trip was made to the Marquesas, followed by a preliminary visit to the Tuamotu Archipelago, upon eleven islets of which collecting was undertaken.

During the first year's work, Mr. Beck was continually on the lookout for a suitable vessel which he might purchase, and in this way become independent of the uncertain movements of trading craft. In December, 1921, after adverse consideration of several vessels, the Committee purchased the 75-ton schooner "France," which is equipped with a sixty horse power engine and which was built at Tahiti three years ago. Through the unfailing courtesy of the French Colonial Government, the usual requirement of partial French ownership was waived, and the schooner was admitted to yacht registry, with permission to carry on work at any of the French islands. Similar permission for the British islands was granted by His Majesty's Colonial officers, and after the "France" had been thoroughly refitted, she sailed with Messrs. Beck and Quayle, in January, 1922, on a trip to the Austral Islands, Rapa, Gambier Islands, Pitcairn, Henderson, Oeno, Elizabeth and Ducie Islands.

While the expedition is primarily ornithological, no opportunity has been lost to obtain desirable material and data in other branches of science, particularly at the many Polynesian islands where the native peoples and fauna are rapidly dying out or are altering materially with changing conditions. With this object in mind, the Museum has cooperated in all possible ways with other institutions that are carrying on research in the Pacific. The Bernice Pauahi Bishop Museum of Honolulu, for example, is now a center of Pacific investigations, coordinated under the administration of Professor Herbert E. Gregory, of Yale, who is serving as Director of the Bishop Museum. The Committee of the Whitney Expedition has been from the beginning in close touch with Professor Gregory and has sought his advice on many details. The members of the Expedition have been instructed to undertake special lines of collecting which do not interfere with their main objects, to offer transportation whenever possible to the field workers of the Bishop Museum, and of other scientific organizations, and in general to further the cause of Pacific investigation by selecting fields of endeavor which lead toward cooperation rather than competition. It has been decided, for instance, to leave the ornithological investigation of the Hawaiian Islands and of certain neighboring groups, such as Midway, Johnston, Palmyra and Washington Islands, to the Bishop Museum, and to confine the efforts of the Whitney Expedition, for the present at least, to the southerly and easterly islands of Polynesia, from Samoa and the Marquesas southward and eastward to the Austral group and Easter Island. In order that the American Museum of Natural History may obtain a full representation of the avian fauna of the Pacific Basin, however, a comprehensive exchange of material has been arranged, and the museum has already received from Honolulu an important collection of Hawaiian birds, which gives it a very nearly complete series of the scarce or extinct *Drepanididæ* as well as other interesting and peculiar birds of the archipelago.

In addition to the advisory services of Professor Gregory and his staff, and of many other friends of the American Museum, the expedition has enjoyed the cooperation of Dr. Charles W. Richmond, of the United States National Museum, in the preparation of abstracted data of great value for any research in Polynesia. Dr. Richmond, who is a distinguished bibliophile, has a rare acquaintance wtih geographical works relating to the Pacific, particularly with the accounts of both early and recent voyages in this field. Upon the basis of his experience and his bibliography, Dr. Richmond has summarized the principal points of geographic and zoological interest in the writings of discoverers, naturalists, travelers, missionaries, and others who have visited the Line, Marquesas, Society, Cook, Austral, Tuamotu, and more easterly groups. Dr. Richmond's manuscript report gives, moreover, all the known synonyms of the names of the various islands and their outliers. His data on this score are based upon hundreds of sources and are far more complete than the list of designations given in the pilot books or atlases. The report also includes a full list of the known vertebrate fauna of each island, with notes on all the extinct, doubtful or mythical species mentioned by the early voyagers. Equipped with such information, the Museum's field workers are in a position to investigate each island with a full knowledge of what they may expect or hope to find.

Emphasis should be laid upon the fact that zoological investigation in Polynesia must be done now if it is to be done at all. Extinction of the native animals has long been in progress. The introduction of pigs, dogs, cats, and even of the mongoose, into islands which had no native mammalian fauna; the rapid spread of the alien minah and weaver birds, and of a hawk transported from Australia; and the periodical concentration of copra workers, or of pearl or bêche-de-mer fishermen, upon small islets, make it certain that many of the native birds are doomed as surely as the splendid race of native people. Dr. Richmond's report has not failed to call attention to the importance of the rapid completion of such work as the Museum has now undertaken. Some idea of the extraordinary changes taking place in Polynesia may be gained from the following press quotation referring to an islet of the Tuamotus:

"The opening of the pearl diving season, the great event of the year in the French settlements, comes in July. Diving is not permitted for two years in succession at the same island. The various pearl islands are opened in rotation. This means that all gear, stocks of merchandise and building material must be taken to a new island each year—no small undertaking when it is remembered that the coral atoll, which in ordinary times supports less than 200 persons, becomes in the diving season the abiding place of 2,500 or more. This year the open island is Hikueru, one of the Paumotu archipelago 400 miles to the eastward of Tahiti. Already this lonely atoll is taking on a metropolitan appearance. The profits to be gained come not only from the pearl-shell won from the lagoon, but from the sale of all kinds of wares dear to the native heart and from the providing of entertainment to refresh the weary diver and his women folk after the labors of the day are over. The average native diver wins a good sum from the bottom of the lagoon and much of it goes on expensive silk dresses for his wife and daughters, on the delectable canned goods of the "popaa" (white man) and on the "movies." This year there are to be, it is said, three moving pictures theaters, any number of motor cars for hire—the length of the roadway in Hikueru is less than a half mile, but that apparently does not make any difference—a brass band and, it is reported, electric lights along the "Great White Way" of this little ring of coral sand. Late advices indicate that the season this year at Hikueru will be the most active in many years. It is estimated there will be at least 1,000 divers at the island. These, together with their families and the traders with their staffs, will swell the population of the island during the season to nearly 4,000."

The collecting work of the Whitney South

Sea Expedition has no more than fairly begun, but the specimens already received at the Museum have given a foretaste of the remarkable zoological and geographical results that are to be anticipated. The material comprises the following:

1. More than 3,000 bird skins, together with representative collections of birds preserved in alcohol, nests and eggs, and the stomachs of specimens prepared as skins. The contents of the bird stomachs are to analysed and reported upon by members of the staff of the United States Biological Survey.

2. A collection of reptiles, including lizards from nearly all the islands visited, as well as marine turtles. Although the lizards are represented by but a small number of species, the aggregation constitutes one of the few collections sent to the United States from Polynesia since the days of the Wilkes Expedition of 1828-1834. A duplicate set of reptiles has been forwarded to the Bishop Museum.

3. Herbarium collections made by Mr. Quayle at the Society Islands, Austral Islands and elsewhere. The plant specimens have, for the most part, been sent to the Bishop Museum for determination, only one set of duplicates being retained in New York.

4. Photographs illustrating not only the birds and other wild animals of the places visited, but also interesting features of the topography, vegetation and the appearance and life of the native peoples.

5. Approximately 3,500 pages of manuscript notes, prepared by Messrs Beck and Quayle, which not only supply a narrative of the expedition, and a running comment upon the ornithological field work, but also throw light upon many phases of Polynesian life conditions.

The birds received from the Whitney South Sea Expedition demonstrate that Polynesia is one of the greatest remaining fields for ornithological investigation. They comprise thus far about a hundred forms, of not more than twenty-five families, but they are all represented in splendid series, and some of them are among the rarest of known birds. Several of the species were, in fact, listed in Rothschild's monograph on "Extinct Birds" (1907). Many of them are of much historic importance in that the status of the species has heretofore rested entirely upon descriptions dating from the golden age of exploration, when Bougainville, James Cook, and other discoverers, brought back to Europe the first collections from Polynesia. The warbler (*Conopoderas æquinoctialis*) of Christmas Island, for example, has not heretofore been represented in any collection, and was known only from the faulty description of Latham. The beautiful fruit pigeon (*Ptilopus huttoni*) of Rapa had previously been known only from the type skin in the Museum at Turin; and there are many other examples. Finally, a relatively large proportion of the birds obtained prove to be new to science.

The sea birds, as well as many of the insular land birds, of Polynesia, throw much light upon broad questions of geographical distribution. The collections of the Whitney Expedition show, for instance, that the birds of the tropical trade wind belt in the South Pacific are, for the most part, specifically or racially distinct from those inhabiting the Horse Latitudes farther south. The terrestrial avifauna is not particularly extensive, but it proves highly interesting. As an example, the warblers of the genus *Conopoderas* appear to exhibit on a vastly larger scale the evolutionary facies of the Galápagos finches. Each large insular group in Polynesia seems to have its peculiar species of this genus, while in some cases every islet within a single archipelago has a well-marked geographic race, the range of which may not be greater than the isolated surface of but a few acres.

Since Mr. Beck left the United States he has from time to time sent home narrative accounts of great general interest, which have been published in "Natural History," the Journal of the American Museum. At the present time Messrs. Beck and Quayle are working from the "France" among the Marquesas Islands, whence additional reports and shipments of material are expected early in 1923.

ROBERT CUSHMAN MURPHY

A MENACE TO THE NATIONAL PARKS

THROUGH its representation on a committee entitling itself the "National Parks Committee," the American Association for the Advancement of Science and all of its members have been placed in the position of endorsing and promoting the Barbour Roosevelt-Sequoia Park Bill (H.R. 7452) now before the House of Representatives. This bill has good prospects of being passed by the present Congress.

Much inquiry and correspondence have shown that the greater part of the support of this measure has been obtained without those giving it understanding what the bill will do, as they hold the erroneous idea that the bill is practically the same as the excellent Roosevelt Park measure which failed to pass the last Congress. It therefore seems important to call attention to the destructive character of the Barbour Bill.

The following resolution regarding it, passed on September 9 last by the San Diego Natural History Society, located in the same region as the Sequoia Park, and one of the most prominent scientific associations of the west, deserves the serious consideration of all scientific men and conservationists.

Whereas, The Barbour Roosevelt-Sequoia Park Bill (H.R. 7452), now before Congress, contains, as one of its provisions, the relinquishment by the National Park Service of about half of the present Sequoia Park, in exchange for extensive, mainly untimbered, tracts in the higher mountain region.

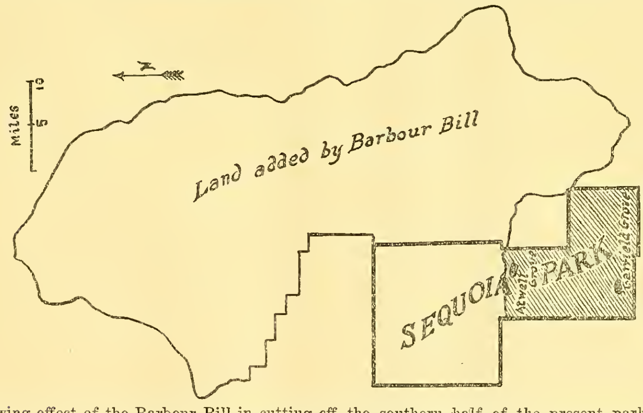
And whereas, The tract relinquished will, under the provisions of this bill, pass under the jurisdiction of the Forest Service, with the avowed object of permitting the cutting of much of the standing timber,

And whereas, This tract contains about one third of the total number of giant sequoias contained in the entire park, together with forests of other majestic trees which are now rapidly disappearing,

And whereas, None of those who are now publicly supporting the Barbour Bill defend this division of the present Sequoia Park, and the sacrifice of a large part of its area, except as a compromise by which other valuable scenic territory is to be acquired,

And whereas, This compromise is known to be the outcome of a factional dispute and a competition for jurisdiction between the National Park Service and the Forest Service,

And whereas, As a result of such internecine strife on the part of those who should be defending the interests of the public, the country will lose for all time large areas of primeval forest which should be preserved for recreation, for esthetic enjoyment, and for scientific study,



Map showing effect of the Barbour Bill in cutting off the southern half of the present park, also the deep bay in the proposed western boundary which will permit commercial exploitation of timber lands almost in the center of the area added.

And whereas, Such a violation of the integrity of our national park system sets an extremely dangerous precedent, and gives heart to those interests which are continually striving to invade the public domain and to destroy our natural scenery for the gratification of purely selfish ends, therefore,

Be it resolved, That the San Diego Natural History Society strongly opposes the Barbour Bill, in its present form, as being a serious blow to our national park system and to the principle of conservation in general, and that it advises the amendment of this bill so as to exclude its provision for the relinquishment of any portion of the present Sequoia Park, while retaining its constructive features, according to which large tracts of high scenic value would be added to the present park.

Be it further resolved, That copies of this resolution be sent to the two senators from California, and to the congressman representing this district; as well as to such organizations as may seem appropriate to the society's conservation committee.

Designs on the fine forests of the national parks are not confined to those of the Sequoia Park. A shifting back of the western boundary of the Yosemite Park is recommended by the director of national parks in his report for 1921 (page 72), and if carried out as there recommended, would eliminate from that park all its three sequoia groves and most of its magnificent sugar pine and yellow pine forests, while a similar treatment of Crater Lake Park has also been under discussion. These three parks contain most of the forest with really large trees that the entire national park system possesses.

The wonderful primeval forests of the Pacific states are disappearing with astonishing rapidity, and it is of the highest importance from a scientific as well as from an esthetic and scenic standpoint that at least the few tracts of them that are in the national parks should be preserved. The immense trees of these forests (there are at least fifteen species that become under favorable circumstances 200 feet tall or over, and at least four that sometimes reach or exceed 300 feet) were never found except in tracts of limited extent where they had good soil and other conditions and had escaped serious fire damage for long periods. Those few that still survive are mainly in the hands of the lumber interests and a few years will see the last of them.

We must not be deceived by the assertion that the forests now in the parks "will be just as safe in the hands of the Forest Service as in the Parks." The totally different purposes of the Park Service and Forest Service bureaus should not be lost sight of in judging of the results of such a transfer. The parks are required to be maintained in as nearly as possible their natural, wild state. The lands under Forest Service control are managed from a purely commercial standpoint to produce as much lumber as possible, the trees being sold and cut when mature and all esthetic, scientific or other considerations being subordinate to that of dollars and cents. This policy is the right and necessary one for the greater part of the national forests, but for areas that are parks, or will in the future be needed for parks, it is fatal. The folly and danger of subjecting things that should be preserved permanently in their natural state to a bureau conducted for purely practical and commercial purposes and officered by men who by training, association and interests see in the wonderful trees of the Pacific states only so many feet of lumber, or so many cross ties, and who moreover will be subjected to constant and powerful political pressure to allow their sale and destruction, need not be discussed.

No promise made by the present Forest Service administration to protect certain of the trees has any standing in law, nor can it in any way bind future administrations. No promise has been made to protect anything except the sequoias, which constitute less than five per cent. of the forest that the Barbour Bill will open up to the lumbermen. Forest Service and Park Service officials do not deny that the magnificent sugar pines and yellow pines (trees 200 feet tall and 200 to 500 years old) of the Sequoia Park are to be cut. In proof of this the following quotations may be given:

"In conceding the new territory to the National Park Service the Forest Service has contended that those sections which would be eliminated from the present Sequoia National Park are required *for the commercial needs of that section* *of California;* that is, for grazing purposes *and for timber* other than the big sequoia trees, which will always be preserved.'' (From a letter by A. B. Cammerer, acting director National Park Service, to H. S. Watson, of date May 19, 1922).

''The transfer of the three townships now in the park is not particularly *with the avowed object* of permitting the cutting of much of the standing timber. As a matter of fact, the timber resources do not anywhere nearly compare in value with those upon other national forest lands readily available for purchase but for which no demand has yet arisen. Some small cuttings might be necessary to supply local needs, and *ultimately good silvicultural practice would require the harvesting of the mature timber.* There is no probability that the timber will be sold or even in demand for some time to come.'' (From letter from L. F. Kneipp, assistant forester U. S. Forest Service, to C. G. Abbott; date October 2, 1922).

That the park as provided for by the Barbour Bill will contain little in the way of forests, we have the assurance of the chief of the Forest Service who in addressing the Public Lands Committee of the House of Representatives at the hearing on the Barbour Bill, December 13, 1921, said, "Aside from the giant forests [the sequoia groves] the areas of commercial timber remaining within the area are of *negligible extent* and of negligible future importance to the forest industries of California." This includes both the land added and the part of the present park that the public is to be allowed to keep. The Barbour Bill, moreover, will make a park of extraordinary shape. An immense bay fifteen miles deep and many miles wide will extend into the very heart of the park, its object being to avoid adding to the park some magnificent forests containing immense pines and sequoias. The lumbermen can therefore operate almost in the center of the park, though legally outside it.

The Sequoia Park should not be cut in half. No reason for doing so has been given other than the desire of private interests to exploit the forests of the park and the desire of the Forest Service to control such exploitation. In view of these facts, can we regard the severe condemnation of the measure expressed in the San Diego Society's resolution as unwarranted? Should not its protest be backed up by every scientific association and every organization interested in real conservation?

W. G. Van Name

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE MEDICAL SCIENCES

For a number of years Section N has held a symposium on subjects of outstanding interest to medical and allied workers. There were symposiums on "Growth and Development of the Child"; "Medical Lessons of the War"; "Ductless Glands"; "Growth Problems," etc. Each of these symposia was an invitation program.

These meetings were extraordinarily well attended, always taxing the capacity of the large halls provided for the meetings. They met a real and large demand on the part of the members of the section, the members of the association, and the non-members in the fields of public health, medicine, bacteriology, etc. The section committee, after mature deliberation, has decided that the section could be more useful by changing its policy. It has decided, beginning with the Boston meeting, to hold a symposium to which will be invited representatives from the fields of medicine, parasitology and medical entomology. It is planned that each representative will discuss his researches with the workers in the allied fields. It is expected that these meetings will afford the long-sought opportunity for the discussion of common problems.

The Entomological Society of America and the Parasitologists have planned to meet with the section at Boston.

The new plan has met with such a widespread and strong response that it is hoped more groups may join with the section in the future, to make the annual meeting as broad, as significant and as useful as possible.

The program for the Boston meeting is to be held in the Massachusetts Institute of Technology buildings at 1:30 on December 29. The program is as follows:

Professor A. B. Macallum, retiring vice-president of Section N, McGill University, Montreal:

"The necessity for advanced research on the intestinal mucosa, the great gateway of disease of the body" (vice-presidential address).

C. T. Brues, Bussey Institution, Harvard University: "Is poliomyelitis an insect borne disease?"

C. A. Kofoid, University of California: "Incidence of the human intestinal protozoan infections in the United States."

Richard P. Strong, Harvard University: "Some aspects of disease associated with the fields of zoology, entomology and parasitology."

C. W. Stiles, U. S. Public Health Service: "Some medico-zoological phases of our immigration problems."

L. O. Howard, U. S. Bureau of Entomology: (Title to be announced).

The secretary desires an expression of opinion from all interested workers, and extends to them an invitation to attend.

A. J. Goldforb,
Secretary of Section N

THE HISTORY OF SCIENCE

At the Boston meeting of the American Association for the Advancement of Science from December 26 to 30, the development of science is to be recorded in more than one aspect. The members of the association will be given an interesting opportunity to learn of the value of historical introspection of scientific thoughts in terms of progress. Also some attempt will be made to discuss the meaning and philosophy of the idea of this progress.

Section L (of which the History of Science is a part) is the youngest of the sections formed within the American Association, and will hold its third meeting on December 27.

The first meeting of those interested in the field of the history of science was held with the American Association for the Advancement of Science in Chicago, December, 1920. At this time plans of organization were formulated. At the Toronto meeting in December, 1921, the organization became a more definite reality. Consequently the Boston gathering of the history of science group will he the second official meeting.

The progress of the interest in the history of science has been growing constantly. Not alone has this been manifested among the scientists, but with the historians as well. The value of the study of the history of science is thus greatly emphasized by being cultivated by two distinct bodies of scholars.

Therefore, at the Boston convocation of scientists the program for the history of science meeting will be presented by two different groups, namely, Section L and the group interested in the history of science from the American Historical Association.

On Wednesday, December 27, at 2 P.M., Section L will present its program with the following speakers: Dr. Florian Cajori, University of California; Dr. H. W. Tyler, Massachusetts Institute of Technology; Dr. George Sarton, Carnegie research associate; Dr. William A. Locy, Northwestern University, also chairman, and the association's vice-president for Section L, with two other scholars active in the history of science movement, to be named later.

On Thursday, December 28, at 2 P.M., the joint conference with the history of science group from the American Historical Association will be held. The following is the program:

Chairman: Dr. James Harvey Robinson, New School for Social Research, New York City.

"The origin of ideas": The chairman of the conference."

"Some psychological and social conditions of the scientific attitude of mind": Dr. George H. Mead, University of Chicago.

"The historical background of modern science": Dr. Lynn Thorndike, Western Reserve University.

"Science in the thirteenth century": Dr. George Sarton, Carnegie research associate.

"What science has contributed to people's thinking about life and destiny": Mrs. Mary Hunter Austin, New York City.

General discussion, opened by William A. Locy, Northwestern University, chairman of Section L.

Frederick E. Brasch,
Secretary of Section L

THE SOCIAL AND ECONOMIC SCIENCES

The program of the section of Social and Economic Sciences at the Boston meeting will deal with problems of the development and conservation of natural resources. The aim is to present the economic background of conservation as related to certain of our resources. An immense amount of misapprehension exists about conservation and the measures that have been proposed to secure a better handling of our resources. The scientific men of the country can perform a public service by furnishing the facts regarding our different resources and their relation to the upbuilding of the nation. To bring out such facts, so far as the limitations of the meeting will permit, is the purpose of the symposium to be presented at Boston.

The most precious resource of any nation is a virile, intelligent and healthy population. The conservation of health, of the energy and the working power of the people constitutes the theme of the morning session on December 27. Papers will be presented by Dr. T. S. Baker, of Pittsburgh, Mr. W. F. Chamberlain, of Hartford, and Dr. E. R. Kelley, of Massachusetts.

A second topic closely allied with the foregoing is the building up and maintaining of a strong rural civilization. Problems relating to the home and to home life and to conserving the qualities of the rural population are of great importance. The questions of home economics and of country life, as well as of land settlement under present conditions, will be discussed on the afternoon of December 27, when Section K meets with the Section on Agriculture. The program includes the names of President Kenyon L. Butterfield, of Amherst, Dr. C. F. Langworthy, Dr. Helen W. Atwater and the Honorable F. H. Newell, of Washington.

Forestry is the subject of the session on the morning of December 28, which will be in conjunction with the New England Forestry Congress. There will be brought out some of the important economic facts that call for a vigorous national policy of forestry. The chief forester, Colonel W. B. Greeley, and a prominent member of his staff, Mr. Raphael Zon, will present papers on the national and on the international problems of our timber supplies. Professor R. T. Fisher, of Harvard University, will discuss certain aspects of forest research, and the state forest commissioner of Massachusetts, Mr. Bazeley, will speak on the subject of a state forest policy.

A series of special topics relating to the conservation of capital and credit and the reduction of waste in industry will form the program in the afternoon of December 28. Mr. H. T. Newcomb, of New York, Dr. R. H. Halsey, of New York, Dr. Frederick L. Hoffman, dean of the advanced department of Babson Institute, Dr. F. B. Gilbreth and Mr. James G. Dudley, of New York, are the speakers.

The session on the morning of the twenty-ninth will be a joint meeting with the Section of Engineers. Problems relating to water resources, power development and flood control will be the general subject, with papers by General Harry Taylor, U. S. Army; Mr. William S. Murray, of New York; Mr. O. C. Merrill, of Washington, and Dr. John T. Black, of Hartford. The conservation of our scenic resources and of wild life constitutes the topic of the session on the afternoon of December 29. The national park problems, with special reference to the present efforts to open them up to commercial use will be discussed by Mr. Robert S. Yard, of Washington. Dr. G. F. Kunz, of New York, will present certain aspects of the practical service of the scenic resources to the public. The conservation of our whale fisheries will be the subject of a paper by Dr. John F. Crowell, of New York.

The chairman of the sessions will be the vice-president for the section, Professor Henry S. Graves, of Yale University. The retiring vice-president is Professor James W. Mavor, of the University of Toronto, who will present on the first day an address on "Certain economic reactions of the war."

The meetings of Section K will for the most part be in Pratt Building, Massachusetts Institute of Technology.

RAILWAY TICKETS TO BOSTON

Those who are to attend the approaching Boston meeting of the American Association for the Advancement of Science will have the benefit of reduced railway rates, as has been previously announced. The reduced rate of a fare and a half for the round trip has been granted by the railway associations representing almost all of the United States and Canada. Those intending to go to Boston for this meeting should state to their local railway agents that they are to attend the Boston meeting of the American Association for the Advancement of Science. They should purchase a single, full fare, one-way ticket to Boston and should secure from the agent a standard certificate. A receipt is not needed. On arrival at the meeting railway certificates are to be deposited at the validation desk in the registration room at the Massachusetts Institute of Technology. A card identifying the certificate will be given out and is to be returned when the certificate is reclaimed. In the meantime, endorsement and validation of the certificates that have been deposited will be cared for. After endorsement and validation the certificate is to be presented at the railway ticket office in Boston and the agent will allow each holder of a certificate to purchase a continuous return trip ticket from Boston to the place of starting, at one half of the regular fare.

It is not necessary for those intending to go to Boston to present to the railway agent when they purchase their tickets any credentials as to membership in the association or societies. Certificates will be endorsed by the American Association for the Advancement of Science for all association members in good standing and also for members of associated societies meeting with the association in Boston, whether or not the latter are also members of the association. Any person having the right to have his certificate validated may also have certificates validated for personal guests, this being limited to members of his immediate family, not including men over twenty-one years of age. Those who have certificates for validation and are not members of the association or societies, nor delegates, nor personal guests, should become associates for the Boston meeting, if they do not care to become members. As all readers of Science know, a new member pays an entrance fee ($5) and the first annual dues ($5), while an associate pays the associate fee only ($5). As far as the validation of railway certificates is concerned, associates are to be treated like members in good standing, and members of associated societies meeting with the association are to be treated in the same way.

SCIENTIFIC EVENTS

LOUIS PASTEUR

At the December meeting of the Syracuse chapter of Sigma Xi the following resolutions were adopted:

Whereas, On December 27, 1922, will occur the centenary of the birth of Louis Pasteur, whose life was characterized by tireless industry and preeminent achievement in research; and

Whereas, These researches conducted on lines of pure science have found remarkable application in many departments of economic and social betterment, culminating in the largest advances in measures of sanitation and consequent conservation of human life; and

Whereas, The unsparing devotion of his life to these ends is a challenge and an inspiration to highest emulation; therefore

Resolved, That the Syracuse Chapter of Sigma Xi record its high esteem and appreciation of these epoch-making discoveries in pure and applied science, and the life of noble devotion thereto;

Resolved further, That with hearty acclaim we join the innumerable company of many lands who gratefully participate in the commemoration of the centenary of his birth and the masterful and enduring achievements of his life.

THE FRANK NELSON COLE PRIZE IN ALGEBRA

At the time of the retirement, in December, 1920, of Professor F. N. Cole as secretary of the American Mathematical Society and editor of its *Bulletin,* a sum of money was collected from members of the Society by a committee, of which Professor H. S. White was chairman, and was presented to Professor Cole in recognition of his distinguished services through a period of twenty-five years. At the next meeting of the Council, Professor Cole donated this fund to the Society, to be used as the Council might think best. The committee, consisting of

Professors Frank Morley (chairman), T. S. Fiske, and H. S. White, which was appointed at that meeting to make recommendations to the council as to the use of the income of this fund, has presented a report recommending that this fund shall be used to endow a prize, to be called the Frank Nelson Cole Prize in Algebra. The recommendations of this committee, which were accepted by the council at its meeting in October, 1922, follow below:

1. The fund shall accumulate until by interest and contributions it reaches the amount of one thousand dollars.

2. At the end of every five years thereafter the Council shall award from the available income not more than two hundred dollars as a prize for the best memoir offered in competition upon some question in the theory of Galois groups, or the theory of numbers, or some other part of algebra.

3. The question or subject for competitive memoirs shall be announced by the Council at least two years in advance of the date for their submission; and the details of the mode of award shall be published at the same time.

4. The prize shall be designated as the Frank Nelson Cole Prize in Algebra. At the time of each award the names of all previous recipients of the prize shall be published in the *Bulletin* of the Society, together with the name of the successful competitor and an abstract of his memoir.

5. The prize may be withheld at the end of any quinquennium if no sufficiently meritorious memoir be submitted; and in such case a double prize may be awarded in the next following quinquennium.

6. These conditions may be altered at any time by a two-thirds vote, in writing, of all members of the Council.

R. G. D. Richardson,
Secretary.

COLLOID SYMPOSIUM AT THE UNIVERSITY OF WISCONSIN

The most important colloid symposium yet held in America will take place at the University of Wisconsin next June from the twelfth to the fifteenth. On this occasion the university will be host to a group of the leading colloid chemists of the country, who will present papers on their specialties and indulge in unusually full discussion. The university will publish the proceedings in adequate form. The whole symposium is in honor of Dr. Thé Svedberg, of the University of Upsala, who will give colloid instruction at Madison during the entire second semester and during the summer. Among those who have already announced their intention of presenting papers are Drs. Jacques Loeb, S. E. Sheppard, R. E. Wilson, Jerome Alexander, Martin H. Fischer, J. H. Matthews, Wilder D. Bancroft, Harry N. Holmes, F. E. Bartell, Gortner, Bogue, E. B. Spear, Hugh Taylor, Weiser, Burton and J. A. Wilson. Every one interested in colloids is cordially invited to come. Time will be allowed for sports and social recreation. This symposium is strongly endorsed by the Colloid Committee of the National Research Council.

Harry N. Holmes,
Chairman Committee on Colloids
Oberlin, Ohio

GRANTS FROM THE BACHE FUND

Grants from the Bache Fund of the National Academy of Sciences have been made as follows:

$200 to Professor N. E. Wheeler, Colby College. For a study of the relationship of electrical conduction in concentrated solutions.

$300 to Professor Gregory P. Baxter, Harvard University. For the determination of the atomic weights of arsenic, titanium and germanium.

$600 to Dr. W. H. Taliaferro, Johns Hopkins University. For the study of the variability and inheritance of size in different species of Trypanosoma.

$500 to Professor L. L. Woodruff, Yale University. For a study of the significance of endomixis and of fertilization in the life history of Infusoria.

$250 to Professor Roger Adams, University of Illinois. For the study of the oxides of platinum, palladium and iridium as catalysts.

$400 to Dr. Keivin Burns, Allegheny Observatory. For the determination of wave lengths of standard lines in the solar spectrum in reference to the cadmium and neon standards.

$100 to Professor Otto F. Kampmeier, University of Illinois. For a monograph on the evolution and comparative morphology of the lymphatic system of vertebrates.

$650 to Professor R. R. Renshaw, New York University. For a study of the basis for the physiological activity of substitutes of the choline type.

$400 to Professor H. I. Schlesinger, University of Chicago. For an investigation of the absorption spectra of inorganic compounds, particularly the oxides of sulphur and the compounds obtained by the interaction of certain salts with nitric oxide.

Applications for grants will next be considered in April, 1923, and should be filed, together with endorsements, with the chairman of the board, Professor Ross G. Harrison, Osborn Zoological Laboratory, Yale University, New Haven, Connecticut, on or before April 1. Blank forms of application will be sent on request.

SCIENTIFIC NOTES AND NEWS

Dr. Robert A. Millikan, of the California Institute of Technology, Pasadena, has been awarded the 1922 Edison medal of the American Institute of Electrical Engineers, for "meritorious experimental achievement in electrical science."

Owing to a severe illness arising from a wound received during the war in France, Sir T. W. Edgeworth David has resigned his position as president of the Australian National Research Council. His place has been filled by the election of Dr. Orme Masson, professor of chemistry in the University of Melbourne. Professor David continues to serve the council as vice-president.

Sir Humphrey Rolleston has been appointed representative of the Royal College of Physicians on the British General Medical Council in succession to Sir Norman Moore.

The diploma of doctor *honoris causa* of the University of Strasbourg has been conferred upon Sir James Frazer, author of "The Golden Bough."

In recognition of his contributions to resuscitation from mine gases, Dr. Yandell Henderson, professor of applied physiology at Yale University, was elected an honorary member of the Coal Mining Institute of America at its meeting in Pittsburgh on December 13.

Mr. George H. Rhodes has resigned as assistant in the department of chemistry of the Massachusetts Institute of Technology, Cambridge, Mass., to accept a position in the color laboratory of Cheney Brothers, South Manchester, Conn.

H. A. Noyes has been appointed research chemist for the State Department of Agriculture at Lansing, Michigan, having severed his connection with the Mellon Institute.

Proffessor S. Winogradsky, at one time director of the Imperial Institute for Experimental Medicine in Petrograd, has been recently appointed as chief of a newly organized division of soil microbiology at the Pasteur Institute. This division is situated at Brie-Comte-Robert (Seine-et-Marne), France. Professor Winograsky would appreciate literature on soil microbiology.

Dr. Louise W. Farnam, a daughter of Professor Henry W. Farnam, of Yale University, reached Changsha on September 21 and has begun her work as head of the department of pediatrics in the Hunan-Yale Hospital and Medical School.

Leave of absence has been granted to Dr. A. B. Stout, of the New York Botanical Garden, who will spend the period in southern California in studies of citrus fruits. He will also lecture at Pomona College.

Captain Roald Amundsen, head of a polar expedition that left Seattle in June, arrived by dog-team at Nome, Alaska, on December 14. He came from Wainwright, near Point Barrow, where he is wintering.

Robert T. Aitken and John F. G. Stokes, of the Bishop Museum, have returned to Honolulu after an absence of two years devoted to anthropological studies in connection with the Bayard Dominick Expedition Their field of work included the islands of Rapa, Rurutu, Ravaivai and Tubuai of the Austral group. On his return journey to Papeete, several islands of the Tuamotu group were visited by Mr. Stokes.

At a meeting of the committee on the C. M. Warren Fund of the American Academy of Arts and Sciences held on December 8, a grant of $250 was made to Professor James B. Conant, of Harvard University, to be used in furthering his research in connection with the electro-chemical study of the reversible reduction of organic compounds. The next meeting of the committee for the awarding of grants will be held on March 1, 1923. Applications for these grants must be in the hands of the chairman of the committee, Professor James F. Norris, Massachusetts Institute of Technology, Cambridge, Mass., before this date.

The Indian Botanical Society took over ownership and control of the *Journal of Indian Botany* in October. Professor P. F. Fyson, who started the journal in 1919 as a private enterprise, will continue as editor.

Professor Wieland has been appointed to the editorial board of *Liebig's Annalen* in place of the late Professor Wislicenus. The board consists, in addition, of Professors Wallach, Graebe, Zincke and Willstätter.

At the College of Physicians in Philadelphia Dr. James Ewing, of the Cornell Medical School, recently delivered the Muetter Lecture for 1922 on "The principles of the radiation treatment of cancer."

Dr. K. F. Wenckebach, former professor of surgery at the University of Strasbourg, will deliver the twelfth course of Herter lectures in pathology at the Johns Hopkins University Medical School. Dr. Wenckebach will arrive in this country in April.

The French committee of organization for the commemoration of the centenary of Pasteur recently held its first meeting under the presidency of M. Strauss, minister of marine. The sum of two million francs has been voted by the French parliament and an exposition has been organized at Strasbourg, where a monument will be erected by public subscription facing the university buildings. Conferences for the popularization of the work of Pasteur will be held throughout France. The celebrations at Paris will take place from May 22 to June 3. The exposition at Strasbourg, which is under the direction of Professor Borrel, will open on June 1.

The hundredth anniversary of Pasteur's birth will be celebrated on December 27 by Chicago physicians, chemists and bacteriologists at a dinner and meeting under the auspices of the Chicago Medical Society and the Chicago section of the American Chemical Society. Dr. Ludvig Hektoen will preside. The address on Pasteur will be delivered by Professor Victor C. Vaughan, and the response in behalf of France will be made by M. Antonin Barthelemy, consul for France.

Sir Isaac Bayley Balfour, for thirty-four years professor of botany at the University of Edinburgh, has died at the age of sixty-nine years.

The death is announced of Henry John Elwes, past president of the Royal English Arboricultural Society and of the Royal Entomological Society of London.

Harry J. Powell, a leader in the scientific development of the manufacture of glass in England, died on November 26 at the age of sixty-nine years.

Dr. Jolyet, formerly professor of physiology of the Bordeaux Medical School, has died at the age of eighty-two years.

Professor Erasmus Majewski, the Polish anthropologist, died in Warsaw on November 15.

The program committee of the Pennsylvania State College Branch of the American Association for the Advancement of Science arranged to have Dr. W. A. Orton, from the Bureau of Plant Industry, Washington, D. C., address the meeting which followed the annual dinner at the University Club on December 12. Dr. Orton discussed the newer knowledge of the properties of plants important in special diet and the necessity of introducing and disseminating additions to our list of vegetables and of providing an all-the-year supply."

Sigma Delta Epsilon, graduate women's scientific fraternity, will hold its national convention in Boston at the time of the meetings of the American Association for the Advancement of Science. There will be an informal luncheon for all scientific women interested in the need of such an organization on Thursday, December 28. At this luncheon Mrs. Anna Botsford Comstock will speak on "The need of organization among scientific women," and Miss Christianna Smith, national president, on "Sigma Delta Epsilon, graduate women's scientific fraternity."

A CAJAL prize is offered this year by the Academy of Medicine and Surgery at Barcelona, as part of the tribute to Professor Ramón y Cajal. The prize, 1,000 pesetas, will be awarded for the best work describing original research on any histologic topic, accompanied with slides, photomicrographs, etc.

JOHN B. HENDERSON, a regent of the Smithsonian Institution, has purchased for the Division of Mollusks the General Evezard collection of mollusks estimated at from 7,000 to 10,000 specimens, including a large number of types.

AN expedition to study seismic disturbances on the bed of the Pacific Ocean under the auspices of the Carnegie Institution of Washington and the Hydrographic Office of the Navy, will leave San Francisco in the near future. Two American destroyers, the *Hull* and the *Corry*, have been selected for the work. They will carry the sonic depth finder, by means of which it is hoped to make continuous soundings for 7,000 miles along the Pacific coasts of the United States and Mexico. The soundings will be made on parallel lines, approximately at right angles to the 2,000 fathom curve, at intervals of five to ten miles, extending from the coast to a point on the deeper floor of the Pacific Ocean. The expedition, through a more accurate charting of the bed of the Pacific Ocean, aims to throw new light on the causes and the effects of the seismic disturbances that so often occur off the Pacific Coast of North America.

WE learn from the London *Times* that a meeting to consider the question of a memorial to Mr. William Henry Hudson, the writer on natural history, who died last August, was held on November 27 at the offices of his publishers, Messrs. J. M. Dent and Sons, Limited. Mr. R. B. Cunninghame Graham presided and was supported by Lord Grey of Fallodon. It was agreed that the memorial should take the form of a drinking and bathing fountain for birds, to be erected in London, preferably, if the Office of Works approved, at the entrance to one of the bird sanctuaries which are being developed in certain of the public parks, the sanctuary itself to be dedicated to Mr. Hudson. It was further agreed that the portrait of Mr. Hudson painted by Professor A. D. Rutherston should be acquired and presented (subject to its acceptance by the trustees) to the National Portrait Gallery, and such moneys as might be further subscribed to the memorial fund should be devoted to objects similar to those mentioned in Mr. Hudson's will. Mr. Hudson left the residue of his property to the Royal Society for the Protection of Birds, to be used for the purpose of printing leaflets and pamphlets designed to excite in children "that interest in and love of the birds which leads to their protection."

THE council of the Royal Aeronautical Society announces that, through the generosity of the trustees of the Carnegie United Kingdom Trust, they have been able to arrange for the purchase of a large number of valuable historical books on aeronautics. This purchase, together with the works already possessed by the society, renders its collection of early and modern aeronautical literature probably unsurpassed in any country. In recognition of their generosity, the council of the Royal Aeronautical Society has, at the request of the Carnegie trustees, agreed to make the books in the society's library available for any student in the British Isles through the medium of the Central Library for Students, 9 Galen Place, W. C. 1. The library has been formed by the Carnegie trustees to provide a loan collection for students of technical books, which are unsuitable for placing in rural libraries.

IT is stated in *Nature* that the suggestion made by Mr. F. Gill, president of the Institution of Electrical Engineers, in his recent address, that an international European conference should be held with the view of establishing on a commercial basis a practical system of long-distance telephony in the European trunk lines, has now been realized by M. Paul Laffont, the French minister of telegraphs and telephones. He proposes to invite a conference at Paris of the technical administrators of the western European countries, and he urges that France would naturally be the center of the vast telephone system formed by combining the systems of these countries. The long-distance telephone calls in daily use in America show that, from an engineering point of view, the scheme presents few difficulties. Thus the New York-San Francisco call (3,000 miles) is equivalent to communication between London and Baghdad; the Key West (Florida) and Los Angeles call *via* New York and San Francisco is equivalent to a London-Delhi communication.

The Department of Commerce announces that provisional figures compiles by the Bureau of the Census for the first six months of 1922 indicate higher death rates than for the corresponding six months of 1921. For the states compared the death rate for the six months was 12.6 in 1922 against 12 for the first six months of 1921. The highest mortality rate for the half year is shown for Maine (15.7) and the lowest for Idaho (8.2). These figures forecast for the year 1922 a somewhat higher rate for the death registration area than the record low rate (11.6) for the year 1921. Provisional birth figures for the first six months of 1922 indicate lower birth rates than for the corresponding six months of 1921. For the states compared the birth rate for the first six months was 22.7 in 1922 against 24.8 in 1921. The highest birth rate for the half year (30) is shown for North Carolina and the lowest (18.1) for Vermont. Births so far reported for the first six months of 1922 indicate a lower birth rate for the year than the 1921 rate for the birth registration area (24.3).

UNIVERSITY AND EDUCATIONAL NOTES

A bequest of $100,000 for the erection of a building for the department of mechanical engineering at the University of Maine, to be named for the donor, is made in the will of Oliver Crosby, head of an engineering firm in St. Paul, Minn.

Baker University announces a gift of $100,000 from Mr. Joab Mulvane, a retired banker of Topeka, Kansas, and a member of the board of trustees of the university. The money will be used in the erection of the Mulvane Science Hall.

The faculty of Case School of Applied Science, Cleveland, Ohio, were notified in October of a new and advanced scale of salaries, which took effect at once. Full professors, of whom there are twelve, will receive $5,000; associate professors, of whom there are eight, will receive $3,300; assistant professors, of whom there are nine, will receive $2,800; and instructors, of whom there are thirty-three, will receive $2,000 to $2,200. The enrollment at Case this year is slightly less than a year ago, numbering 615, with a freshman class of 198.

Sir Auckland Geddes, British ambassador to the United States, and previously a distinguished professor of anatomy, delivered the address in dedication of the J. William White Surgical Pavilion of the University of Pennsylvania, on December 14. The pavilion is named after the late Dr. J. William White, who was for many years professor of surgery. It was built at a cost of $1,000,000, of which $350,000 was contributed by the state and the remainder by friends of the university.

Professor George David Birkhoff, of Harvard University, has been appointed lecturer in mathematics at Yale University for the second term. He will give a course in the Graduate School during Professor Ernest W. Brown's absence.

Louis Agassiz Fuertes, the artist, has been appointed lecturer in ornithology in Cornell University.

Dr. H. M. Jennison, who recently received the degree of Ph.D. from Washington University, has been appointed associate professor of botany at the University of Tennessee, after having completed eleven years' service at the Montana State College.

Dr. A. W. Gibb has been appointed to the newly founded Kilgour chair of geology at Aberdeen.

Dr. Fritz Straus, of Berlin, has been appointed professor of chemistry at the Breslau School of Technology.

DISCUSSION AND CORRESPONDENCE

RADIATION A FORM OF MATTER

To the Editor of Science: One sees the statement frequently made that, if one accepts Einstein's conclusion that the mass of a body is proportional to the total energy which it possesses, the principle of the conservation of matter must be abandoned. For if during any change energy is gained or lost by the body through radiation, there should be a corresponding gain or loss of mass. It has been calculated that in the case of radioactive disintegration the energy thus lost (or gained) through radiation represents an appreciable fraction of the total mass of the radioactive material. If, however, one takes the point of view that radiation is a form of matter, and that the amount of this matter is measured by the mass or inertia of the radiation, the total mass of the body plus that of the radiation emitted is unaltered by such changes. On this view the principle of the conservation of mass is strictly valid, being, as has been remarked, a corollary of the energy principle.

It is perhaps surprising to notice that according to the definitions of matter usually given electromagnetic radiation must be classed as matter. It is admittedly difficult to find a satisfactory definition. "Matter is that which occupies space," "matter is that which possesses mass or inertia," "matter is that which affects the senses," are, however, common statements. But radiation certainly occupies space; that it possesses mass is shown by the momentum which it imparts to a body which it strikes, producing radiation pressure; and who would deny that sunlight affects the senses? Unless, therefore, we change our idea of what is meant by the word "matter," this word includes not only solids, liquids and gases, but also the less tangible electromagnetic radiation.

The inclusion of radiation as a form of matter has important bearings in addition to the fact that it renews the validity of the principle of the conservation of matter. Thus, for example, we can no longer say that matter is composed wholly of positive and negative electrons, for the form of matter known as radiation includes no such electric charges. The statement that matter is composed of positive and negative electrons and electromagnetic radiation is, on the other hand, more complex than is required. We see rather that the fundamental thing in matter is not the electric charge but the electromagnetic field, for the electromagnetic field includes both the electrons and the radiation.

If the further simplification is made of considering the magnetic field as due to the electric field in motion, we may describe all forms of matter in terms of the intensity of the electric field at different points. The mass or inertia of the matter is proportional to the integral through the volume considered of the square of the electric intensity and of the magnetic intensity resulting from the motion of the electric field, whether this electric field is due to the presence of electrons or to the existence of electromagnetic radiation. The electric charge in an element of volume is proportional to the divergence of the electric intensity at the point. Thus all the fundamental properties of matter are determined if the intensity of the electric field throughout space and time is known. While the electrons can not be considered the fundamental elements which make up all matter, we have thus the intensity of the electric field as that which can be thought of as composing both the electrons and the radiation. Electric intensity, then, may be considered as that of which all matter is composed.

According to this point of view, matter is perfectly continuous. It is true that there are certain perhaps limited regions, the electrons, from which electric intensity diverges; but whether or not these regions of divergence are limited, the mass of the matter is associated with the electric intensity and is hence distributed through all space. Similarly, radiation propagated through space, as for example light coming from the sun to the earth, is on this view a continuous series of waves of matter. The old argument for the existence of an ether because some medium is necessary to transfer the radiant energy from the sun to the earth has accordingly no weight. For we now see that the radiation may be its own medium, somewhat as the stream of water from a hose acts as the medium for a wave if the nozzle is shaken.

Perhaps the only new thing in this letter is that, according to the common significance of the word, radiation must be considered a form of matter. But it has seemed to me that a consideration of this fact shows more clearly than we have seen before that matter is essentially continuous, and that the fundamental thing in matter is not the positive and negative electrons but is rather electric intensity.

ARTHUR H. COMPTON
WASHINGTON UNIVERSITY,
ST. LOUIS, MISSOURI

RUSSIAN SCIENTIFIC AID

AT the request of the American Relief Administration, which has been receiving, repacking and forwarding the contributions of American scientific books, journals and papers published since January 1, 1915, for distribution in Russia, I wish to ask that any further shipments from contributors to the New York warehouse (Gertzen and Company, 70 West Street, New York) of the American Relief Administration should be made prior to December 30, 1922. Up to date approximately eleven tons of scientific literature have been sent to Russia by the American committee. This committee wishes to extend its warm thanks to all donors.

In response to the appeal for some money with which to relieve the distress of the hundred Russian intellectual exiles in Berlin, I have received up to this writing $865, of which $500 came as a single gift from Princess Cantacuzene and the rest in five and ten dollar lots from American scientific men. I have no doubt that the total of $1,000 asked for will be reached.

VERNON KELLOGG
NATIONAL RESEARCH COUNCIL,
WASHINGTON, D. C.

SCIENTIFIC BOOKS

THE WATCHERS OF THE SKY[1]

The romance of Science is not an infrequent phrase and it describes as well as any other the dramatic and striking phases of one side of human activity. Its domain is modern because all science is modern as a recognized pursuit and one which is of good repute. It is treated in many forms which vary from the fascinating stories of Jules Verne and H. G. Wells to the lurid and generally inaccurate articles in the Sunday Press. In between, we have many an essay or address which emphasizes the picturesque features of the search for the secrets of nature. But it is new for a poet of the first rank amongst those living to recognize its claims to be classed with love, war, and the more obvious forms of nature's works and human activities for expression in verse. In one respect Mr. Noyes, who follows the great poets of the past in taking a single theme, differs from them. Homer tells of the struggle of man against man, Virgil of man against nature, Milton of man against the unseen powers; it is always warfare or struggle in which one side or the other is to conquer. Here there is no victory and no defeat. The Torch-bearers are striving to learn not by defeating nature but by cooperating with her, and the achievements of nature are of less importance than the methods by which she works. He who learns hands on his knowledge; the torch is passed, not extinguished.

From the preface we learn that the "Watchers of the Sky" is the astronomical portion of a trilogy the title of which "The Torch-bearers" describes the main idea of the treatment. There is no pretence at completeness—the poem is a story not a history—but the torch is followed with some degree of consecutiveness as it passes from the hands of Copernicus through those of Tycho, Kepler, Galileo, until Newton held it high for all the world to see. Later glimpses show William Herschel putting out his hand to take it and Sir John bearing it for a time. The setting of the whole poem places the first and last word on the summit of Mount Wilson

[1] By Alfred Noyes. Published by the Frederick A. Stokes Company.

where Mr. Noyes joined the group of astronomers, mechanics and laborers for the first night on which the hundred inch reflector was ready for use and took his place with them for a glance through it at Jupiter and its moons.

This bare outline is but the frame-work which Mr. Noyes built to contain the ideas he tries to set forth. He recognizes fully that the great common ground between science and poetry is the exercise of the creative imagination and in all his description pays less attention to the actual discoveries than to the ideas which led to them. Copernicus and Galileo in their interpretations of the motions of the planets and stars, Tycho in his observations for the use of future astronomers, Kepler in framing simple laws, and Newton in placing the key-stone in the arch, are to Mr. Noyes guides who lighted up the routes rather than discoverers and builders. Let lesser men string the lights which illuminate the territories of knowledge; the torch-bearers are those who show the way to them. In fact, Mr. Noyes has succeeded to a considerable extent in absorbing and emitting thoroughly modern views of what constitutes the highest achievement in scientific work.

One is tempted to much quotation to illustrate how Mr. Noyes has worked out his theme and I shall indulge in it to some extent. Some of his attempts strike the reader as achieving a high plane of expression. He has, it is true, almost wholly used the medium of blank verse, which gives him considerable freedom, but the rhythm rarely fails even when he has set himself the difficult task of setting forth some of the more technical laws of nature. While he exercises the poet's right to give such parts of the truth as will illustrate the whole, in doing so he avoids with some success the danger of making wrong statements. Kepler's three laws are given in detail: his wording of the third is rather happy:

Third, that although their speed from point to point
Appeared to change, their radii always moved
Through equal fields of space in equal times.

In describing Newton's experiments, he tells how

He caught
The sunbeam striking through that bullet-hole
In his closed shutter—a round white spot of light
Upon a small dark screen. He interposed
A prism of glass. He saw the sunbeam break
And spread upon the screen its rainbow band
Of disentangled colours, all in scale
Like notes in music; first, the violet ray,

And then, after describing how each ray was bent differently by a second prism,

Last, he took a lens,
And, passing through it all those coloured rays,
Drew them together again, remerging all
On that dark screen, in one white spot of light.

The last steep is not quite clear but it gives the idea.

Mr. Noyes exhibits considerable skill in choosing the method by which he shall describe each of his characters and make them tell of their work and ideas. For the first of them,

The neighbours gossiped idly at the door.
Copernicus lay dying overhead.

* * * * * *

His book has come
From Nuremberg at last; but who would dare
To let him see it now? They have altered it!
Though Rome approved in full, this preface, look,
Declares that his discoveries are a dream!
He has asked a thousand times if it has come;

While waiting and hoping for it to come he muses on his life and work:

So, all my life I pondered on that scheme
Which makes this earth the centre of all worlds,
Lighted and wheeled around by sun and moon
And that great crystal sphere wherein men thought
Myriads of lesser stars were fixed like lamps,
Each in its place,—one mighty glittering wheel
Revolving round this dark abode of man.

He was puzzled how to account for the motions of the planets and felt that he must tell the world his ideas before he goes out. Blindness comes on and they put the book in his hands:

It is here!
Put out the lamp, now. Draw those curtains back,
And let me die with starlight on my face.

The story of Tycho is told in full from

The boy at Copenhagen, with his mane
Of thick red hair, thrusting his freckled face
Out of his upper window, holding the piece
Of glass he blackened above his candle-flame

who later

While his tutor slept,
Measured the delicate angles of the stars,
Out of his window, with his compasses,
His only instrument.

Looking down he sees Christine, "the blue eyed peasant girl," who afterwards accompanies him to Wheen in the Sound where with the King's help he

built himself that wonder of the world,
Uraniborg, a fortress for the truth,
A city of the heavens.

He tells her all his hopes:

There's one way,
And only one, to knowledge of the law
Whereby the stars are steered, and so to read
The future, even perhaps the destinies
Of men and nations,—only one sure way,
And that's to watch them, watch them, and record
The truth we know, and not the lies we dream.

Mr. Noyes follows him through the many years of work on the island to the time when, under a succeeding ruler, support was withdrawn. He was exiled and as a result meets with Kepler who describes his last moments. The story of Tycho is perhaps the most successful effort in the volume.

Kepler is shown in his home expecting a visitor, Sir Henry Wotton, and discoursing to his wife about poets and their natures. She lets him run on and after his longest disquisition:

'John, I'm afraid!'
'Afraid of what, Susannah?'
'Afraid to put those Ducklings on to roast.'

But the ambassador arrives early and Kepler has to fill in the time talking with him in his study. It is here he has the opportunity to tell of his work and to state the laws of planetary motion. Throughout, however, he gives the credit to Tycho:

I owed so much
To Tycho Brahe; for it was he who built
The towers from which I hailed those three great laws.

The story of Galileo is chiefly written round the famous trial which Mr. Noyes has apparently investigated with some care. There is here much less astronomy and physics and more philosophy. The story of the reception of his telescope is interestingly told, however, and the author finds an opportunity to give a politician's view of a scientific discovery:

Whereat old senators, wagging their white beards,
And plucking at golden chains with stiff old claws
Too feeble for the sword-hilt, squeaked at once:
'This glass will give us great advantages
'In time of war.'

Mr. Noyes follows Isaac Newton through the productive period of his life and gives in some detail the chief of his discoveries. We have already quoted from the description of his experiments on light. There follow a few lines about

That first reflecting telescope which should hold
In its deep mirror, as in a breathless pool
The undistorted image of a star.

A long and faithful description of the work on gravitation follows, incuding the incident where Newton obtained the new value of the Earth's diameter and was too excited to finish the calculations which showed that his theory was right. Mr. Noyes gets some fun with talk of Pepys about Newton and his table,

Littered with papers, cups, and greasy plates
Of untouched food. I am told that he would eat
His Monday's breakfast, sir, on Tuesday morning,
Such was his absent way!

In the penultimate scene, Newton, now an old man, muses over his early days and his work in a letter to an old sweetheart. The last phase is put into the mouth of Dean Swift.

The "Watchers of the Sky" is probably not a literary landmark of the first order, but it is a very important and attractive addition to the growing list of volumes which are bringing scientific ideas and their history to the attention of the general public. Whatever may be said concerning its merits,—and there are decided differences of opinion possible on that score—it has certainly the excellent quality of being interesting throughout. Many will read it through for that reason alone. It is essentially a volume which should be in everyone's library especially where there are boys and girls growing up. Parents are advised to "leave it about" but not to recommend their children to read it if they wish them to enjoy it.

Ernest W. Brown

SPECIAL ARTICLES

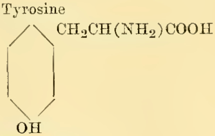
IODINE AND ANURAN METAMORPHOSIS

The following experiment shows clearly the importance of iodine in inducing anuran metamorphosis and indicates that other halogens such as bromine can not be substituted for it.

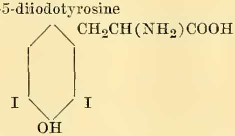
Thyroidectomized and hypophysectomized *R. sylvatica*, the glands of which had been extirpated early in embryonic life, were kept until after the normal time for metamorphosis had elapsed and the normal controls had transformed, and then divided into three sets for experimental purposes. It will be recalled that thyroidless and pituitaryless larvæ do not metamorphose but remain permanent tadpoles unless fed thyroid derivatives or very large amounts of iodine. One set of animals was fed quantities of pure tyrosine $CH_2CH(NH_2)COOH$ each day and allowed to remain in weak solutions of this substance six to eight hours every day. The remainder of the time they were kept in large glass containers and fed large quantities of spirogyra.

The second lot of animals was fed equal quantities of tyrosine in which two atoms of iodine had been substituted for two hydrogen atoms of the tyrosine—forming the well-known compound, 3-5-di-iodo-tyrosine. The iodine in this compound is, of course, an integral part of the molecule.

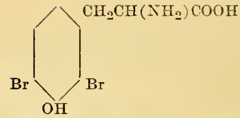
Tyrosine



3-5-diiodotyrosine



The third set of tadpoles was fed quantities of tyrosine equal in amount to that received by the other two cultures, in which two atoms of bromine had been substituted for two hydrogen atoms of the tyrosine molecule forming the compound 3-5-di-brom-tyrosine.



The di-brom-tyrosine was prepared according to the method of C. T. Mörner, 1913, *Zeitschrift für physiologische Chemie*, Vol. 88.

The animals fed tyrosine and spirogyra showed no changes indicative of metamorphosis after sixty days of continuous feeding, though the normal growth rate was not interrupted. After the twenty-fifth day the hind legs differentiated and grew very slowly until they attained a length of 3 to 5 millimeters. There were no signs of fore legs, skin autolysis in the pectoral region, tail shrinkage or anything suggesting transformation.

The animals fed 3-5-di-brom-tyrosine behaved in identical fashion with those of the tyrosine-fed culture and no metamorphosis resulted. At the end of the second month of feeding the hind legs of the animals of the culture averaged five millimeters. The growth rate of the animals was not interfered with by the brom-tyrosine compound. Insofar as the acceleration of metamorphosis is concerned, the results obtained by feeding tyrosine and 3-5-di-brom-tyrosine are essentially negative.

Conversely the administration of 3-5-di-iodo-tyrosine to thyroidless and pituitaryless larvæ brought about very striking results, and in so far as metamorphosis is concerned, simulated the action of thyroid extract, although the effect of the latter is somewhat more rapid. Within a few days after feeding iodo-tyrosine the animals appear thin and emaciated; the limbs grow rapidly and the other changes incident to metamorphosis appear. Twenty days after the date of first feeding the entire culture of thyroidless animals had completed metamorphosis except for the loss of the tail. The pituitaryless animals developed fore and hind legs, frog mouths but invariably died before tail resorbtion was complete. In two pituitaryless animals the right fore legs broke through the skin eight days after the animals were placed upon the iodo-tyrosine diet. These two individuals were exceptional in this respect, the average time being about twenty days.

These results are of significance for several reasons: 1. The experiment is clear cut and admits of but one interpretation, *i. e.*, that it is the iodine within the tyrosine molecule that is essential for Anuran metamorphosis, because tyrosine without the two atoms of iodine is incapable of inducing metamorphosis.[1]

2. Thyroidless and pituitaryless frog larvæ do not metamorphose unless fed thyroid substance or very large quantities of elemental iodine. Such larvæ have no thyroid mechanism for the manufacture of the thyroid hormone, yet apparently are able to utilize inorganic iodine when administered in very large quantities along with normal food. The substitution of the two iodine atoms for two hydrogens of the tyrosine molecule transforms the tyrosine into a highly active metamorphosis-inducing agent far superior to any quantity of elemental iodine in its rate of action and second only to the thyroid hormone itself. It seems clear that in tadpoles metamorphosis depends upon an organic iodine complex of some sort, and that the iodine to be effective does not need to undergo transformation within the thyroid gland. It is evident that when thyroidless larvæ metamorphose when fed quantities of inorganic iodine, the latter to be active must enter into organic combination with either the body proteins of the larvæ or the algæ fed with it.

3. Iodized proteins and amino-acids have been employed by several investigators in the treatment of various disorders of the thyroid in cases of human hypothyroidism, but the writer has never heard that such products can completely take the place of the thyroid hormone. Yet in thyroidless Anuran tadpoles iodo-tyrosine to all intents and purposes is as good as the thyroid secretion in transforming the individual, *i. e.*, it completely takes the place of the gland secretion in so far as metamorphosis is concerned.

Metamorphosis in Anurans is dependent upon a peculiar property of the iodine atom when organically combined in a certain way and it seems that mammals and Anurans are not to be compared in regard to their reactions to iodine. Thyroidless tadpoles promptly metamorphose when fed iodized amino-acids or large quantities of elemental iodine, but thyroidless mammals and individuals with atrophied and very degenerate glands can not utilize elemental iodine at all, and the same is probably true of iodized amino acids. Voegthlin and Strouse ('09, *Journal Pharm. and Exp. Therap.*) observed that iodized amino-acid fails to replace the thyroid function in pathological cases of hypothyroidism, *i. e.*, myxedematous and cretinous mammals, nor was the nitrogen metabolism or blood pressure of dogs influenced by administration of this substance. Furthermore, Miura ('22, *Jour. Lab. and Clinical Med.*, Vol. 7) has made the interesting observation that di-iodotyrosine gives no protection to mice against lethal doses of acetonitrile, whereas thyroid tissue protects these animals against the poison.

It is clear that in so far as the metamorphosis of thyroidless and pituitaryless tadpoles is concerned iodo-tyrosine is practically as good as the thyroid hormone but this same substance in mammals can not be substituted for the glandular tissue itself.

4. The suggestion of some recent writers that bromine if it could be substituted for the iodine of the thyroid might prove just as active physiologically, is not borne out by these experiments. Bromine has no influence upon Anuran transformation and can not be substituted for iodine.

W. W. Swingle
Osborn Zoological Laboratory,
Yale University,
October 5, 1922

[1] Large axolotls seven inches long were *thyroidectomized* and kept five months following the operation and then twice injected with iodotyrosine. Metamorphosis resulted within seventeen days following the first injection. Similar animals injected with tyrosine and dibromtyrosine did not transform. Partially thyroidectomized axolotls (two thirds of the gland excised) were kept five months and then twice injected with iodo-serum globulin. Metamorphosis occurred within sixteen days. Uhlenhuth's claim that Urodele larvæ differ from Anurans in regard to metamorphosis and iodine is not sustained.

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF PHYSICAL AND ORGANIC CHEMISTRY

(Continued from November 17)

The conductivities, viscosities and densities of solutions of mixed electrolytes. (Lantern): C. E. Ruby and J. Kawai.

The mutual solubility of liquids: Two new methods for determining the same: Arthur E. Hill. The published results on the solubility of liquids are meagre compared with the voluminous data on the solubility of solids. It is proposed to study a number of new cases, and repeat some determinations which appear to be inaccurate. No methods have proved to be of universal applicability. In place of the terms synthetic and analytic methods, which do not indicate the essential differences in procedure, the term thermostatic is proposed for methods in which the temperature is held constant and plethostatic for methods in which the concentration is fixed and the temperature changed to the point of beginning heterogeneity or homogeneity. As a new thermostatic method suitable to liquids of moderate solubility, the measurement of the volumes obtained in suitable volumetric apparatus in two experiments may be used, on the basis of the phase rule, to calculate the solubilities. An accurate determination of the solubility curves for ether and water has been made by this method. For liquids dissolving very small amounts of water the use of silver perchlorate is proposed; the solubility of this salt rises sharply with the presence of small amounts of water, so that, after establishment of a reference curve at a standard temperature (25°), the solubility of water at any other temperature can be determined. The solubility of water in benzene and in aniline has been measured by this second method.

The occurrence of closed solubility curves in three-component systems: Arthur E. Hill. Closed solubility curves have been found in several two-component systems, such as nicotine and water. Among three-component systems the closed curve has been found only once, in the case of silver perchlorate, water-benzene, recently published by the author. The same type of curve has now been found in the system silver perchlorate-water-toluene, and exists from room temperature to some temperature above 100°. In both these cases, the curve for the two component systems (silver perchlorate-benzene and silver perchlorate-toluene) approaches a perpendicular to the temperature axis, *i. e.*, the two components just fail of breaking into two liquids; the addition of the third component evidently decreases the mutual solubility, causing the formation of two liquid phases. It is well known that, when there is limited solubility of two liquids, a third component may either increase or decrease that solubility. Where there is unlimited solubility of two components in the fused state (*i. e.*, only one liquid phase exists), the addition of the third component should again act either to increase or decrease miscibility; but if the two-component system shows a nearly perpendicular curve, indicating that the forces existing are only just sufficient to hold the two components in solution, a third component chosen to reduce mutual solubility should result in a separation into two liquid phases, which, in the three-component diagram, leads to a closed curve. We may therefore look for closed curves in three-component systems most hopefully where one of the two-component systems shows a solubility curve of the type described.

Solubilities up to the critical temperature: P. A. Bond and M. C. Waddell. I—Methods of manipulation. II—Solubilities in sulfur dioxide at 25° C. A method for determining solubilities up to the critical temperature has been developed. The apparatus and method of manipulation are discussed. Solubilities in sulfur dioxide at 25° C. have been determined for salts of potassium, silver, cadmium, tin, antimony, tellurium, manganese and in one case for Ba as the thiocyanate. Aside from the solubilities as determined, interesting reactions between sulfur dioxide and chlorates, bromates, iodates and nitrates were noticed. Also a double layer was formed in the case of SnBr. Work is to be continued until salts of all metals have been tried, and in cases where solubility is shown is to be carried on at different temperature levels.

Vapor pressures of certain hydrated sulfates: Clifford D. Carpenter and Eric R. Jette. The vapor pressures of some of the hydrated sulfates of Cu, Mn, Mg, Co, and Cd have been studied at a number of temperatures below the transition points, and the saturated solutions of some of them at several temperatures above these points. Some of the determinations have been carried as high as 90° C. A modification of the Bremer-Frowe tensimeter was used. All points were determined by approaching equilibrium from both a higher and a lower pressure. A special thermostat was constructed for the higher temperatures. The results obtained have been used in plotting the vapor pressure curves, in calculating the heats of vaporization, and for plotting the log $p - \frac{1}{T}$ relation. The log $p - \frac{1}{T}$ relation gave straight lines in every case, and these lines intersected sharply at the transition points. Some transition points are definitely located by the intersection of the vapor pressure curves. There are certain limitations in using vapor pressure data for interpreting the nature of the phenomenon.

Electroadsorption as a pure chemical phenomenon: J. W. Elder, E. B. Starkey and N. E. Gordon. An investigation to throw more light on the relation between electroadsorption and pure chemical action. The work was carried out with the hydrogels of ferric oxide and silica acting as the adsorbents. Such salts were used so as to have the resulting products of different solubility provided there was a chemical reaction. The electroendosmosis of each system was investigated in order to correlate, if possible, any electrochemical behavior.

Adsorption by activated sugar charcoal. II: F. E. Bartell and E. J. Miller. This paper presents the results obtained in a study of the nature of adsorption of electrolytes from solution by activated ash-free sugar charcoal. It includes data on the adsorption of acid dyes, basic dyes, organic and inorganic acids and inorganic bases. A brief discussion of the theory of hydrolytic adsorption of electrolytes is given, followed by a consideration of results obtained with a number of salt solutions with activated sugar charcoal. The variation of these results from those obtained by other investigators who have used charcoals of animal or vegetable origin is pointed out.

The influence of temperature pressure and catalyst support material upon adsorption by catalytic nickel: A. W. Gauger and Hugh S. Taylor. (1) Adsorption isotherms of hydrogen on nickel have been determined, using nitrogen as a reference gas. A definite saturation capacity of nickel for hydrogen exists, dependent upon the temperature; (2) From the variation of the saturation pressure with temperature the heat of adsorption of hydrogen on nickel has been calculated to be approximately 2,500 calories; (3) The effect of using an inert material for catalyst support has been found to increase greatly the adsorptive capacity per gram of nickel and to yield a catalyst that will stand much more severe heat treatment without diminution of its adsorbing power.

An instrument for measuring the rate of swelling of gelatine films on rigid supports: S. E. Sheppard and Felix A. Elliott. An instrument was described which consists essentially of a balance beam resting upon a fulcrum which can be raised and lowered by means of a micrometer screw. At one end of the balance beam hangs a slender but rigid quartz rod, the end of which is flattened to form a foot ca. 2 mm. in diameter. The weight of this rod is carefully counterbalanced within a few mgs., allowing just enough "out of balance" to insure constant but practically weightless contact between the foot and the swelling gelatin surface. The gelatin coated plate is securely clamped in a jacketed tray just below the quartz rod. An optical system indicates the condition of balance, the fulcrum is lowered until balance is indicated, a reading made, and solution acting on the gelatin poured in the tray and the fulcrum raised as may be necessary to maintain balance. Readings are made periodically. The sensitivity is about 0.001 mm. and the precision 5 to 1 per cent., depending upon the rigidity of the jelly. Measurements have been made using glass plates coated with gelatin and also emulsion coated plates. These were swollen in acids and alkalis as well as salt solutions and photographic developing baths. Although differing in degree all curves indicated a rapid initial swelling asymptotically approaching an equilibrium.

The effect of gravity and light on the formation of Liesegang bands in gelatin and silicic acid. (Illustrated): Earl C. H. Davis. Gravity has but little effect on the formation of periodic bands in gelatin as shown experimentally. Light is one of the most important variables in making rhythmic bands of gold in silicic acid. At the concentrations used no bands were formed in the dark at either 0° C. or at room temperatures. Periodic variations of strong light and darkness produce bands in those regions in which there is still adsorbed molecular gold, excess oxalic acid and suitable amounts of the products of the reaction. These by-products make precipitation in bands possible because they influence the tendency toward imbibition and peptization so that the gold is precipitated in "pockets" just large enough to give a colloidal dispersion. There is no fundamental difference between the bands of blue gold and those of red. The location of the colloidal bands can be governed by a black paper which surrounds the tube and has slits cut in it at regular intervals. With a Mazda light placed near such a tube in the dark room for a week the bands at the openings are coarse particles instead of being colloidal. That is, they are yellow crystals. Contrary to some previous observations rhythmic bands of the silver chromate form in darkness at 0° C. and room temperatures.

Ferric oxide hydrosol. II. The chlorine and hydrogen ion activities and the heat of coagulation with sodium sulfate: FREDERICK L. BROWNE. A study has been made of the hydrogen and the chlorine ion activities in ferric oxide hydrosol and in hydrolyzed and unhydrolyzed ferric chloride solutions. From these data the distribution of $FeCl_3$ and HCl between the dispersed phase and the dispersion medium has been computed. When the heat of coagulation of these sols with Na_2SO_4 is corrected for the heat of mixing of Na_2SO_4 with the $FeCl_3$ and HCl present, there is left a small positive heat effect which is proportional to the amount of Na_2SO_4 adsorbed during coagulation and amounts to about 1,200 cal. per g. eq. Na_2SO_4 adsorbed.

Ferric oxide hydrosol: ARTHUR W. THOMAS and ALEXANDER FRIEDEN.

A note on quinaldine pink: HANS T. CLARK and FELIX A. ELLIOTT.

The coagulation and repeptization of colloidal ferric hydroxide by alkalis: ROBERT E. WILSON and PHILIP S. CLARK. In order to improve the efficiency of removal by filtration of small amounts of colloidal ferric hydroxide from hot water which has been passed over sheet iron to remove dissolved oxygen, a study was made of various possible coagulating agents for ferric hydroxide. It was found that alkalis were by far the most effective precipitating agents in small amounts, and that as low as .05 per cent. NaOH effected practically complete coagulation in a very short time. *Larger* amounts of alkali were found to *decrease* the efficiency of filtration, and this behavior was eventually shown to be due to the repeptization of the ferric hydroxide as a *negative* colloid, with markedly different properties.

Gum dammar as an emulsifying agent: HARRY N. HOLMES and DONALD CAMERON. Since gum dammar is insoluble in water but soluble in many other liquids its use as an emulsifying agent forces water to become the internal or dispersed phase in the "water-in-oil" type of emulsion. Such emulsions are more stable and may be made much richer in water than by the use of calcium soaps. Salve-like emulsions are readily made by mixing a solution of the gum in benzene with a relatively large amount of vaseline or heavy oil and then rubbing in the desired amount of water. Printers' or lithograph inks may be greatly cheapened by the incorporation of water, dispersed in minute drops, by the use of this gum as emulsifying agent. Since much of the drying oil is used merely to give a proper working body, the use of water, well emulsified, will give the requisite body more cheaply while a smaller amount of the drying oil is adequate for adhesive purposes. Paints, varnishes and greases may be diluted in similar fashion.

Cupric oxide jellies and the general theory of jelly formation: HARRY B. WEISER. A dilute colloidal solution of hydrous cupric oxide is formed by adding ammonia short of precipitation to a saturated solution of cupric acetate. This colloid coagulates on standing, forming a gelatinous precipitate of the hydrous oxide. By adding a suitable small amount of sulfate to the acetate solution before adding ammonia, a more concentrated colloidal solution of hydrous cupric oxide may be prepared. This colloid is likewise instable and, under suitable conditions, coagulates with the formation of a stable jelly. The sharply defined conditions of formation and the effect of electrolytes on the stability and rate or precipitation of the colloidal oxide support the author's general theory of the formation of inorganic jellies proposed at the Birmingham meeting.

A rapid method for the preparation of some dilute silica gels: L. H. REYERSON and WM. T. MORIN. It has been found that ammonium hydroxide solutions will under certain conditions cause solutions of sodium silicate, mixed with hydrochloric or sulfuric acids, to set to gels. Using this method it has been possible to set gels with an SiO_2 concentration as low as approximately one half of one per cent. Gels as low as two per cent. will set almost instantly. The characteristics of these dilute gels are being studied.

Studies on the nature of the reducing action of charcoals on certain salt solutions. I. Silver nitrate: L. H. REYERSON and MAX LATSHAW. The reducing action of various charcoals upon silver nitrate solutions has been studied. An almost ashless charcoal was prepared in order to eliminate the interferences due to impurities. Neutralization of surface charges does not account for the reduction to metallic silver. Evidence from Hulett's work as well as our own investigations points to the fact that an active form of hydrogen, strongly adsorbed by the charcoal, is the reducing agent. Silica gel outgassed at 400 C. and cooled in an atmosphere of hydrogen reduces silver ion in silver nitrate solutions to silver. This reaction is being studied in its effect on various cations,.

especially those which lie below hydrogen in the electromotive force series.

Behavior of aqueous potassium permanganate in the presence of potassium hydroxide: WILLIAM LERCH and J. E. DAY. The rate of decomposition of an aqueous solution of potassium permanganate (free from reducing substance) in the presence of varied amounts of potassium hydroxide (free from reducing substances) was observed at the temperatures 75 and 105° Centigrade (approximately) For a concentration of KOH at and below 0.7 M no change in oxidizing potential occurred at 73° in 182 hours. Increasing temperature and alkalinity resulted in an increase in the per cent. of $KMnO_4$ converted to K_2MnO_4. At 105° Centigrade and a causticity of 11.7 M the percentage change was 90.3. The rate of change curves are log curves.

Some properties of arsenic trioxide in aqueous solution: ERNEST ANDERSON and R. G. STORY. The density and refractive index curves of As_2O_3 in aqueous solution were found to be straight lines. The equation for such a curve is: $W = A + BX$. The constants A and B for both curves were accurately determined at 25° C. The weight of As_2O_3 calculated from either density or refractive index by the constants A and B agree exactly with analytical determinations. The solubility curve, degree of hydration and hydrogen ion concentration were also determined for As_2O_3 in aqueous solutions.

Preparation of antimony-free arsenious trioxide: C. W. FOULK, P. G. HORTON and G. M. MCCLURE. Arsenious trichloride is first prepared either by heating the oxide with concentrated hydrochloric acid and distilling or by adding sulfuric acid to the hydrochloric acid solution and drawing off the layer of trichloride. The separation from antimony can be effected by several distillations of the arsenious trichloride or better and easier by shaking the trichloride two or three times in a separatory funnel with a little less than its own volume of concentrated hydrochloric acid. The antimony goes into the water-acid phase.

The determination of lead in lead amalgam: M. G. MELLON. Lead in lead amalgam may be displaced by copper from an aqueous solution of copper nitrate with the formation of copper amalgam and lead nitrate. The lead may then be precipitated and weighed as the chromate. Data are given to show the accuracy of the method and the effect of time, temperature and concentration of copper nitrate upon the displacement reaction. The mercury is not dissolved in the determination, and it may be purified for further use.

The volumetric determination of phosphorus: WILLIAM A. TURNER. Experiments undertaken using the Pemberton or Kilgore volumetric method for phosphorus show a positive error of approximately 8 per cent. when compared with results obtained by the gravimetric method. It is shown that the factor for the phosphorus equivalent of the alkali solution as given in the official methods of the A. O. A. C. and in many textbooks is derived from an incorrect reaction. The precipitate of ammonium phosphomolybdate as ordinarily produced contains acid not removed by washing with a neutral salt solution. The precipitate, therefore, is not $(NH_4)_3PO_4 \cdot 12MoO_3$, as commonly assumed, but $(NH_4)_3PO_4 \cdot 12MoO_3 + 2$ mols. HNO_3 or an equivalent amount of some other acid. Such a precipitate requires a larger proportion of alkali. The correct reaction is, $2[(NH_4)_3PO_4 \cdot 12MoO_3 \cdot 2HNO_3] + 50NaOH = 2(NH_4)_2HPO_4 + (NH_4)_2MoO_4 + 23Na_2MoO_4 + 4NaNo_3 + 26H_2O$. A factor calculated on this basis calls for an 8 per cent. reduction in the phosphorus equivalent of the alkali solution. Such a factor gives results which agree very closely with the gravimetric method.

Note on apparatus for preparation of conductivity waters: C. W. FOULK and A. P. BAWDEN. The device is an accessory for conductivity water stills because its use eliminates corks or rubber stoppers for connecting glass flasks with condensers. Briefly, it consists of a circular tin block on one end of which an annular depression is turned to engage the mouth of the flask to be used. Gaskets of tin-foil can be employed if necessary. The block is held in place by means of springs stretched between it and a brass collar around the neck of the flask. The inner tube of the condenser passes through a hole in this block, the connection being made by soldering with tin.

Determination of the specific gravities of minimal amounts of materials by the immiscible balance: WILLIAM G. EXTON. It is often necessary (blood and other body fluids, scums, dust, etc.) or expedient (viscosity, expense of materials, etc.) to determine the specific gravity of minimal amounts of liquids or solids, and this may be done rapidly and conveniently with the immiscible balance. The material to be tested is suspended in equilibrium in a mixture of two solutions (light and heavy) which are miscible with each other but not with the sample, *i. e.*, petroleum ether-carbon tetrachloride, benzol-chloroform, alcohol-water, brine-water and other combinations are suitable. The apparatus consists of a cylindrical mixing chamber having for its floor a stopcock of special design which connects with a thistle tube and a spout. With the cylinder partly filled, a drop or a fragment of the material to be tested is immersed, and the specific gravity of the mixture is then varied at will without agitation of any kind by dropping the heavier component in from above or forcing the lighter component into the cylinder from below until the mixture has the same specific gravity as the material to be tested. The specific gravity of the mixture is then determined by Westphal balance or by a hydrometer of special design. The design of the stopcock permits the separated discharge of mixing chamber and thistle tube into their respective containers so that the solutions may be used repeatedly or determinations made in series without discharging the contents by removing the material. The method is delicate, has a wide margin of safety from error and the attainable accuracy seems limited to the accuracy of the method used to obtain the specific gravity of the mixture.

A new method for the control of thermostats: D. J. and J. J. BEAVER. A method for accurately controlling the temperature of a thermostat for long periods is described in which a very small current, of the order of 10^{-5} amperes, is amplified by a vacuum tube sufficiently to actuate a magnetic relay. The circuit is so designed that the chattering of the relay can be prevented by electrical methods. The effect of an oscillating point is obtained without an elaborate mechanism and the back-lash at the mercury contact surface is prevented by the use of iron wire for the contact point. A sensitive thermoregulator is described which is made of monel metal tubing filled with mercury. A simple method of connecting glass to metal is described.

Adiabatic calorimetry at high temperatures: J. W. WILLIAMS and FARRINGTON DANIELS. Adiabatic calorimetry is possible at high temperatures if sufficient precautions are taken to prevent thermal leakage from the inner calorimeter to the room. The construction of such a calorimeter is described. The outer bath, a glycerine solution of ferric chlorids, is heated electrolytically. Thermal leakage along the resistance thermometer is difficult to overcome, so it is placed in the outer bath, and readings are taken when its temperature is identical with that of the inner calorimeter as shown by zero reading on a sensitive thermocouple. The specific heats of aniline and nitrobenzene in the neighborhood of 100° have been determined.

Black phosphorus: CLAUDE HAINES HALL, JR. The author has collected and analyzed the somewhat extensive and complicated literature relating to black phosphorus. He has shown that in reality two distinct substances have been given this name. The first, discovered by Thenard in 1812, is not a true allotropic modification but is a colloidal suspension while the second, discovered by Bridgman in 1914, is a true modification. He has devised an apparatus to extend Svedberg's method of preparing colloidal suspensions to phosphorus and has definitely prepared suspensions of copper phosphide and mercury in phosphorus. The properties of these suspensions are described.

Notes on potassium chlorate: H. W. MOSELEY. In this paper the following matters are presented: first, the preparation of specimens of potassium chlorate by altogether different and independent methods; second, the details of the determination of the melting point of the several specimens with check results (the literature shows a variation of 40° in this constant), the composition of the bath necessary for this measurement, and the fact of no decomposition at the melting point; third, the determination of the temperature of beginning decomposition with a study of the decomposition reaction up to and including 500° C.

Ozone: electrical preparation and analysis: A. SILVERMAN and PAUL C. SAUNDERS. Ozonizing unit employed for the generation of ozone is a modification of the Berthelot apparatus. The oxygen generator, purifying train, ozonizer, manometer and analyzer are all parts of a single piece of apparatus. All connections are of glass. The parts of the unit are so constructed that all readings can be made in a thermostat. Within the limits of operation employed only O_3 was obtained. Yields have been calculated on the basis of energy consumption. Concordant results have been obtained under given sets of conditions. Drawings accompany the article and lantern slides will be employed in its presentation.

The analysis of gaseous mixtures of nitrogen peroxide, nitric oxide, nitrous oxide and nitrogen: LOWELL H. MILLIGAN and C. HERBERT QUICK. The gases are conveyed by pure CO_2 through an absorption train which removes NO_2 and NO, and then through NaOH soln, which takes out the CO_2 and over the surface of which the N_2O and N_2 collect. The N_2O is determined by slow-combustion with hydrogen and the N_2 is obtained by difference. In the absorption train conc. H_2SO_4 is used to absorb NO_2, and part of the NO if the latter is present with NO_2. The total nitrogen and the nitrous nitrogen in the acid are afterward determined, and from them the NO_2 and NO absorbed are calculated. A definite volume of std. permanganate soln., acidified with H_3PO_4, is used to absorb the rest of the NO, and afterward the excess permanganate is determined. The total NO originally present is the sum of that absorbed in the H_2SO_4 and in the permanganate soln. The method was tried on known quantities of the gases, and was found satisfactory.

The action of hydrogen peroxide on photographic gelatino-silver halide emulsions: S. E. SHEPPARD and E. P. WIGHTMAN. A detailed study of the action of hydrogen peroxide on photographic plates has been made with the idea of obtaining more complete data on the subject in order to compare the action with that of light in the formation of latent images. Both the intensity (concentration) and time factors were considered as well as development conditions. As a side problem it was found necessary to consider also the effect of concentration of the acid (or alkali) content of the hydrogen peroxide. The effects are in many ways quite similar to the action of light. Other conclusions can not be drawn until further work has been completed. We have proposed the tentative hypothesis that silver nuclei in the silver-halide grains serve as catalytic agents for the decomposition of hydrogen peroxide which is chemi-luminescent.

Reactions at boundaries of phases; the problem of promoter action and the theory of the latent photographic image: HUGH S. TAYLOR. From a literature study and from investigations it has been established that the boundaries of two phases constitute a most reactive portion of a heterogeneous system. Evidence is available to show that a number of cases of promoter action can be attributed to enhanced reactivity of mixed catalysts at interfaces between the components of the catalyst mixture. The analogy between the development of the latent photographic image and the reduction of metallic oxides by various reducing gases at low temperatures can be established. Studies of the latter are very suggestive as to the necessary extent of nuclei production precedent to the production of a developed image in the individual grain of the photographic emulsion.

Hydrogen ion catalysis in lactone formation: H. W. CLOSE and HUGH S. TAYLOR. A study of the catalytic conversion of hydroxy-acids to lactones, using acids as catalysts, has been made. The influence of variation of the catalyzing of acid and of its concentration, of added neutral salts and of their concentration, of temperature and of the solvent, have been made the object of investigation. It has been shown that it is probably the non-hydrated hydrogen ion which is the active catalytic agent. The remarkable results which this leads to, when ether is used as solvent, have been outlined and experimentally verified.

The hydrogen ion concentration of buffer solutions at elevated temperatures: ROBERT E. WILSON. Despite its importance from a number of aspects, there is practically no data in the literature as to the hydrogen ion content of the various recognized "buffer" solutions at temperatures above 40° Centigrade. Since the p_H of neutral water and of ordinary solutions of alkalies drops off markedly with increasing temperature, on account of the increased ionization constant of water, it was especially desired to determine how the alkaline buffer solutions behaved in this respect. Measurements have been made on various borate, phosphate and phthalate solutions and indicate that the change in p_H between 30° to 90° (calculated on the assumption that the p_H of 0.1 N HCl is constant) is very small, compared with that of ordinary alkaline solutions. This is, of course, due to the fact that all owe their buffer action to the ionization of *acid* salts of some polyvalent acid. A phosphate buffer solution has been prepared which is *acid* at 30° and *alkaline* at 90°, although its p_H remains constant. Most indicators behave much like the buffer solutions, and hence a given color may indicate acidity at low temperatures and alkalinity at higher temperatures. The paper presents the results in graphical form.

Tracks of alpha particles in gases: R. W. RYAN and W. D. HARKINS.

The ferrocyanide test for zinc: R. D. MULLINIX and A. L. STALLBAUMER. Potassium ferrocyanide precipitates a white zinc ferrocyanide which, when treated with bromine water, turns a characteristic yellow color. No systematic work has been done to determine the best conditions for the test or to compare its sensitiveness with that of the hydrogen sulfide test. Such work has been done by the authors and leads to the following conclusions: (1) $K_4Fe(Cn)_6$ test for zinc is ten times as delicate as the H_2S test. 0.1 mg. of zinc ion in 50 c.c. of solution can be detected, 1.0 mg. is about the limit for the sulfide method. (2) The test should be carried out in a solution about one half normal with acetic acid and should contain ammonium salts. Warming to 60 aids flocculation. (3) The ferrocyanides of the alkaline earth metals are too soluble to interfere, other metal ions must be removed. (4) The yellow color with bromine water is also given by cadmium ferrocyanide.

Qualitative analysis without hydrogen sulfide: R. D. Mullinix. G. Almkvist has proposed a method without the use of H_2S, but Na_2S followed by H_2SO_4. (*Zeit. anor. Chem.*, 103, 221-242, 1918). I have used for the past two years with qualitative classes a method in which, after the removal of the silver group by HCl, a mixture of NaOH, Na_2CO_3 and bromine water precipitates a group of hydroxides and carbonates, which are then further separated. The As, Sb, Sn, Pb traces, Au, Al and Cr are in the filtrate. This is divided by HCl followed by NH_4OH, and zinc tested for in the presence of chromate and arsenate by the potassium ferrocyanide method. This is a preliminary communication and will be followed by more detailed work on the group analyses and end tests.

DIVISION OF SUGAR CHEMISTRY

S. J. Osborn, *chairman*
Frederick Bates, *secretary*

Detection of sugar in condensed waters by means of cresol: G. E. Stevens. Fifteen ml. of cresol (U. S. P. Merck) is dissolved in a castile soap solution (6 gms. soap in 100 c.c. of distilled water). The mixture is warmed until a complete solution is obtained. This solution can be made up in litre quantities in the above proportions without deterioration. Approximately one inch of water to be examined is placed in a 6 inch by ⅝ inch test tube and five to ten drops of the cresol solution is added and then thoroughly mixed. Cool if the water is hot and then add concentrated sulfuric acid from a dispensing burette, holding the tube in an inclined position so that the acid will run down to the bottom and form a separate layer, and continue to add the acid until the acid layer is ¾ inch deep. The tube is then rolled between the palms of the hands and if sugar is present a reddish black to pink color ring will develop, the color depending upon the concentration of sugar in solution. A white translucent screen is recommended, to be placed between the eye and the source of light, such that the color reaction will be more easily recognized, especially in solutions containing very faint traces of sugar.

Hydrogen-ion determination as a method of refinery control. Preliminary report: H. Z. E. Perkins. Direct control of acidity and alkalinity in sugar refining is obtained only at certain points, chiefly at beginning. After washing, sugar goes through main process of clarification, bone-black decolorization and crystallization without material change in ionization. By-products are unstable in composition, ferment quickly and are moreover treated with defecating agents, acid and alkaline. Ionization is variable, being resultant of several factors, natural and artificial. Main products, highly crystallizable, light in color, are easily tested with color indicators, but appear sluggish and uncertain with potentiometer. Lower products, dark colored, can not be used in color reactions, but respond better to electrometric tests. Figures are given showing variations and stability.

A study of the formation of gum levan from sucrose: W. L. Owen. The formation of gum levan from sucrose by bacteria is not, as has been claimed by previous investigators, dependent upon its inversion and the utilization of invert sugar while in the nascent condition. Experiments on the production of gum levan in the presence of added invertase show that under these conditions it is decreased to the extent to which the invertase is active. The decrease is always greatest where the conditions are most favorable for invertase action. The optimum p_H for gum production is between 6.7 and 7.0, but the fermentation can proceed slowly where the p_H is 9.5. Under the latter conditions the addition of invertase does not reduce the production of levan by the bacteria.

The invertase value of the clerget constant: R. F. Jackson.

A simple check valve: J. F. Brewster. A check valve for use with the water vacuum pump to prevent sucking back is made by cutting part way through a solid rubber stopper at the narrow end, leaving a thin flap or disk. The stopper is then bored to receive a piece of glass tubing, the flap being left intact. The valve stopper is inserted in a short length of glass tubing wide enough to allow free play of the valve. By means of a second one-hole stopper, glass and rubber tubing the valve is connected between the pump and the apparatus to be evacuated.

Some notes on activated vegetable chars: C. E. Coates. This article gives some data relative to the preparation and analysis of vegetable chars from various sources. There are also given some tentative conclusions as to some of the underlying principles in the preparation of decolorizing chars.

The influence of borax on the polarizing power of mannitol: C. A. Browne.

The contraction in volume of sucrose solutions upon inversion: R. F. Jackson.

The Vallez rotary filter press: W. D. Horne. This newly introduced filter press differs from the preceding types of leaf presses in having its filtering discs set upon a hollow horizontal shaft which revolves slowly during filtration, insuring uniformity of deposit of cake upon the leaves. Paper pulp is used as the filtering medium, which gives greatly increased speed of filtration, while the uniformity of the cake allows of sweetening off with the minimum amount of water and gives a very low sucrose content in the washed cake. The washing out is particularly effective, and the arrangement of parts allows of very rapid discharging, cleansing and refilling.

Comparative color determinations in cane sirups and molasses: F. W. Zerban and S. Byall. The object of this investigation was to ascertain whether it was possible with the Hess-Ives tint photometer to detect any difference in the specific transmissive index of cane products when the sample was in one instance dissolved in water and filtered with a small amount of kieselguhr, as previously practiced by the authors, and in the other diluted with white sugar sirup and filtered according to Peters' and Phelps' method. It was found, with twelve cane products representing the entire color range, that water dilution gave too low figures in 70 per cent. of the determinations, and too high figures in the remainder; the average difference was surprisingly small, —0.78 per cent. of the color for the red glass, —2.13 per cent. for the green glass and —6.28 per cent. for the blue glass. Only in a few individual determinations did the error due to water dilution exceed to any extent that attributable to the permissible error in the readings themselves. With the Hess-Ives instrument, therefore, the method previously used by the authors is sufficiently exact for practical factory purposes. Conditions are, of course, different when the spectrophotometer is used.

The countercurrent application of kelpchar in the decolorization of sugar and syrup: J. W. Turrentine. A process is described for the continuous, automatic and countercurrent application of kelpchar in the decolorization of sugar and other solutions and liquids. Use is made of the best filter practice, the process admitting of the employment of the most adaptable of modern filters. Thus vacuum or pressure filters or centrifugals may be employed, depending on the nature of the liquid to be filtered. The kelpchar by this process is admitted at one end of the apparatus, is applied countercurrent-wise to the liquid undergoing decolorization in as many applications as desired, and is discharged as spent cake; while the crude liquid is admitted at the end of the apparatus at which the spent cake is discharged and is delivered in a completely purified state at the other, upon entering the apparatus coming into contact with the practically spent carbon and finally before emerging undergoing treatment with the fresh kelpchar entering. In the one-stage application of a decolorizing carbon, the carbon first loads itself up with those impurities most easily removed, and finally adsorbs those least easily taken up. Thus an excess of the reagent is required, and at that an excess probably out of proportion to the decolorization to be effected. In the present system kelpchar that has been used to adsorb the impurities most difficult to remove is still available with unimpaired power to adsorb the impurities more easily adsorbed. In this way full use is made of the decolorizing properties of the kelpchar and the most efficient application of that material results. The advantages gained are that smaller quantities of kelpchar are in use and require reactivating and losses of values are correspondingly reduced. The process admits of continuous and automatic operation, and labor and laboratory supervision are reduced to a minimum.

Estimation of caramel in sugar products: A criticism of the Ehrlich method: G. P. Meade. Ehrlich bases his method on the claim that saccharan, a component of caramel, is not precipitated by lead subacetate. The present investigation shows that this is true only with saccharan dissolved in distilled water; if any of the ordinary impurities are present that form a precipitate with lead the saccharan is carried down with the precipitate. Known amounts of saccharan and of caramel, added to molasses solutions, are largely removed by clarification with lead subacetate. Therefore, the Ehrlich method is valueless.

A steam-heated laboratory vacuum pan: J. F. Brewster. The body of the vacuum pan consists of an inverted bell jar with open wide neck fitted with a rubber stopper through which pass the leads of the $\frac{3}{16}$ or $\frac{1}{4}$ inch coil of copper tubing, the feed and drain-off pipes. A second open neck bell jar, or better, the dome of a porcelain vacuum evaporating apparatus fitted to the body with a rubber gasket forms the top of the pan. Through the upper rubber stopper passes the connection to the condenser. The apparatus is very efficient and may be used for all sorts of evaporations under diminished pressure.

Charles L. Parsons,
Secretary

THE AMERICAN MATHEMATICAL SOCIETY

The two hundred and twenty-fourth regular meeting of the American Mathematical Society was held at Columbia University, New York City, extending through the usual morning and afternoon sessions. The attendance included forty-eight members of the society. The secretary announced the election of twenty-one persons to membership in the society; twenty-two applications for membership were received.

At the meeting of the Council, a list of nominations for officers and other members of the Council was presented by the Committee on nominations, and was unanimously accepted. Ex-Secretary F. N. Cole, who has served twenty-five years as secretary of the society, was nominated for the presidency. Secretary Richardson reported that Professor Cole, while appreciating the honor done him by the nomination, found himself unable, on account of the condition of his health, to accept. The Council with regret accepted his decision, and adopted an alternative nomination presented by the committee. The following resolution was adopted:

We, the Council of the American Mathematical Society, desire to place on record an expression of our profound regret that Professor Cole feels compelled because of ill health to decline the nomination to the presidency of the Society. We believe that the members of the Society in general will share our disappointment that the opportunity is thus denied us to confer on Professor Cole the honor which would most suitably express our high esteem of him and of his signal services to the Society.

The Committee on the Cole Fund presented a report recommending that the fund be used to endow a prize to be called the Frank Nelson Cole Price in Algebra. The recommendations, which appear elsewhere in Science, were accepted by the Council.

The following papers were read at this meeting:

Parallels and geodesics in Weyl's affine geometry: Edward Kasner.

Einstein's equations of the second and third kinds: Edward Kasner.

Projective and affine geometry of paths: Oswald Veblen.

Theorems on irreducible continua: G. A. Pfeiffer.

On the mapping of dyadic sets: G. A. Pfeiffer.

On the analysis situs of the plane when the (directed) line is taken as element: Jesse Douglas.

Note on the integral of mean curvature over a surface: Jesse Douglas.

Note on quartiles and allied measures: Dunham Jackson.

Particle geometry: B. Z. Linfield.

On certain polar curves with applications to the location of the zeros of the pth derivative of a rational function: B. Z. Linfield.

On the expression of the sum of any two determinants as a determinant of more dimensions: L. H. Rice.

A Pythagorean functional equation: Einar Hille.

A class of functional equations. Preliminary communication: Einar Hille.

Oscillation theorems in the complex domain: Einar Hille.

Note on the internal evidence of the reliability of a test: W. L. Crum.

The use of the median in determining indices of seasonal variation: W. L. Crum.

A general construction for circular cubics: R. M. Mathews.

A theorem on conics, with applications: R. M. Mathews.

A property of the characteristic elements of a group: Louis Weisner.

Visual intuition in Lobachevsky space: E. L. Post.

Note on a generalization of the old puzzle of 8, 5 and 3 pint vessels: Elizabeth B. Cowley.

The Annual Meeting of the Society will be held at Harvard University December 27-28, 1922, in connection with the meeting of the American Association for the Advancement of Science.

R. G. D. Richardson,
Secretary

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THE EXPLANATION OF THE COLLOIDAL BEHAVIOR OF PROTEINS[1]

I

THIS year's Pasteur lecture coincides with the commemoration of the hundredth anniversary of Pasteur's birth. The application of Pasteur's ideas and discoveries has benefited humanity to such an extent that they have become part of the consciousness of civilized mankind. What is, perhaps, less widely understood is the fact that Pasteur changed the method of medical research. In the study of infectious diseases Pasteur substituted for the method of hit or miss (with the chances infinitely in favor of missing) the method of a definitely oriented search which never fails to give results when properly applied. Thousands of physicians had studied infectious diseases before Pasteur, but they tried to solve their problem by starting from observations of the symptoms of some special disease. This led to no result for the simple reason that without knowing beforehand for what to look—or, in other words, without knowing the general cause of infectious diseases—it was impossible to discover the cause of any special infectious process. Pasteur reversed this method by his discovery of the action and omnipresence of microorganisms, leaving it to the medical men to look for the special agency in the individual cases.

There is little doubt that the old empiricism, still in vogue in some other fields of medicine and in the physiological sciences, must be replaced by the more rationalistic method of Pasteur of knowing the general fundamental principles before attempting to explain the more special phenomena, since, unless we follow this method, we never know which of

[1] Pasteur Lecture delivered before the Institute of Medicine of Chicago on November 24, 1922.

the details we observe are significant and which are negligible.

II

Living matter is essentially colloidal in character and we can not well conceive of an organism consisting exclusively of crystalloidal matter. This fact suggests that life phenomena depend upon or are intrinsically linked with certain characteristics of colloidal behavior. It is, therefore, natural that a systematic study of the nature of special life phenomena should be preceded by a scientific theory of colloidal behavior. By a scientific theory, however, we do not understand speculations or guesses built on qualitative experiments or no experiments at all, but the derivation of the results from a rationalistic, mathematical formula which permits us to calculate, with an adequate degree of accuracy, the quantitative measurements of colloidal behavior.

Proteins are amphoteric electrolytes which are capable of forming salts with either alkalies or acids. With alkalies they form salts like Na proteinate, Ca proteinate, etc., and with acids they form salts like protein chloride, protein sulfate, etc. Whether they do the one or the other depends on the hydrogen ion concentration of the protein solution. There is one definite hydrogen ion concentration at which a protein can combine practically with neither acid nor alkali, and this hydrogen ion concentration, which may be different for different proteins, is called the isoelectric point. The isoelectric point is (in terms of Sörensen's logarithmic symbol) for gelatin and casein at p_H 4.7; for crystalline egg albumin at p_H 4.8. Gelatin can combine with acid only or practically only when the p_H is less than 4.7 and with alkali only or practically only when the p_H is higher than 4.7. Or in other words, when a salt, *e. g.*, $NiCl_2$, is added to gelatin solutions of different p_H, Ni gelatinate can only be formed when the p_H is greater than 4.7; and when $K_4Fe(CN)_6$ is added gelatin-$Fe(CN)_6$ can only be formed when the p_H is less than 4.7. This can be shown by methods discussed in a recent book.[2]

[2] Loeb, J.: "Proteins and the Theory of Colloidal Behavior," New York and London, 1922.

The proof that proteins combine stoichiometrically with acids and alkalies can be furnished by titration curves. For this purpose (and perhaps for work with proteins in general) it is necessary to use as standard material protein of the p_H of the isoelectric point. We have seen that proteins combine with acids only at a p_H below that of the isoelectric point, which for gelatin or casein is about p_H 4.7 and for crystalline egg albumin 4.8. It happens that at a p_H below 4.7 most of the weak dibasic and tribasic acids dissociate as monobasic acids. Thus H_3PO_4 dissociates into H^+ and the monovalent anion $H_2PO_4^-$. Hence if acids combine stoichiometrically with isoelectric protein, it should require exactly three times as many cc. of 0.1 N H_3PO_4 to bring a 1 per cent. solution of an isoelectric protein, *e. g.*, gelatin or crystalline egg albumin or casein, to the same hydrogen ion concentration, *e. g.*, p_H 3.0, as it requires of 0.1 N HCl or HNO_3. Titration experiments show that this is the case. Furthermore, since H_2SO_4 is a strong acid, splitting off both hydrogen ions even at a p_H below 4.7, the same number of cc. of 0.1 N H_2SO_4 as of HCl should be required to bring 1 gm. of isoelectric protein in 100 cc. of solution to the same p_H, *e. g.*, 3.0, and this was found also to be true.

Fig. 1 gives the titration curves for crystalline egg albumin for four acids, HCl, H_2SO_4, H_3PO_4, and oxalic acid. One gram of isoelectric albumin was in 100 cc. H_2O containing

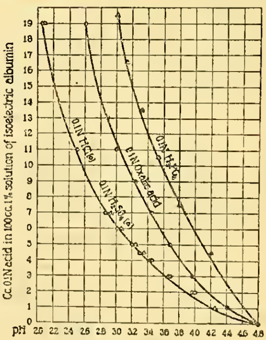

FIG. 1

various cc. of 0.1 N acid. These cc. of 0.1 N acid in 100 cc. solution are the ordinates of the curves in Fig. 1. The abscissæ are the p_H to which the protein solution was brought by the addition of acid. It takes always exactly three times as many cc. of 0.1 N H_3PO_4 as it takes cc. of 0.1 N HCl or H_2SO_4 to bring 1 gm. of isoelectric albumin in 100 cc. solution to the same p_H. In order to bring the 1 per cent. solution of originally isoelectric albumin to p_H 3.2, 5 cc. of 0.1 N HCl or H_2SO_4 and 15 cc. of 0.1 N H_3PO_4 must be contained in 100 cc. of the solution. To bring the albumin to p_H 3.4, 4 cc. of 0.1 N HCl or H_2SO_4 and 12 cc. of 0.1 N H_3PO_4 must be contained in the solution, and so on.

Oxalic acid is, according to Hildebrand, a monobasic acid at a p_H of 3.0 or below, but begins to split off the second hydrogen ion in increasing proportion above p_H 3.0. The titration curves show that about twice as many cc. of 0.1 N oxalic acid as 0.1 N HCl are required to bring the 1 per cent. solution of isoelectric albumin to the same p_H below 3.0, while it takes less than twice as many cc. of 0.1 N oxalic acid as 0.1 N HCl to bring the albumin solution to the same p_H if the p_H is above 3.0.

It can be shown in the same way with the aid of titration curves that isoelectric albumin combines with alkalies in the same stoichiometrical way as any acid, *e. g.*, acetic acid, would combine with the same alkalies. If the cc. of 0.1 N KOH, NaOH, $Ca(OH)_2$, or $Ba(OH)_2$ in 100 cc. solution required to bring a 1 per cent. solution of isoelectric protein to the same p_H are plotted as ordinates over the p_H of the protein solution as abscissæ, it is found that the values for all four alkalies fall on one curve as they should if the combination occurred strictly stoichiometrically.

The same stoichiometrical results were obtained also with casein and gelatin by the writer, and with edestin and serum globulin by Hitchcock. There is little doubt that they will be obtained in the case of all proteins. It follows from this that proteins react with acids and alkalies in the same way as do amphoteric crystalloids like amino-acids. If the methods for measuring the hydrogen ion concentrations of protein solutions had been employed by the colloid chemists nobody would have thought of suggesting that proteins react with acids and alkalies according to the empirical adsorption formula of Freundlich instead of stoichiometrically.

The purely chemical character of the combination of proteins with hydrochloric acid can also be demonstrated by measuring the chlorine ion concentration of the solutions of protein chloride. When HCl is added to NH_3 (according to Werner) the H ions of the HCl are attracted to the nitrogen of the ammonia, while the Cl ions remain unaltered. The same type of reaction occurs when HCl is added to a solution of isoelectric gelatin. This was proven by measurements of the p_{Cl} of solutions of gelatin chloride. Different cc. of 0.1 N HCl were contained in 100 cc. of 1 per cent. solutions of originally isoelectric gelatin and the p_H and p_{Cl} of the solutions were measured, the p_H with the hydrogen electrode and the p_{Cl} with the calomel electrode. It was found that the p_{Cl} was the same as if no gelatin had been present while the p_H was, of course, higher; thus showing that part of the hydrogen combines with the NH_2 and NH groups of the protein molecule while the Cl remains free (Table I). Dr. Hitchcock has obtained similar results with crystalline egg albumin, edestin, casein, and serum globulin, by using a silver chloride electrode, so that it is possible to state that these results are true for most if not all proteins.

TABLE I

Cubic centimeters of 0.1 N HCl in 100 cc. solution	Solution containing no gelatin		Solution containing 1 gm. of isoelectric gelatin in 100 cc.	
	p_H	p_{Cl}	p_H	p_{Cl}
2	2.72	2.72	4.2	2.68
3	2.52	2.54	4.0	2.53
4	2.41	2.39	....	....
5	2.31	2.29	3.60	2.33
6	2.24	2.26	3.41	2.25
7	2.16	2.18	3.23	2.18
8	2.11	2.12	3.07	2.11
10	2.01	2.01	2.78	2.025
15	1.85	1.85	2.30	1.845
20	1.72	1.76	2.06	1.76
30	1.55	1.59	1.78	1.60
40	1.43	1.47	1.61	1.47

The titration curves prove another fact, namely, that the salts of proteins are strongly hydrolyzed. When we add acid, *e. g.*, HCl, to isoelectric protein, part of the acid combines with the protein giving rise to protein chloride, while the rest of the acid remains free. There is then an equilibrium between free HCl, protein chloride, and non-ionogenic (or isoelectric) protein. The more acid is added to originally isoelectric protein, the more protein chloride is formed until finally all the protein exists in the form of protein chloride. It is possible to find out from the p_H measurements how much of the acid added is free and by deducting this value we know how much is in combination with the protein. By saturating the protein with acid the combining weight of a protein with acid can be found. Hitchcock found in this way that the combining weight of gelatin is about 1090.

III

The colloidal behavior of proteins shows itself in a peculiar effect of electrolytes—acids, alkalies or salts—on such properties as the swelling of gels or the osmotic pressure or viscosity of protein solutions. All these properties, swelling, osmotic pressure, viscosity, are affected by electrolytes in a very similar way; suggesting that all are due to the same cause. We shall see that by giving the explanation for one of these properties, osmotic pressure, we shall by implication give the explanation for all of them.

Measurements of the osmotic pressure of solutions of a protein—gelatin, crystalline egg albumin, casein and edestin—were made with solutions containing 1 gm. dry weight of originally isoelectric protein in 100 cc. of solution; and the 100 cc. of solution included also varying concentrations of 0.1 N acid. These solutions were put into collodion bags suspended in water free from protein. The outside water was at the beginning of the experiment brought to the same p_H as that of the protein solution, using always the same acid as that added to the protein. The measurements of the osmotic pressure were read after 18 hours when osmotic equilibrium was established. It was found that the osmotic pressure varied in a characteristic way with the p_H of the protein solution and the valency of the anion of the acid used. This effect is shown in the curves in Fig. 2 which were obtained from gelatin solutions. But the curves are similar in the case of other proteins such as crystalline egg albumin, casein or edestin. These curves show that the osmotic pressure of a protein solution is a minimum at the isoelectric point, that it increases when little acid is added until a maximum is reached, and that on the further addition of acid the osmotic pressure is again diminished. They show, moreover, that only the valency and not the nature of the anion of the acid influences the osmotic pressure of a protein solution. We know from the titration curves that in the case of H_3PO_4 the anion in combination with the protein is not the trivalent PO_4 but the monovalent H_2PO_4; and the curves in Fig. 2 show that the influence of phosphoric acid and hydrochloric acid on the osmotic pressure is the same if measured for the same p_H of the protein solution. Oxalic acid is a monobasic acid below p_H 3.0 and we notice that the descending branch of the oxalic acid curve below p_H 3.0 practically coincides with the descending branch of the HCl curve. The curve for the influence of H_2SO_4 is only about half as high as that for HCl and we know from the titration curves that the anion of protein sulfate is bivalent. It was found that all monobasic acids, *e. g.*, HBr, HNO_3, acetic acid, etc., and all weak dibasic or tribasic acids, *e. g.*,

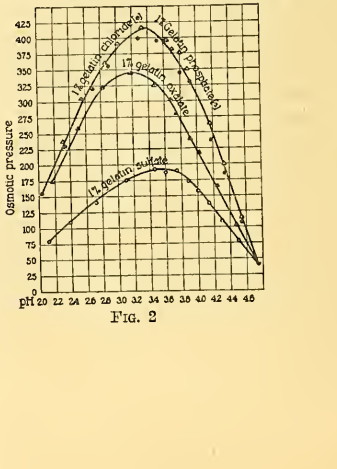

Fig. 2

tartaric, malic, citric, etc., which below p_H 4.7 dissociate as monobasic acids, give osmotic pressure curves identical with those for HCl and H_3PO_4. We may, therefore, draw the conclusion that only the valency but not the nature of the acid influences the osmotic pressure of protein solutions, that all acids which are monobasic on the acid side of the isoelectric point of a protein influence its osmotic pressure in the same way, and that this influence is considerably greater than the influence of strong dibasic acids like H_2SO_4.

If alkali is added to a solution of isoelectric protein it can be shown that the addition of little alkali increases the osmotic pressure until a maximum is reached when the addition of more alkali depresses the osmotic pressure again. All alkalies with monobasic cation like Li, Na, K, NH_4, have the same effect at the same p_H, while alkalies and all dibasic cations like Ca or Ba act alike, the curve for the effect of the alkalies with divalent cation being only about half as high as that of the alkalies with monovalent cation.

A third fact (discovered by R. S. Lillie) is that the addition of salts to a solution of a protein salt always depresses the osmotic pressure.

The curves representing the influence of acids and salts on the osmotic pressure are almost identical or very similar to those representing the influence of the same acids and salts on swelling and viscosity. These results are specific for colloidal behavior and any theory of colloidal behavior will have to give not only a qualitative but a quantitative theory of these curves.

It was suggested by Zsigmondy that the influence of acid on osmotic pressure was due to an influence on the degree of dispersion of the protein in solution, but since the degree of dispersion can not be accurately measured, this suggestion is only a qualitative speculation. But it is of no use even as a qualitative speculation since it fails to account for the fact that viscosity and swelling are affected in a similar way as osmotic pressure. The correct explanation is as follows: When acid (or alkali) is added to a solution of an isoelectric protein, part or all of this is transformed into an ionizable protein salt according to the amount of acid added. This ionization of the protein causes the colloidal behavior on account of the inability of protein ions to diffuse through membranes which are easily permeable to crystalloidal ions, such as collodion or parchment membranes or the walls of capillaries or probably of all cells. Now it was shown by Donnan that whenever the diffusion of one type of ions such as colloidal ions is prevented by a membrane which is readily permeable to crystalloidal ions, an unequal distribution of the diffusible crystalloidal ions results on the opposite sides of the membrane. This unequal distribution of diffusible crystalloidal ions is the cause of the colloidal behavior of proteins.

IV

When a collodion bag is filled with a solution of gelatin chloride of p_H 3.0 and the bag is immersed in an aqueous solution of HCl also of p_H 3.0 but free from protein, acid is driven from the protein solution into the outside aqueous solution free from protein. Donnan has shown thermodynamically that when osmotic equilibrium is established the products of the concentrations of each pair of oppositely charged diffusible ions (*e. g.*, H and Cl in the case of gelatin chlroide) are equal on the opposite sides of the membrane. Let x be the molar concentration of the H and Cl ions on the outside, y the molar concentration of the free H and Cl ions inside the protein solution, and z the concentration of the Cl ions in combination with the protein; then equilibrium is defined by the following equation, first used by Procter and Wilson to explain the influence of acid on swelling,

$$x^2 = y(y + z) \qquad (1)$$

The first step in an attempt to explain the influence of acids, alkalies and salts on the osmotic pressure of protein solutions is to find out whether the variations in osmotic pressure under the influence of acids as shown in Fig. 2 are accompanied by corresponding differences in the concentration of diffusible ions inside and outside the protein solution and whether these differences can be calculated from Donnan's equilibrium equation (1).

The writer was able to show that this is true by making measurements of a property of protein solutions, which had received little if any attention in colloid chemistry, namely, the measurements of the membrane potentials existing between a protein solution and the surrounding aqueous solution at the time of osmotic equilibrium.

Donnan's equilibrium formula can be written in the form

$$\frac{x}{y} = \frac{y+z}{x}$$

where $\frac{x}{y}$ is the ratio of the molar concentration of the hydrogen ions outside to the concentration of the hydrogen ions inside, while $\frac{y+z}{x}$ is the ratio of the molar concentration of the chlorine ions inside to that outside. Donnan had shown that there should exist a potential difference between the inside and outside solutions, which at 24° C. should be equal to $59 \times \log \frac{x}{y}$ millivolts or $59 \times \log \frac{y+z}{x}$ millivolts. Since p_H inside is $= -\log y$ and p_H outside is $= -\log x$, $\log \frac{x}{y}$ is equal to p_H inside minus p_H outside. p_H inside and p_H outside can be determined directly with the aid of the hydrogen electrode; $\log \frac{y+z}{x}$ is equal to p_{Cl} outside minus p_{Cl} inside and this quantity can be measured directly by titration or with the silver chloride electrode.

On the other hand, the P.D. between the protein solution and the surrounding aqueous solution across a collodion membrane can be measured directly with the aid of a Compton electrometer and a pair of identical indifferent calomel electrodes (and saturated KCl). If the unequal distribution of diffusible crystalloidal ions (*e. g.*, H and Cl in the case of gelatin chloride) on the opposite sides of the membrane is really determined by the Donnan equilibrium, then the P.D. observed directly with the pair of identical calomel electrodes should be equal to the P.D. calculated in millivolts from the values $59 \times$ (p_H inside minus p_H outside) or from $59 \times$ (p_{Cl} outside minus p_{Cl} inside), where p_{Cl} or p_H may be obtained by titration or by the silver chloride or hydrogen electrodes respectively. The writer has made these measuremeents and found that when various quantities of acid are added to solutions of isoelectric protein—*e. g.*, crystalline egg albumin, or gelatin, or casein—the observed membrane potentials always agree with the membrane potentials calculated on the basis of Donnan's equation within one or two millivolts, *i. e.*, within the limits of accuracy of the measurements.

The net result of extensive measurements of membrane potentials was, first, that when a protein solution, enclosed in a collodion bag (impermeable to protein ions but permeable to crystalloidal ions), is in osmotic equilibrium with an outside aqueous solution, the concentrations of crystalloidal ions in the protein solution and in the outside aqueous solution are not the same; and second, that the difference in the two concentrations can be calculated from Donnan's equilibrium equation.

V

We are now in a position to explain the osmotic pressure curves in Fig. 2. The colloid chemists would have taken it for granted that such curves were due to an influence of the acids on the state of dispersion or on some other real or imaginary colloidal property of proteins. Before we have a right to indulge in such speculations we must realize that these curves of observed osmotic pressure are not exclusively the expression of the osmotic pressure due to the protein particles, or protein molecules, and protein ions alone, but are also the result of the demonstrable unequal concentrations of the crystalloidal ions on the opposite sides of the membrane, caused by the establishment of a Donnan equilibrium. In other words, the observed osmotic pressure of a protein solution needs a correction due to the Donnan equilibrium before we can begin to speculate on the cause of the influence of acid on these curves, and it is our purpose to calculate the value of this correction.

We begin with the curve expressing the influence of HCl on the osmotic pressure of a 1 per cent. solution of originally isoelectric gelatin and we consider the distribution of ions inside the protein solution and in the aqueous solution outside the collodion bag containing the protein solution at osmotic equilibrium. We also assume complete electrolytic dissociation of gelatin chloride as well as HCl. Let a be the molar concentration of the protein molecules and ions, let z be the molar concentration of the Cl ions in combination with the ionized protein, let y be the molar concentration of the hydrogen ions of the free HCl inside the protein solution; the molar concentration of the Cl ions of this HCl is also y. In that case the osmotic pressure of the protein solution is determined by

$$a + 2y + z$$

From this must be deducted the osmotic pressure of the HCl of the outside aqueous solution. If x is the molar concentration of the H ions of the outside solution, it is also the molar concentration of the Cl ions. Hence the observed osmotic pressure of a protein solution is determined by the following molar concentration,

$$a + 2y + z - 2x$$

Fig. 2 shows how this value varies with the p_H of the protein solution (*i. e.*, y). In order to arrive at a theory concerning the influence of HCl on the osmotic pressure of protein solutions it is necessary to calculate the value of $2y + z - 2x$ and to deduct it from the observed osmotic pressure of the protein solution. The term $2y + z - 2x$ we will call the Donnan correction. In this term y and x can be calculated from the measurements of the p_H, p_H inside being $-\log\ y$ and p_H outside being $-\log\ x$. z can be calculated from x and y with the aid of the Donnan equation (1)

$$z = \frac{(x + y)(x - y)}{y}$$

since we now know that x and y are determined by the Donnan equilibrium. If the value of $2y + z - 2x$ is calculated for different p_H of a gelatin chloride solution (of the same concentration of originally isoelectric gelatin which in this case was 1 per cent.); and if from this value is calculated the osmotic pressure due to this excess of the molar concentration of crystalloidal ions inside the protein solution over that outside, it is found that the curve for the Donnan correction is almost identical with the curve for the observed osmotic pressure. In other words, it turns out that the increase in osmotic pressure of a 1 per cent. solution of originaly isoelectric gelatin upon the addition of little acid until a maximum is reached, and the diminution of osmotic pressure upon the addition of further acid are not due to any variation in the state of dispersion of the protein, or any other real or imaginary "colloidal" property of the protein, but purely to the fact that protein ions can not diffuse through the collodion membrane which is easily permeable to crystalloidal ions; as a consequence of which the molar concentration of the crystalloidal ions must always be greater inside the protein solution than outside. What varies with the p_H of the gelatin solution is the quantity of the excess of $2y + z$ over $2x$. This follows from the Donnan equation (1) according to which

$$x = \sqrt{y^2 + yz} \text{ or } 2x = \sqrt{4y^2 + 4yz}$$

while

$$2y + z = \sqrt{4y^2 + 4yz + z^2}$$

Now it is obvious that

$$\sqrt{4y^2 + 4yz + z^2} > \sqrt{4y^2 + 4yz}$$

i. e., the concentration of the crystalloidal ions inside the protein solution $2y + z$ is always greater than the concentration of the crystalloidal ions $2x$ outside, when z is not 0 or ∞.

If we substitute for the term $2y + z - 2x$ of the Donnan correction the identical term

$$\sqrt{4y^2 + 4yz + z^2} - \sqrt{4y^2 + 4yz}$$

we can visualize why the osmotic pressure is a minimum at the isoelectric point, why it increases with the addition of little acid, reaching a maximum, and why it diminishes again with the addition of more acid.

At the isoelectric point no protein is ionized and z being zero, the whole term

$$\sqrt{4y^2 + 4yz + z^2} - \sqrt{4y^2 + 4yz}$$

becomes zero. Hence at the isoelectric point the observed osmotic pressure is purely that due to the protein, which is very low on account of the high molecular weight of gelatin.

When little acid, *e. g.*, HCl, is added to the solution of isoelectric gelatin, gelatin chloride is formed and some free acid remains, due to hydrolytic dissociation. Hence both z (the concentration of Cl ions in combination with protein) and y (the Cl ions of the free HCl existing through hydrolysis) increase, but z increases at first more rapidly than y and hence the excess of concentration of ions inside over that of ions outside increases until the greater part of protein is transformed into protein chloride, when the excess of crystalloidal ions inside over those outside reaches a maximum. From then on z increases comparatively little while y increases considerably with further addition of acid, so that z becomes negligible in comparison with y. This explains why the Donnan correction becomes zero again when enough acid is added, and why the observed osmotic pressure becomes as low again as at the isoelectric point.

In the same way it can be shown why the addition of salt has only a depressing effect on the osmotic pressure. Let us assume that there is inside the bag a gelatin chloride solution of p_H 3.0 to which NaCl is added. z (the concentration of Cl ions in combination with the gelatin) will not increase with the addition of salt, while y (the concentration of the Cl ions *not* in combination with gelatin) will increase. Hence with the increase in the concentration of the salt the value of

$$\sqrt{4y^2 + 4yz + z^2} - \sqrt{4y^2 + 4yz}$$

will become smaller, finally approaching zero.

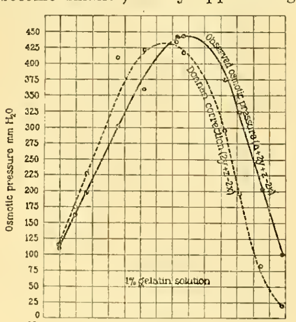

FIG. 3

When another salt than a chloride, *e. g.*, $NaNO_3$, is added to a solution of gelatin chloride, we may assume that the gelatin in solution is gelatin nitrate.

Fig. 3 gives a comparison of the curves for the observed osmotic pressure and for the Donnan correction. Both curves rise in a parallel way from the isoelectric point reaching a maximum which is 450 mm. H_2O pressure in the case of the observed osmotic pressure and slightly lower in the case of the Donnan correction. The observed osmotic pressure should be higher than the Donnan correction by the osmotic pressure due to the protein solution itself. A difference exists in the values between p_H 4.6 and 3.2 but disappears later, and this difference is in all probability the expression of value a, *i. e.*, the osmotic pressure due to the protein itself. The disappearance of this difference at p_H below 3.2 is probably due to the fact that an error of one unit in the second decimal of the p_H causes a considerable error in the calculations of z which increases when the p_H is too low.

Fig. 3 shows that when we correct the observed osmotic pressure for the Donnan effect it follows that the influence of the p_H of the acid on the osmotic pressure is entirely or practically entirely due to the excess of the concentration of crystalloidal ions inside the membrane over that outside and that this excess is caused by the Donnan equilibrium. The osmotic pressure of the protein itself is either not altered at all by the addition of acid or if it is altered the effect is too small to be noticeable. There is then nothing left for the "dispersion theory" or for any other of the colloidal speculations to explain. These results were confirmed for crystalline egg albumin and casein by the writer and for edestin by Hitchcock. We now understand why only the valency and not the nature of the ion plays a rôle in the osmotic pressure of protein solutions. The equilibrium equation is one of the second degree when the ion with which the protein is in combination is monovalent while it is of the third degree when the ion is divalent. Only the valency of the ion and not its nature enters into the Donnan equation.

We can therefore summarize these results by stating that the so-called colloidal behavior of protein solutions, as far as osmotic pressure is concerned, is merely the result of an equilibrium condition of classical chemistry which results in an excess of the concentration of crystalloidal ions inside the protein solution over that of an outside aqueous solution, when the two solutions are separated by a membrane which is permeable to crystalloidal ions but impermeable to protein ions. The colloidal behavior of proteins depends therefore entirely on the relative non-diffusibility of protein ions through membranes which are easily permeable to crystalloidal ions. Since the majority of membranes in plants and animals belong to this class, it can easily be surmised how great a rôle the proteins must play in the regulation of osmotic pressure in the body.

VI

It remains to show briefly why swelling and viscosity of protein solutions are affected in a similar way by electrolytes as is the osmotic pressure. The answer is that we are dealing in both cases with the same fundamental property, namely, osmotic pressure.

In 1910 Procter made the ingenious suggestion that the swelling of gelatin might be an osmotic phenomenon and in subsequent papers he and J. A. Wilson put this theory on a quantitative basis by deriving it from the Donnan equilibrium. They showed that the swelling of a solid gel of gelatin in hydrochloric acid can be explained quantitatively on the basis of the Donnan equilibrium on the assumption that there exists an excess of concentration of crystalloidal ions inside (in this case H and Cl) over the concentration of the same ions outside, and that the excess of osmotic pressure inside the gel over that outside due to this Donnan effect accounts for that share of the swelling which is caused by the influence of the acid. The agreement of their calculated values with the observed values is excellent. The writer is inclined to consider Procter's theory of swelling and the proof of this theory by Procter and J. A. Wilson as the most brilliant contribution to the theory of colloidal behavior next in importance only to Donnan's theory of membrane equilibria. There was only one detail left by these authors, namely, to prove the existence of membrane potentials between the gel and the surrounding aqueous solution at equilibrium. The writer was able to fill this gap and to show that the observed P.D. between gel and surrounding aqueous solution can be calculated with a fair degree of accuracy from the value p_H inside minus p_H outside with the aid of Nernst's logarithmic formula.

VII

It may seem strange that the influence of electrolytes on the viscosity of certain protein solutions should be explained in the same way, but this seems to be the case. According to Einstein's formula, the viscosity of an aqueous protein solution is a linear function of the relative volume of the solute occupied in the solution, as expressed in the formula

$$\eta = \eta_0(1 + 2.5\varphi)$$

where η is the viscosity of the solution, η_0 that of pure water, and φ the proportion of the volume of the solute to that of the solution. If, therefore, the addition of little acid to a 1 per cent. solution of isoelectric gelatin increases the viscosity of the solution until a maximum is reached and if the addition of more acid depresses the viscosity again, it follows that the addition of acid changes the relative volume occupied by the gelatin in water. This is only possible by water being absorbed by the protein and the question is how to account for this absorption of water by the protein under the influence of acid. Pauli assumed that the ionized protein surrounds itself with a jacket of water which is lacking in the non-ionized protein. If this were true, all the proteins and amino-acids should show such an influence of acid on the viscosity of their solutions. The writer found that no such influence exists in the case of amino-acids and at least one protein, namely, crystalline egg albumin; if Pauli's assumption were correct, there is no reason why crystalline egg albumin should not show the same influence of acid on viscosity which is found in the case of gelatin. The difference between gelatin and crystalline egg albumin is that the former sets to a solid gel if the temperature is not too high while the latter does not. The formation of a continuous gel in the gelatin solution is preceded by the formation of submicroscopic aggregates which occlude water and which are capable of swelling and these aggregates or precursors of the continuous gel increase in size and number on standing. To test this idea the writer made experiments with suspensions of powdered gelatin in water and found that such suspensions of powdered gelatin had a much higher viscosity than a freshly prepared solution of gelatin. This was to be expected if the influence of acid on the viscosity of proteins is due to the swelling of submicroscopic particles of gel. It harmonizes with this fact that the viscosity of solutions of crystalline egg albumin is of a low order of magnitude, which was to be expected if solutions of crystalline egg albumin contain few or no micellæ. It was found, moreover, that the viscosity of suspensions of powdered gelatin increased under the influence of acid or alkali in the same way as did the swelling of jellies or the osmotic pressure of protein solutions. The viscosities were measured at 20° C. When the suspension of powdered gelatin was melted, it was found upon rapid cooling to 20° C. that the viscosity was considerably lower and that the influence of acid had almost disappeared. By these and a number of similar experiments it was possible to prove that the similarity between the influence of electrolytes on the viscosity of gelatin solution and the influence of electrolytes on osmotic pressure is due to the fact that the influence on viscosity in such cases is in reality an influence on the swelling of submicroscopic protein particles. This proof was made complete by showing that there exists a Donnan equilibrium between powdered particles of gelatin and a surrounding weak gelatin solution.

VIII

It may not be amiss to illustrate by way of an example why it is that the neglect of measuring the hydrogen ion concentration of protein solutions necessarily leads into errors. In a paper published in 1921 by Kuhn,[3] it was intended to show that different acids of the same valency have different effects on the swelling of gelatin. In order to furnish such a proof it is necessary to start with isoelectric gelatin and to compare the effect of different acids on the swelling of this isoelectric gelatin at the same hydrogen ion concentration of the gel, since only in that case have the gels the same concentration of gelatin ions. Instead of starting with isoelectric gelatin or gelatin of a measured p_H, Kuhn failed to measure the p_H of his gelatin, though it makes quite a difference whether acid is added to isoelectric gelatin or to gelatin at another p_H. Further, instead of measuring the p_H of the gel with the hydrogen electrode, Kuhn calculated the hydrogen ion concentrations from Kohlrausch's tables as if acid had been added to water free from gelatin and as if the presence of the protein did not alter the hydrogen ion concentration. Our titration curves, however, show that when acid is added to isoelectric gelatin the hydrogen ion concentration is less than when acid is added to water free from protein. And finally, on account of the Donnan equilibrium the p_H inside and outside the gel are entirely different; yet no mention is made of the Donnan equilibrium in the paper referred to. The hydrogen ion concentrations of protein solutions which were considered as equal by Kuhn were on account of all these errors entirely different, and it is quite natural that Kuhn came to the conclusion that different monobasic acids have different effects on swelling, since it would have been a miracle if with his faulty methods he had ever compared two acids of the same p_H. The same criticism applies to all the older experiments on the influence of electrolytes on swelling in which the authors reached the conclusions that different anions of the same valency have different effects on swelling (Hofmeister series). In all these experiments the authors failed to measure the p_H of their gels and erroneously attributed effects due to differences of the p_H of the gels to the difference in the nature of the anion.

IX

We therefore come to the conclusion that the chemistry of proteins does not differ from the chemistry of crystalloids, and that proteins combine stoichiometrically with acids and alkalies forming protein salts which dissociate electrolytically. The enormously large protein ions and molecules can not diffuse freely through gels or many membranes which are easily permeable to small crystalloidal ions.

[3] Kuhn, A.: *Kolloidchem. Beihefte*, 1921, xiv, 147.

This fact leads, under proper conditions, to an unequal distribution of the diffusible crystalloidal ions between a protein solution and an outside aqueous solution; or between a protein gel and an aqueous solution. In this distribution the total concentration of crystalloidal ions is always greater inside the protein solution or inside a gel than in the surrounding aqueous solution. This is the cause of the colloidal behavior of protein solutions and protein gels. Measurements of membrane potentials have shown that this excess of the concentration of crystalloidal ions inside over the concentration of the crystalloidal ions outside the protein solution or the gel, and consequently all the effects of electrolytes on osmotic pressure, swelling and viscosity of proteins, can be calculated with a satisfactory degree of accuracy from Donnan's equilibrium equation, which is not an empirical but a rationalistic mathematical formula. We can therefore state that it is possible to explain the colloidal behavior of proteins quantitatively on the basis of a rationalistic mathematical formula. What appeared at first as a new chemistry, the so-called colloid chemistry, now seems to have been only an overlooked equilibrium condition of classical chemistry; at least as far as the proteins are concerned. The oversight was due to two facts, first, to the failure of colloid chemists to measure the hydrogen ion concentration of their solutions, which happens to be the chief variable in the case, and second, to their neglect of measuring and taking into consideration the membrane potentials of protein solutions and protein gels, which furnish the proof that the theory of membrane equilibria must be used to explain the colloidal behavior of proteins.

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THE AWARD OF THE HENRY DRAPER MEDAL

The Henry Draper medal for 1921, awarded by the National Academy of Sciences to Professor Henry Norris Russell, professor of astronomy at Princeton University, was presented to him by Dr. C. G. Abbot, assistant director of the Smithsonian Institution at the annual dinner in New York City on November 15. Dr. Abbot spoke as follows:

The brilliant and penetrating insight of Dr. Henry Norris Russell, of Princeton University, has led in recent years to a development of astronomy so rapid that it has proved thus far impossible to publish really up-to-date text-books on the subject. Before the manuscript of a text on astronomy can be prepared, much less carried through the press, new knowledge renders the treatment stale.

Dr. Russell has made basic contributions to the great problem of stellar evolution. He saw clearly that the brightness of a star as we see it depends on several factors. First, there is the intrinsic brightness of the star as a source of light. What the tallow candle is to the electric arc, so one star may be to another in the brightness of its shining surface. Secondly, the total amount of light which a star sends out depends upon its diameter. Quite recently it has been shown, for instance, that the star Alpha Orionis is three hundred times the diameter of the sun, and accordingly its cross-sectional area is ninety thousand times the cross-sectional area of the sun. Hence, if they were of equal surface brightness, the star Alpha Orionis would send out ninety thousand times as much light as the sun. In the third place, the brightness of the star depends upon its distance from the earth and falls off as the square of that distance. Thus, the sun, which is so near that it takes light eight minutes to come from it, being about two hundred thousand times as near as the next nearest star which takes light three or four years to reach the earth will appear forty million times brighter on that account.

With these conditions in mind, Dr. Russell, in collaboration with Dr. Hinks, of England, began by the application of a new photographic method of determining the distance of stars, and in 1910 published the results showing the approximate distance of 55 stars. With this and other such information which had been laboriously acquired by others, he was able to show that the red stars evidently must fall into two classes: one class sending out very much more light than our sun, and another sending out very much less, and that between these two very widely separated extremes there are no red stars intervening.

Going on, he applied the, until then little used, knowledge of the eclipsing variable stars with the most penetrating theoretical ability. For many years measurements have been going on at Harvard Observatory and elsewhere on the march of brightness of such stars as Algol, in which we see a pair of objects which in their rotation about their common center of gravity periodically eclipse each other. Dr. Russell showed how the elements of the eclipse, comprising the observed brightness and the corresponding times, could be treated in order to give probable relative values of the densities of stars in the different eclipsing systems, and with his pupil and collaborator, Dr. Shapley, who applied Russell's methods, the results for 87 stars were obtained and published in 1913.

In the meanwhile, many additional stars had been measured for distance from the earth, and by combining the information then available, Russell showed in 1913 that the stars may be divided into two extraordinary sequences which, following Hertzsprung, he called the "giants and dwarfs."

In short, the "giants" beginning with the red and going on to the yellow, white and blue, form a series of substantially equal output of light far in excess of that which is expended by our sun, and their densities, beginning with the red stars which are so rare that the material of which they are composed is more to be compared to a fairly high vacuum than to ordinary gaseous, liquid or solid densities, increase as the sequence goes on until with the blue stars the density has become much more considerable.

From this point the descending series of the dwarfs begins, and the density reaches in our yellow sun about one and one half times that of water and from this goes on to the very red and small stars whose density is as great or greater than that of the earth itself.

So regular is the light progress of this fascinating series of dwarf stars that if one merely observes the type of spectrum which one of its members possesses he can tell with reasonable limits the total amount of light which is emitted and therefore, in connection with its apparent brightness, can determine the probable distance away from the earth in space.

On the other hand, if a cluster, such, for instance, as the great cluster in Hercules which are known to be stars of substantially equal distance from the earth, contains a group of stars of approximately equal brightness ranging through all the types of spectrum from the blue to the red, it follows that they are all giants and therefore emitting light of a roughly known quantity thousands of times in excess of that emitted by the sun, and from this the distance of the cluster can be fairly well estimated. Such considerations have been pursued by Dr. Shapley in regard to a great many of the clusters of stars, and have led him to assign distances in the stellar system some tenfold in excess of those which have been generally assumed before.

Professor Russell, taking as his text the frescoes on the walls of the banquet hall which, being known as the "College Room," was decorated exclusively with scenes of college sport, replied as follows:

Team work wins in science as well as in games. But there is this important difference, that scientific team work is free cooperation; there is no coaching and no central control.

If I have done anything to deserve this medal, it is because of the many men who have contributed to these investigations. I was particularly indebted to Professor Pickering of Harvard for the encouragement that he gave to a young and unknown instructor in his science. When I talked to him about my proposed work on stellar parallaxes, he volunteered his aid and provided me with observations of the magnitudes and spectra of 300 stars, which gave me the first evidence of the existence of giant and dwarf stars. Robert Ball says that "astronomy consists in sitting up all night and doing arithmetic all day." Some men like the one thing better than the other. My part has been largely doing arithmetic. But this would not have amounted to anything without the men who were willing to sit up all night. Here, again, is scientific team work.

At Princeton we are working on double stars. If you can guess how massive a star is, you can calculate how far away it is. If you can guess at the mass of a double star you can calculate its distance. Now double stars—at least, those with spectra of the same sort—are remarkably alike in mass, so that the guess that those which we have not yet investigated are similar to those which we know about is likely to be a very good guess. In this way we have nearly finished calculating the distances of about 1,600 double stars. To calibrate our formulæ, we use parallaxes determined in other ways, which have been generously sent us (published and unpublished material alike) by Drs. Adams and Schlesinger. All the investigators of stellar distances are now playing on the same team.

Not only must astronomers cooperate in research, but they must have the aid of the physicists and chemists. To know more about the stars we must know more about atoms. In fact, we would not know anything about the stars, even their existence, if it were not for the atoms, which send us information by means of light. As we now know, each particular kind of light comes from one particular atom behaving in a particular way, each line in the spectrum is due to a special kind of atomic behavior.

As seen with the spectroscope, the white or hottest stars seem to be made of permanent gases, and the red and cooler stars to consist of metallic vapors. The difference in the character of the stars is probably not due so much to differences in constitution as to the character of the radiation given off by the atoms. If an electron is knocked off by an atom we get a new set of spectral lines. If another electron is knocked off, we may get an ultra violet spectrum, which can not be seen or even photographed, since the air is opaque to such short wave lengths. Such gases as oxygen, nitrogen and helium are hard to excite, so they do not show at low temperatures. But in the hot stars they get stirred up and become visible. In this case the metals are so knocked to pieces that they do not make themselves visible at all. All the stars may have similar composition, but, since the physical conditions are different, different elements reveal their presence in the spectra.

The relative degree of ionization of different elements (which determines the appearance of the spectra) depends on an equilibrium under the law of mass action.

I had always supposed that this law was the exclusive property of the chemist; but now it appears to be of fundamental importance in astro-physics. We need the chemist on our team, and we may help in their game too. By comparing the spectroscopic behavior of their lines in the sun, sun-spots and stars, it appears that the ionization potentials of all the elements in the periodic table between calcium and nickel are between 6 and 9 volts, increasing steadily along the series. So here astronomy gives information about properties of atoms, which have not as yet been measured in our laboratories, owing to practical difficulties. There is no limit in sight to the possibilities of team work such as this.

APPEAL ON BEHALF OF THE LEAGUE OF NATIONS FOR AID TO AUSTRIAN INTELLECTUAL WORKERS

No greater danger can threaten a civilization than the successive destruction of its homes of learning. It is beyond dispute that the war and its economic consequences have brought intellectual life in one entire region of Europe into an extremely precarious position. The machinery of intellectual life has been seriously impaired in almost all those nations of eastern Europe, to say nothing of Russia, which extend from the Baltic to the Ægean. One of them—Austria—is suffering from economic distress to a degree which threatens soon to bring all intellectual work to a standstill in the winter of 1922-1923.

The truth of this statement is demonstrated by the report which we attach to this letter. Since the report was drawn up, the situation has been greatly aggravated, and its consequences are: (1) intellectual isolation; (2) a complete lack of all the appliances which are indispensable for intellectual work; (3) the formation of an intellectual proletariat, less favorably situated than the working-class proletariat—for muscle commands better wages than brain; (4) diminishing numbers of students and a dearth of recruits of the cultured classes for the liberal professions and for the teaching staffs.

The committee on intellectual cooperation, constituted by the League of Nations, decided, at its first meeting on August 1, 1922, "expressly to call the attention of the Council of the League of Nations to the desperate situation of intellectual life in certain European countries and the urgent need of intervention." These words had special reference to the case of Austria.

At its meeting of October 4, the Council of the League of Nations requested the committee to launch an urgent appeal to universities, academies and learned societies in all countries in aid of Austrian intellectual workers and intellectual life in Austria. We have accordingly the honor, in the present letter, to invite you to organize measures of relief as soon as possible, with the object of saving one of the most cultured countries in Europe—a country which formerly possessed one of the chief centers of European civilization—from the fate of seeing its higher education and learning disappear from sheer want.

We leave it to your judgment to organize such relief measures as you may deem most practical and to employ such methods as you may consider most efficacious; we are prepared to supply you, through our secretariat, with any information or explanations which you may require. We merely beg to draw your attention to the following points:

As a result of the depreciation in the Austrian exchange, quite insignificant sums, if converted into crowns, amount to very considerable figures. For instance, we have pointed out in the attached report that, with the aid of 1,000 Swiss francs, the Academy of Science in Vienna could resume its publications, and that a sum of 500 Swiss francs would enable almost any of the great scientific associations—such as the Anthropological Society or the Society for Modern Philology—to recommence their work.

We earnestly invite the universities, academies and learned societies of the whole world to send their publications to the Austrian universities, academies and learned societies, or to organize systems of exchange with them. We urge them to conclude with the *Amba* (the Austrian "office for providing books and instruments") agreements for cooperation similar to that established with England. Such agreements would provide an excellent basis for the organization of intellectual relief and might be extended, with suitable adaptations, to other countries whose needs are similar to those of Austria.

As regards the supply of purely material requirements (such as clothing, boots, articles of primary necessity, etc.) it is suggested that agreements should be concluded with the *Zegam* (the "Central Purchase Organization for Associations of Intellectual Workers").

We further invite universities, academies and learned societies to organize the exchange of professors and lecturers with similar establishments in Austria, and we suggest that men of science should either visit Austria themselves or endeavor by means of personal intercourse to break down the wall of intellectual isolation with which that unfortunate country is surrounded.

In order to relieve the unhappy condition of Austrian professors, men of science, writers and artists, who are suffering increasingly from under-feeding, we would urge you to assist them and their families to spend their holidays abroad.

It might even be possible—and no form of assistance could be more useful or more urgently desirable—to place certain immediately available funds or foundations at the disposal of Austrian men of science and students in order to enable them to continue their researches and studies.

The aim of these suggestions, which are put forward at the beginning of a winter which may well prove decisive for the fate of Austria, is to encourage to the utmost the organization of relief measures from as wide a field and in as uniform a manner as possible.

Much can be accomplished with small means. In coming to the assistance of Austria, and of other nations whose intellectual life is in danger, you will be strengthening that sense of professional brotherhood which should unite all brain-workers, you will be taking effective and practical action to promote intellectual cooperation, and, above all, you will be helping to support civilization in the struggle against the most serious peril which threatens it. For these reasons we are confident that our appeal will not be launched in vain.

For the committee on intellectual cooperation:

H. Bergson,
of the "Académie Française,"
President

G. de Reynold,
Professor of Berne University,
Rapporteur

O. de Halecki,
Professor of Warsaw University,
Secretary

Geneva,
November 4, 1922

SCIENTIFIC EVENTS

LONDON BIRD SANCTUARIES[1]

The committee on the establishment of bird sanctuaries in the royal parks, appointed by

[1] From the London *Times*.

Lord Crawford last year, has already added to the amenities of London. Early this spring small enclosures in Hyde Park and Kensington Gardens were prepared by suitable fencing, a small amount of planting, and exclusion of tidying gardeners. The birds accepted the hospitality; no fewer than twenty species, including willow wrens, great and blue tits, redbreasts and lesser whitethroats, spotted flycatchers, carrion crows, tawny owls, pheasants and moorhen nested there this year. According to a report just issued by the committee, it is proposed to extend these successful experiments. In Hyde Park the bank near the framehouse and an enclosure beside the magazine are to be allowed to grow wild, and some planting of suitable shrubs is to be carried out. The area on the east side of the Long Water in Kensington Gardens and a smaller enclosure on the west side are to be sanctuaries. The Duck Island in St. James's Park, two or three sites in Buckingham Palace Gardens, by consent of His Majesty, the islands in the lake in Regent's Park, the wilderness in Greenwich Park, and the Isabella Plantation in Richmond Park are all to be prepared and reserved. These admirable sanctuaries, due to the initiation of Mr. Harold Russell, a well-known London ornithologist, cost little, give pleasure to many, and will not incommode a single human being. They are not to incommode even the London cats, for the committee, after consultation with the Office of Works, decided that there was no practical cat-proof fence. But war is declared against the grey squirrels, absolute to extermination in Richmond Park, and intermittent in Hyde Park and Kensington Gardens. Public sentiment will be on the side of these pleasant rogues. The charge against them, of being habitual robbers of nests, is not proven, but, were it so, there are fences in the London Zoo which retained them, and which, therefore, could exclude them from the sanctuaries. Their charm persists through the year, and is, indeed, even greater in the bleak months when the migrant birds have left their sanctuaries bare. But perhaps they will succeed in defeating even Lord Crawford's competent committee.

THE AMERICAN ELECTROCHEMICAL SOCIETY

The forty-third semi-annual meeting of the American Electrochemical Society will be held in New York City, at the Hotel Commodore, on May 3, 4 and 5, 1923. The principal attractions of the technical program will be a whole day session on the general topic: "The Production and Application of the Rarer Metals." The arrangements for this session are in charge of Dr. F. M. Becket, of the Electrometallurgical Corporation, New York City. There will be papers on vanadium, tungsten, cobalt, molybdenum, zirconium, cerium, uranium, tantalum, calcium, magnesium and others.

Among the speakers will be:

H. N. McCoy, president of the Carnotite Reduction Company, of Chicago.

H. W. Gillett, of the Bureau of Mines, Ithaca, N. Y.

B. D. Saklatwalla, of the Vanadium Corporation.

F. E. Carter, of the Baker Platinum Works, Newark, N. J. (paper on platinum).

H S. Cooper (paper on zirconium metal).

J. A. Holladay, of the Eletrometallurgical Corporation (paper on analyses).

M. A. Hunter, of the Rensselaer Polytechnic Institute, Troy, N. Y. (two papers; one on Ti).

Mr. Clancy (paper on alloys as catalyzers)

Mr. Cutter, of the Climax Molybdenum Company.

Russel Lowe, Bario Metal Corporation (paper on bario metal).

Colin G. Fink, secretary of the society (paper on tungsten).

C. E. Minor, Aravaipo Leasing Company, Klondyke, Graham County, Arizona.

W. R. Whitney, director of research laboratories, General Electric Company, Schenectady, N. Y.

Another session will be devoted to a discussion of "Electrode potentials," headed by Dr. Wm. G. Horsch, of the Chile Exploration Company, New York. The papers will cover studies on:

(*a*) Reversible electromotive force.
(*b*) Overvoltage.
(*c*) Ion activities and dissociations.
(*d*) Electro-titration.
(*e*) p_H determinations.

The headquarters of the society are at Columbia University, New York City.

PROFESSOR MAX WEBER

THERE is printed in *Nature* the following letter addressed on December 5 to Professor Max Weber, of Amsterdam:

You celebrate your seventieth birthday to-day, and we, who are your colleagues and are but a few of your many friends in England, join together to congratulate you and to wish you many years to come of work and happiness. By your long life of teaching aand research, by your leadership of the *Siboga* Expedition, by your great handbook of the Mammalia, and by innumerable other important publications, you have come to be the acknowledged leader of zoology in the Netherlands and to be recognized far and wide as one of the most distinguished naturalists of our time. Your solid learning has upheld the great scientific traditions of your country, your investigations have influenced and stimulated many of us, your broad interests, your singleness of purpose, the simplicity of your life, and your genius for friendship have set an example to us all.

The letter is signed by the following leading British naturalists:

A. Alcock, E. J. Allen, Chas. W. Andrews, J. H. Ashworth, W. Bateson, Gilbert C. Bourne, W. T. Calman, Geo. H. Carpenter, Wm. J. Dakin, Arthur Dendy, J. C. Ewart, F. W. Gamble, J. Stanley Gardiner, Walter Garstang, James F. Gemmill, Sidney F. Harmer, J. R. Henderson, W. A. Herdman, Sidney J. Hickson, Jas. P. Hill, Wm. Evans Hoyle, J. Graham Kerr, E. W. MacBride, W. C. McIntosh, Doris L. Mackinnon, P. Chalmers Mitchell, C. Lloyd Morgan, Edward B. Poulton, R. C. Punnett, C. Tate Regan, G. Elliot Smith, Oldfield Thomas, D'Arcy W. Thompson, D. M. S. Watson, A. Smith Woodward.

OFFICERS OF THE AMERICAN CHEMICAL SOCIETY

DR. EDWARD C. FRANKLIN, professor of organic chemistry of Leland Stanford Junior University, has been elected, as already announced, president of the American Chemical Society, succeeding Dr. Edgar F. Smith, formerly provost of the University of Pennsylvania.

Dr. Wilder D. Bancroft, of Cornell University, was reelected a director of the society and William Hoskns, consulting chemist, of Chicago, was made a new director of the society. The following councilors-at-large for the period from 1923 to 1925 also were elected: Drs. Roger Adams, University of Illinois; G. N. Lewis, University of California; Ralph H. McKee, Columbia University, and William McPherson, the Ohio State University.

Dr. Franklin was born at Geary City, Kansas, in 1862. He was graduated from the University of Kansas in 1888 and received his master's degree in 1890. He was a student at the University of Berlin in 1890-91; he received the degree of doctor of philosophy at Johns Hopkins University in 1894. He was a member of the advisory board of the U. S. Bureau of Mines in 1917-18; physical chemist of the U. S. Bureau of Standards and consulting chemist of the Ordnance Bureau of the Army during the war. Dr. Franklin's work on liquid ammonia as an electrolitic solvent is familiar to all chemists. In addition to his university work, he also was in industrial work for a number of years, serving in the sugar industry and also in the gold mining industry. In the latter work he was stationed at Miramar, Costa Rica, in 1897.

Dr. Franklin was chosen from among the four nominees for president of the society who received the largest number of votes from members of the society. The choice among these four was determined by a vote of the councilors. The three other leading candidates were Dr. James F. Norris, of Massachusetts Institute of Technology, Professor Samuel S. Parr, of the University of Illinois, and Dr. Charles L. Reece, chemical director of E. I. du Pont de Nemours and Company, of Wilmington, Delaware.

THE HAYDEN AWARD OF THE PHILADELPHIA ACADEMY

THE Academy of Natural Sciences of Phildelphia announces the selection of Professor Alfred Lacroix, president of the Geological Society of France, as the recipient of the "Hayden Memorial Geological Award" for 1923. This award was created by a deed of trust made with the academy, on April 11, 1888, by Mrs. Emma W. Hayden, widow of Dr.

Ferdinand V. Hayden, one time director of the United States Geological Survey, "as a reward for the best publication, exploration, discovery or research in the sciences of geology and paleontology." The award consists of a gold medal, and is made every three years. Previous to 1900 the award consisted of a bronze medal and was made annually.

Professor Lacroix was born February 4, 1863, at Mâcon, province of Saône-et-Loire, France. Educated at the Lycée of Mâcon, at the Sorbonne and at the Collège of France, he received the degree of doctor of science in 1889. In 1893 he was made professeur at the Muséum d'Histoire Naturelle, and in 1896, director of the Laboratoire de Minéralogie, École des Hautes Études. In 1904 he was elected a member of the Académie des Sciences, and ten years later he became Secrétaire perpetual of the Section of Physics of the Académie. Professor Lacroix's numerous and important publications and discoveries, as well as his exhaustive studies of Mont Pelée, of the phenomena of contact metamorphism and endomorphic metamorphism are familiar to all geologists.

The committee by whom the nominee for the 1923 award was selected consisted of Dr. Richard A. F. Penrose, Jr., *chairman,* Dr. John M. Clarke, Dr. Henry Fairfield Osborn, Dr. Charles D. Walcott and Dr. Edgar T. Wherry.

Previous recipients of the Hayden award were: 1890, James Hall; 1891, Edward D. Cope; 1892, Eduard Suess; 1893, Thomas H. Huxley; 1894, Gabriel August Daubrée; 1895, Karl A. von Zittel; 1896, Giovanni Capellini; 1897, A. Karpinski; 1898, Otto Torrell; 1899, Gilles Joseph Gustave Dewalque; 1902, Archibald Geikie; 1905, Charles D. Walcott; 1908, John Mason Clarke; 1911, John C. Branner; 1904, Henry Fairfield Osborn; 1917, William M. Davis; 1920, Thomas Chrowder Chamberlin.

SCIENTIFIC NOTES AND NEWS

A PORTRAIT of Sir Joseph Thomson, by Mr. Fiddes Watt, has been presented by a number of subscribers to the Royal Society.

DR. FRIDTJOF NANSEN, who recenty received the Nobel peace prize, received a further award when it was announced by the Nobel Committee that Christian Erichsen, of Copenhagen, had granted another award to Dr. Nansen equal in value to the Nobel peace prize, in recognition of his work on behalf of the starving millions of Europe. Dr. Nansen proposes to use the prizes for relief work.

DR. IRVING LANGMUIR, research chemist of the General Electric Company, has been elected an honorary member of the Royal Institution, London.

EDWARD LONGSTRETH MEDALS were presented by the Franklin Institute, Philadelphia, on December 20 to Dr. A. H. Pfund, of Baltimore, for his cryptometer, paint film gauge, colorimeter and rotating sector, and to Mr. Edward J. Brandt, of Watertown, Wis., for his automatic cashier.

WE learn from the *Bulletin* of the American Mathematical Society that on the occasion of the celebration of its seven hundredth anniversary the University of Padua conferred its honorary doctorate on Professors R. C. Archibald, of Brown University, J. Lipka, of the Massachusetts Institute of Technology, and V. Snyder, of Cornell University.

THE University of Frankfort and the Zurich Technical School have conferred honorary degrees on Dr. David Hilbert, professor of mathematics at Göttingen, on the occasion of his sixtieth birthday.

DR. E. H. STARLING, professor of physiology in the University of London, has been appointed the first Foulerton professor under the foundation of the Royal Society created by the will of the late Miss L. A. Foulerton.

SIR GEORGE GREENHILL has been awarded a pension by the British government in recognition of his services to science and his ballistic work.

ON December 8 the members of the department of botany of the Ohio State University and friends celebrated with a dinner the completion of twenty-five years of service of Professor John H. Schaffner in the department.

DR. FRANCIS CARTER WOOD, director of the Institute of Cancer Research, Columbia University, received an "honorary degree" from the Radiological Society of North America, on December 7, 1922, in recognition of his experimental researches on X-ray and cancer.

Franklin Thomas, professor of civil engineering at the California Institute of Technology, was recently elected a member and vice-chairman of the Board of Directors of the City of Pasadena, Calif. He is first vice-president of the Pasadena Chamber of Commerce.

Professor Edson S. Bastin, chairman of the department of geology in the University of Chicago, has been appointed a member of the State Board of Natural Resources and Conservation by the governor of Illinois. Professor John Merle Couler, head of the department of botany, is already a member of the board.

Professor Joseph Eugene Rowe, head of the department of mathematics in the College of William and Mary, was the official delegate from the State of Virginia at the annual meeting of the American Society of Mechanical Engineers held in New York City during the week of December 4.

At the annual general meeting of the Faraday Society, London, held on November 20, Sir Robert Robertson was elected president. The vice-presidents are: Professor C. H. Desch, Professor F. G. Donnan, Dr. J. A. Harker, Professor T. M. Lowry, W. Murray Morrison, Professor J. R. Partington and Dr. G. Senter.

John Oliver La Gorce, associate editor of the *National Geographic Magazine* and trustee of the National Geographic Society was elected a vice-president of the society on December 13.

At a general meeting of the members of the Royal Institution held on December 4, Sir Arthur Keith was elected secretary in succession to the late Colonel E. H. Grove-Hills.

Dr. I. P. Tolmachoff, formerly chief keeper of the Geological Museum at Petrograd, has been appointed curator of invertebrate paleontology in the Carnegie Museum at Pittsburgh, Pa. Dr. Tolmachoff, who has been in Vladivostok for some time, has arrived in Pittsburgh and assumed his new duties.

Julius Matz, pathologist of the Insular Station of Porto Rico, has been engaged to conduct research in agriculture for Central Porvenior, San Pedro de Macoris, Dominican Republic.

Professor L. Kahlenberg, of the chemistry department of the University of Wisconsin, lectured at the University of Illinois on December 7 on "The chemical replacement of the metals by one another."

The Academy of Sciences and the Philosophical Society of Washington held a joint meeting on December 21, when Dr. H. A. Clark, physicist of the Taylor Instrument Companies, Rochester, N. Y., delivered an address on "The manufacture of thermometers."

Dr. Ludwik Silberstein, mathematical physicist, Eastman Kodak Company, Research Laboratory, gave the following lectures at Harvard University on December 18, 19 and 20: "Oriented quantum emission and the selective principle of spectroscopy"; "Perplexities in the domain of non-hydrogenic spectra"; "Rotational terrestrial optical experiment and its bearing upon fundamental physical questions."

Dr. William T. Bovie, assistant professor of biophysics at Harvard University, will deliver the fourth Harvey Society lecture at the New York Academy of Medicine, on January 13. His subject will be "The physiological effects of light rays."

Professor R. G. Hoskins, head of the department of physiology of Ohio State University, will deliver the annual address before the Portland, Oregon, Academy of Medicine on January 11 and 12.

Spencer Baird Newberry died on November 28 at the age of sixty-five years. Dr. Newberry, a son of John Strong Newberry, was at one time professor of chemistry at Cornell University and in 1893 founded the Sandusky Cement Company. He made important contributions to the scientific study of cement.

Henry John Elwes, distinguished for his contributions to forestry and other sciences, died on November 26, at the age of seventy-six years. Mr. Elwes was a fellow of the Royal Society and had been president of the Royal Entomological Society of London and of the Royal English Arboricultural Society.

John Henry Gurney, the English naturalist and ornithologist, died at his residence, Keswick Hall, near Norwich, on November 9, aged seventy-five years.

The first of the customary lectures arranged by the Central Ohio Chapter, at the Ohio State University, of the Society of Sigma Xi, following its usual program for the encouragement of research, was a lecture with experimental demonstrations by Mr. Thomas Midgely, Jr., and Mr. T. A. Boyd, research fuel engineers of the General Motors Research Corporation of Dayton, entitled, "The chemical control by catalysis of detonation." Experimental demonstrations of the use of selenium and lead derivatives were made with internal combustion engines. The program is under the direction of the new officers of the local chapter, namely, James R. Withrow, professor industrial chemistry, president; Edward Mack, Jr., assistant professor of physical chemistry, secretary, and C. A. Norman, professor of machine design, retiring secretary.

The directors of the Fenger Memorial Fund have set aside $500 for medical investigation. The work should have a clinical bearing and if possible it should be carried out in an institution that will furnish facilities and ordinary supplies free of cost. Applications with full particulars should be sent to Dr. L. Hektoen, 637 S. Wood Street, Chicago, before January 15, 1923.

Mr. Arthur H. Helme, whose gift to the Museum of the Brooklyn Institute of Arts and Sciences of a large collection of Long Island birds and mammals was announced during the spring, has been engaged since summer in affixing labels bearing name, locality and date to all of his specimens, which, instead of the original estimate of 3,000, it has now been shown number about 4,000. This donation, together with that of Mr. Peavey, Mr. Puttfarcken and others, represents the addition of fully 5,000 specimens, all received during the present year and this signifies that the Brooklyn Museum has attained its goal in now possessing the most exclusive and authentic collection of birds and mammals from Long Island.

The Hurley expedition, which left Australia in August with a flying boat and seaplane to explore the country at the head of the Fly River, Papua, has had its plans dislocated by climatic conditions. The air pilot, who has reached Brisbane, reported that the machines were found unsuitable. Rain every night and terrific heat by day destroyed the fabric covering and made it unsafe to proceed. The only planes possible in such country must be of metal, with high horse-power.

The first number of a new Italian mathematical journal, entitled *Bolletino della Unione Matematica Italiana,* was issued under the date of October, 1922. S. Pincherle, of Bologna, is provisional president of the union.

It is announced by the United States Geological Survey, that the price of radium has decreased owing to the discovery of radium bearing ores in Africa, which are easily worked at a much lower cost than the American mines. This caused a drop from $120,000 a gram to $70,000, which is the lowest price at any time since radium has been used. In connection with Cancer Week, the Survey announced, the state of New York and the city of Philadelphia have each bought two grams for the use of their citizens, and the city of Quebec one gram.

The Seismos-Gesellschaft, of Hanover, Germany, has lately issued a pamphlet on the determination of underground geological structures and ore deposits by seismic methods, apparently an outcome of devices used in locating heavy guns in the war. The needed apparatus can be carried by two men. The work is said to be more expeditious and economical than exploration by borings. A number of sectional illustrations of investigated structures are included.

The Swedish Parliament, as reported in *Eugenical News,* voted, May 13, 1921, to establish a Swedish Institute for Race-Biology with 82,500 crowns (Swedish) in addition to the salary of the director. Of this sum, 24,000 crowns are to be utilized for the first equipment of the institute, 26,500 for working expenses, and the remainder for salaries for assistants during 1922. Work began January 1, 1922. The institute has its own council, appointed by the king and standing directly under the government. At present it is located at Upsala and the director is nominally on the university staff; but the institute is governmental rather than university department or agency. The first council comprises: H. Hammarskjöld, lord lieutenant of Upland; A. af Jocknick, Esq., director general in the Royal Committee for Pensions, Stockholm; F. Lennmahn, M.D., rector of the "Karolinska Instutet," Stockholm; Mrs. Emilia Broomé, Stockholm; J. V. Hultkranz, M.D., professor of anatomy, Upsala University; H. Nilsson-Ehle, M.D. and Ph.D., professor of heredity in Lund University (at Åkarp); H. Lundborg, M.D., director of the institute. The present staff includes: Dr. F. J. Linders, statistician, archivist and vice director; G. Dahlberg, M.D., medical assistant, at present doing anthropometric work; Dr. W. W. Krauss (formerly of Vienna), assistant anthropologist; E. Heckscher, genealogist; Mrs. G. Dahlberg, who helps her husband in anthropometric work, recorded as social worker; and Mr. E. A. Ohlsén, photographer.

UNIVERSITY AND EDUCATIONAL NOTES

Ground has been broken for the new laboratory of the department of hygiene and bacteriology at the University of Chicago to stand between the psychological laboratory on the north and the university press on the south. The building, of brick, will front 110 feet on Ellis Avenue and will contain a general laboratory, a laboratory devoted to the bacteriology and chemistry of water and foods, five research rooms, a room equipped with sterilizing devices, and an animal room.

By the will of the late General Frank Sherwin Streeter, Dartmouth College receives $50,000. A bequest of $10,000 is left to Dr. Ernest M. Hopkins, president of the college.

The council of the senate of the University of Cambridge has issued a report on the allocation of the Special Government Grant, which has now become a recurrent grant of £30,000. This is divided as follows: Professorships, £14,675; readerships, £5,304; university lectureships, £3,750; university officers, £3,240; grant to Geographical Education Fund, £250; university library, £2,000; Museum of Classical Archeology, £750.

At Indiana University, Associate Professor U. S. Hanna has been promoted to a full professorship, and Assistant Professor Cora B. Hennel to an associate professorship of mathematics.

The *Bulletin* of the American Mathematical Society states that, on the return of pre-war conditions, the U. S. Naval Academy has reduced the number of its civilian officers of instruction in academic departments by about one third. From the department of mathematics, Assistant Processors R. P. Johnson and G. F. Alrich have accepted assistant professorships at the Carnegie Institute of Technology, and Mr. L. S. Johnston an assistant professorship at Pennsylvania State College.

Dr. Raymond A. Dart, formerly of Sydney University, Australia, and recently of the anatomical department, University of London, has accepted the professorship of anatomy in the University of Witwatersrand, Johannesburg, South Africa, where a new medical college building has recently been completed. Dr. Dart came to the United States two years ago on the invitation of the Rockefeller Foundation to examine American laboratories and methods of teaching, and to help encourage the development of a better understanding and closer relations between English and American scientists teaching in medical schools. As traveling fellow of the foundation, Dr. Dart spent some time in our laboratories, and at the Marine Biological Laboratory at Woods Hole, Mass., where he was married to Miss Dora Tyree, assistant in anatomy at the University of Cincinnati.

Dr. Holburt J. Waring has been elected dean of the faculty of medicine of the University of London.

DISCUSSION AND CORRESPONDENCE

RESEARCH IN MARINE BIOLOGY

To the Editor of Science: Notices of the death of Dr. Alfred Goldsborough Mayor have referred to the lamentable possibility that the undertaking in marine biology which he directed might fail to be continued. Mr. Potts,[1] Professor Coe,[2] Dr. Davenport[3] and Dr. Schaeffer,[4] among others, have voiced or hinted at this fear, that a chief American instrument for research might be abandoned. Emphasis has been placed upon the unique opportunities until now provided by the Carnegie Institution Department of Marine Biology for investigations involving travel to more or less distant places, where material of unusually favorable type might (for a short time) be available to especially qualified students.

There is another side to this matter, and since there seems some likelihood of its being overlooked, I venture to comment upon it—for it is an aspect of marine research concerning which a continuous experience of several years as resident naturalist at the Bermuda Biological Station has given me strong convictions.

The "easy work" of zoology is to a large extent already done—although I have had expressed to me, by an eminent naturalist of the elder generation, the thought that "all the hard problems of zoology have been solved—you younger men need only to fill in the vacant spots." (Those "vacant spots"!) Research is costly. Adequate return for money and energy to be invested in biological investigation demands, and henceforth will increasingly necessitate, that the conditions attending investigative pursuits be the least unfavorable possible. Those whose varied experiences have provided an adequate background for judgment in this matter are unanimous in the conviction that the most suitable locations are to be found on the shores of tropical or semi-tropical seas. Supreme variety and abundance of animals, ease of access to them throughout the year, a comparative isolation conducive to their scholarly and productive treatment—these can be found in combination only in the warmer seas. There, some of the wasteful, merely mechanical, handicaps to fruitful research are eliminated.

It is not too much to take for granted, that studies of this nature are worth while. The financial support of numerous marine stations in America is sufficiently demonstrative. Yet if we examine the actual operation of these existing laboratories, we find that in general they are utilized for productive work during but a small portion of the year. The splendid material possessions of the Woods Hole Laboratory, to take an especially noteworthy instance, are as good as wasted, so far as research is concerned, during some eight to nine months of the year. The plain fact of the matter is that the existing American institutions for research in marine biology are either more or less unfortunately situated, with regard to climatic conditions or otherwise; or else overburdened in their potentially productive seasons by the requirements of elementary instruction—necessary work, and I speak of it only with respect; but it is not enough.

In Mayor's hands the Department of Marine Biology of the Carnegie Institution had before it two large tasks—the conduct of explorative expeditions, and the upkeep of a fixed laboratory serving as a central resort at favorable seasons. The workers at the Tortugas Laboratory being recruited from college and university staffs, and the possible season at Dry Tortugas brief at best, the actual time of the laboratory's session each year was necessarily short. The problems attackable under such conditions are limited in kinds. Some truly fundamental questions can not be faced at all without intimate knowledge of faunal conditions over extended periods of time. The notion, moreover, that "favorable material" for one kind of "problem" is to be found here in this place, for another kind there in that other place, is largely fallacious. Most naturalists acquainted with the subtropical marine fauna

[1] *Nature*, 110, 224.

[2] *Amer. Jour. Sci.*, Ser V, 4, 173.

[3] Science, N. S., 56, 134.

[4] Science, N. S., 56, 468.

have come into contact with it during only one part of the year, and are unaware of its seasonal fluctuations.

A permanent marine laboratory, adequately located, engaged actively in research during the whole year, I should suppose to be a cardinal necessity for biological development. As Mayor himself realized, the need is so obvious as to require frequent restatement; his reports, and letters from him, show that the realization of such a laboratory was for him a great hope.

In such a laboratory inquiries become possible which in other situations can hardly be undertaken at all. Temporary social isolation would perhaps have to be faced by resident investigators, and partial loss of contact with libraries; but there are compensations. Time to "sit still and think things over," on the ground, is of tremendous value in itself. The zoologist's business, I take it, is to provide an account of animals, in terms, ultimately, of the properties of materials and of their relations. An enormous segment of this task remains relatively unexplored. A truly scientific natural history of animals, prerequisite for the stability of biological theory, is still for the future. There is here a possibility of huge reward. To grasp it requires intensive work of a character which existing agencies for zoological inquiry do not make possible, for the work can not be done by means of visits to the seashore in summertime. A permanent laboratory in semitropical waters, moderately equipped, with a stationary staff, not cursed with a "program," could justify itself in this necessary work, and that without great expense.

That the only American institution for research in a position to fill this need may fail to do so, seems to me the most serious aspect of the case, rather than the possibility that another summer laboratory may be closed.

W. J. Crozier

Zoological Laboratory,
Rutgers College

ON TRANSLATING EINSTEIN

To the Editor of Science: Generally I am well pleased with whatever Dr. W. J. Humphreys writes but I can't say I like so much his pleasantly written criticism in *Science* of November 24. He says that he very much dislikes my little article on relativity in *The Scientific Monthly* of November, 1922.

> Because, giving the words used the only meanings recognized by layman and scientists alike, save a few specialists, several of the assertions are sheer nonsense. Certainly no system of equations, however clever, can prove to one of common sense, the existence of a real fourth dimension; that time and space are not wholly independent; that just because we and the Martians may be unable to synchronize our clocks there is no "now"; that time is "curved"; that a phenomenon may be seen before it happens; that the mere inclusion of gravitation in a more comprehensive expression eliminates it from nature; and so forth, and so on, through a long list of absurdities—absurd, that is, if their customary meanings be given to the words used.

It is my custom, whenever I get a new scientific book to pick out the most perplexing passage and try to put it into ordinary language. It is more fun, to my mind, than trying to solve the problem of three bodies on a billiard table and pays better. The book I had in hand was the English version of "Time—Space—Matter" by Weyl, the leading exponent of *Einsteinismus* in Germany. The paragraph I selected for translation into the vernacular was the following: (p. 274.)

> Every world-point is the origin of the double-cone of the active future and the passive past. Whereas in the special theory of relativity these two portions are separated by an intervening region, it is certainly possible in the present case for the cone of the active future to overlap with that of the passive past; so that, in principle, it is possible to experience events now that will in part be an effect of my future resolves and actions. Moreover, it is not impossible for a world-line (in particular, that of my body), although it has a time-like direction at every point, to return to the neighborhood of a point which it has already once passed through. The result would be a spectral image of the world more fearful than anything the weird fantasy of E. T. A. Hoffman has ever conjured up. In actual fact the very considerable fluctuations of the g_{ik}'s that would be necessary to produce this effect do not occur in the region of world in which we live. Nevertheless there is a certain amount of interest in

speculating on these possibilities inasmuch as they shed light on the philosophical problem of cosmic and phenomenal time. Although paradoxes of this kind appear, nowhere do we find any real contradiction to the facts directly presented to us in experience.

Now I have two favors to ask:

First, that any reader who is interested compare my little skit on "Tangling Up the Time Line" with this and see whether I have made any serious misuse of the text.

Second, that Dr. Humphreys put this same idea into five hundred words so that mathematicians would approve of it and editors accept it. I am proposing this, not because I think that Dr. Humphreys can't do it, but because I know he can. I greatly admire, and have often benefited by, his power of clear exposition and I want him to apply it in this case. I will not only thank him for it but I will pay him for it.

Somebody must do this job of translating Einstein and it ought to be done by thorough mathematicians like Dr. Humphreys rather than by outsiders like myself. I realize that translating mathematics is like translating music. Still I suppose that even the most complicated equation could be put into ordinary language though it would be so wordy and involved that nobody would read it. All that can be done is to give by illustrations and analogies some notion of the conception. I may say that, according to my custom, I submitted my version to a professor of mathematics in one of our leading universities, who specializes in Einstein and I reworked the wording twice in accordance with his suggestions although I will not incriminate him by mentioning his name.

Most of the "long list of absurdities" that Dr. Humphreys mentions are not in the article he criticizes; for instance, gravitation. I know that Einstein has not eliminated gravitation from the universe, for if he had I should have felt a sense of relief amounting to 187 pounds. What he has done is well expressed by Lord Haldane, in his "Reign of Relativity," when he says that Einstein's doctrine "has banished out of physics the necessity of attributing an objective character to gravitation," and he adds "a time may arrive when even the good old name gravitation will not be discoverable in any respectable textbook." The way Weyl puts it is: (p. 226).

> We shall find actually that the planets pursue the courses mapped out for them by the guiding field, and that we need not have recourse to a special ''force of gravitation,'' as did Newton, to account for the influence which diverts the planets from their paths as prescribed by Galilei's Principle (or Newton's first law of motion).

Is not Weyl to be taken literally when he makes such a statement as the following: (p. 278)?

> We conclude that space is closed and hence finite. If this were not the case, it would scarcely be possible to imagine how a state of statistical equilibrium could come about. If the world is closed, spatially, it becomes possible for an observer to see several pictures of one and the same star. These depict the star at epochs separated by enormous intervals of time (during which light travels once entirely round the world).

Professor Eddington of Cambridge, who started the Einstein boom by his report of the British eclipse expeditions of 1919, puts this point still more plainly and literally in "Space, Time and Gravitation": (p. 161)

> Perhaps one or more of the many spiral nebulæ are really phantoms of our own stellar system. Or it may be that only a proportion of the stars are substantial bodies; the remainder are optical ghosts revisiting their old haunts. It is, however, unlikely that the light rays after their long journey would converge with the accuracy which this theory would require.

Both Weyl and Eddington are careful to state that what is theoretically possible may be a practical impossibility and I imitated their caution when I said:

> Such a thing (as the influence of the future on the present) is conceivable in the generalized theory of relativity, though, like most conceivable things, it does not occur, or is never known to occur, in reality.

I submit that this is a fair warning to the reader as to the speculative nature of these deductions and a fair translation of Weyl's words:

> In actual fact the very considerable fluctuations

of the g_{ik}'s that would be necessary to produce his effect do not occur in the region of the world in which we live.

I did not invent Einstein. I am not responsible for the theory of relativity or the deductions made from it by physicists and mathematicians. It seems to me that Dr. Humphreys' criticism should be directed toward them rather than toward their humble interpreter.

Edwin E. Slosson
Science Service, Washington

ON THE FORMATION OF FAMILY NAMES LIKE TINGIDÆ

It is astonishing to observe how great a display of erudition may be made in vain, the net result being error. In recent numbers of Science Dr. Holland, Mr. A. C. Baker and I have issued manifestoes on how to construct family names based on third declension *i*-stems not increasing in the genitive, and in each case the argument has been vitiated by at least one mistake. However, each author has contributed an item of truth, and it is now possible to settle the matter for good and all.

As Dr. Holland says, the stem of the Latin word *Tinge* is undoubtedly *Tingit-;* but, as Mr. Baker points out, Fabricius did not adopt this word, rather he introduced into the neo-Latin language the word *Tingis,* genitive *Tingis,* stem *Tingi-*. This brings us to my contribution, *i. e.,* that Fabricius considered *Tingis* "his own and indicated what its declension should be"—perhaps a somewhat misleading statement of the idea clearly formulated by Mr. Baker. My argument, however, had the merit of reaching the right conclusion, namely, that *Tingidæ* is the correct form for this family name, and I have no hesitation in diagnosing as pathological the form *Tingitidæ* in this particular case and *Tingiidæ* or its like in all similar cases.

I have always had a vague notion, founded chiefly on unconscious observation, that in forming patronymics from *i*-stems (not increasing in the genitive) the final *i* of the stem is to be dropped; and, indeed, who ever heard of such terms as Apiidæ, Aphiidæ, Feliidæ or Caniidæ, until the publication of the last number of the Proceedings of the Entomological Society of Washington?[1] To confirm or disprove this belief and so to settle the matter beyond question, I lately addressed an appropriate question to Mr. Henry Pennypacker, now of Harvard University and formerly Greek teacher and headmaster of the Boston Latin School. In reply I received the following statement of the grammatical principle concerned, as the joint opinion of my old teacher and of Professor Clifford H. Moore, head of the department of the classics at Harvard:

> Rules regarding the formation of family names which may be described as patronymics are subject to modification not only in the interest of convenience but also of euphony, and in spite of the fact that the stems of the nouns you mention [Nabis, Apis, Tingis, Coris, Aphis] in Latin end in "i" and that the termination "idæ" is conventional in such cases there seems to be no doubt that the spelling with a single "i" carries universal authority and the penultimate "i" is short in quantity.

The authors of the International Code, of course, were fully conversant with this principle and expected it to be applied in connection with Article 4, as it had been in the past.

Lest my acquaintance with the unexpressed expectations of the members of the commission be questioned, I should say that it is founded on three considerations: (1) They were and are educated men; (2) their own works contain no such monstrosities as "Feliidæ" or "Anguiidæ"; (3) authors and editors of standing throughout the world have unanimously acted upon the assumption which I have expressed above.

There remains the widely but not universally accepted belief that priority should obtain in family names, but the Code is not clear on this point (*i. e.,* What determines the type genus of a family?); however this may be settled in future, we arrive in the present instance at the following conclusions: (1) that *Tingidæ* is nomenclaturally and philologically correct, as Westwood was well aware when he proposed the name in 1840; and (2) that it will not be necessary to make the change in hundreds of

[1] The editor, Mr. A. C. Baker, substitutes the term "Aphiidæ" for the term "Aphididæ" used by the author of an article.

family, subfamily, tribal and divisional names which Mr. Baker's novel idea implies.

H. M. PARSHLEY

SMITH COLLEGE

THE BEGINNINGS OF AMERICAN GEOLOGY

TO THE EDITOR OF SCIENCE: Referring to Dr. T. C. Mendenhall's article on page 661 of the current volume of SCIENCE, I desire to say that I have no wish to enter into any controversy in regard to the facts of Newberry's connection with the Geological Survey of Ohio and I sincerely hope for the benefit of the history of American geology that Dr. Mendenhall is correct. Moreover, I yield to none in my high regard for both Newberry and Orton. My reference was entirely to a period prior to Orton's accession to the directorship of the survey and to the feelings which Newberry publicly expressed at the time I was a student under him at the Columbia School of Mines.

In confirmation of which I can only add that Charles A. White, than whom none knew Newberry better, writes in his memoir that was published by the National Academy of Sciences as follows: 'In 1874 the work of the survey was suspended by failure of the legislature to provide the necessary funds and much dissatisfaction and even bitterness of feeling was engendered among those who had taken part or had been interested in it. Dr. Newberry thought and with apparently good reason that injustice had been done him in his relation to the survey."

MARCUS BENJAMIN

QUOTATIONS

THE FEDERAL BUDGET

THE estimates of the money needed by the federal government for 1924 are about $3,000,000,000, excluding the Post Office, which it is hoped will be self-supporting. At a very moderate estimate, over two thirds of this will be spent on wars past, present or future. Nearly half a billion goes to the veterans, about a billion goes into the service of the debt accumulated in the last war, well over half a billion to maintaining the army and navy.

Half of the total expenditure is a debt to veterans and to bondholders. It is fixed. The other half of the expenditure is for the army, the navy and the civil government. Here alone retrenchment is possible. Assuming that the administration sees no way to reduce the cost of the army and navy, but on the contrary, according to Secretaries Denby and Weeks, would like to increase these costs if possible, the taxpayer's position comes to this: If the whole civil government were dismantled or run free of charge the tax-saving would be less than 30 cents on a dollar.

Some part of this 30 cents is all that Mr. Harding has any hope of saving. The part which he is now thinking about is the part which goes into "research, improvement and development." Less than $11,000,000 goes to research. If it were all abolished it would save just a trifle over one third of a cent on each dollar. Ten millions goes to education. Abolish this item and you have cut your budget .003 per cent. Sixteen millions goes for public health. Cease this activity and you save half a cent on a dollar. Abolish all public works, river and harbor improvements, road construction, the Reclamation Service, Alaskan railroad expenditures, hospital construction and other public improvements and the total saving would be less than 5 cents on a dollar. Abolish everything in the way of "research, improvement and development" and the taxpayer would not save 7 cents on a dollar.

The budget figures are the greatest indictment of modern civilization. They show that two thirds of the energy of government goes to the business of fighting, and that less than a third of the remaining third goes to the civilized business of research, improvement and development.—*The New York World.*

THE APPRECIATION OF SCIENCE

AT the anniversary dinner of the Royal Society it is customary to include among the guests some public men of distinction in other fields than those with which scientific men are concerned. Among such guests this year, at the dinner held on November 30, were Mr. Justice Darling, who proposed the toast of "The Royal Society," and Mr. L. S. Amery, first lord of the Admiralty, who responded to the toast of "The guests." If the assembly had consisted of leading representatives of literature or art, music or the drama, neither of these speakers would have professed, facetiously or otherwise, want of knowledge of the functions of the institution they honored by their presence, or of the meaning of subjects surveyeed by it. Mr. Justice Darling, for example, said he had heard of the Royal Society as he had heard of the equator, and had been told that the society "concerned itself with medicine and biology, and particularly natural knowledge and natural philosophy, but the moment the knowledge became unnatural—and so far as he could see most of it was—then the society had nothing more to do with it." Of course, the society was founded for the promotion of *natural* knowledge by inquiry as against *supernatural* by revelation or authority. Mr. Justice Darling should understand the distinction, for he referred to Francis Bacon several times in the course of his remarks, though always incorrectly, as "Lord" Bacon. As Sir Charles Sherrington, who presided, said, "The field of truth which the society explores is in the realm of natural knowledge, and the manner of the exploration of this field is in research." Sir Ernest Rutherford was right when, in responding to the toast of "The Medallists," he referred to the spirit of adventure possessed by every scientific pioneer. In no other department of intellectual activity is this spirit more manifest, and in none are such fertile provinces being opened. To us it seems strange, therefore, that so little is commonly understood of the origin and purpose of such a body as the Royal Society, now in its two hundred and sixtieth year, or of the achievements of modern science represented by it.—*Nature*.

SCIENTIFIC BOOKS

United States Life Tables 1890, 1901, 1910, and 1901-1910. Explanatory Text, Mathematical Theory, Computations, Graphs, and Original Statistics. Also Tables of United States Life Annuities, Life Tables of Foreign Countries, Mortality Tables of Insurance Companies. Prepared by James W. Glover. Bureau of the Census 1921, pp. 1-496. 4to.

Since their appearance some years ago Glover's earlier United States Life Tables have been a standard reference work on mortality in this country. With characteristic thoroughness, the author has extended and improved his earlier work, and has produced what may well be regarded as, at the moment at least, *the* standard actuarial reference work. For it can be said that in this present volume so much of actuarial science as concerns itself with the construction of mortality tables is covered with meticulous attention to detail. Nothing is left to the imagination of the reader and little to his intelligence. Every point in regard to the construction and the interpretation of life tables which could possiby arise to puzzle a voyager into these placid, because carefully "smoothed" seas, is explained thoroughly, comprehensively, and completely, with copious illustrations domestic and foreign in origin.

This is as it should be. Life tables have had the quite undeserved reputation of being mysterious documents, capable of being understood only by the highest order of intellects. As a matter of fact they are, of course, nothing of the sort, but only a quite obvious and simple set of derivative functions from age specific death rates. Such an exposition of actuarial arts and science as Glover gives in this volume will most effectually remove from the mind of the careful reader any lurking notion that there is an element of the occult or transcendental in life tables, and will impress him with the simple virtues of these documents. He must, however, be a careful, by which is meant painstaking, reader, because no light or fantastic touches will cheer his way through the solid, substantial mass of lucent but lucubratory details.

To turn to technical matters, it may be said that in the construction of the United States tables (based upon Registration Area data variously subdivided demographically for three different periods) Glover has followed the most highly approved, orthodox actuarial methods. The q_x values were smoothed between ages 5 and 85 by osculatory interpolation using fifth differences. The first 5 years of life were dealt with by a special method based upon German official procedure, and this section was welded to the main portion by fourth difference interpolation formulas. The upper tail end of the curve was graduated by Wittstein's formula and welded to the main portion by the application of Spencer's 21-term formula. Glover felt it important to alter the raw figures as little as possible and apologizes in various places for little roughnesses in the tables, especially around junction or welding points.

Much might be said about the orthodox actuarial philosophy regarding the smoothing or graduation of raw data. The present reviewer finds himself in disagreement with some of it, looking at the whole matter from the broad standpoint of scientific methodology. But this is clearly not the place to enter upon a discussion of this mathematically recondite and emotionally delicate subject. Suffice it to say that the reviewer is acquainted with no more honest, through, and skillful application of the standard actuarial methods than that of Glover in the construction of these tables.

Altogether this is a substantial and notable contribution to American vital statistics. We may well be proud of it. It stands at least on a level with the very best that any country, not excepting the Registrar-General's Office of England and Wales, under Farr and Ogle and Stevenson, has produced in the same line. Every health officer and vital statistician should have a copy of it on his desk. Two features of the book are especially noteworthy. The first is that the best recent life tables for Australia, Denmark, England, France, Germany, Holland, India, Italy, Japan, Norway, Sweden, and Switzerland are given in full for comparative purposes. The second is that there are given, for the United States, tables of life annuities, premiums and commutations. This last is an interesting departure for an official government publication. Hitherto in litigation involving questions of life expectancy in the settlement of estates, etc., the courts have had to depend for their actuarial basis in the main upon the material of insurance companies. Now official tables based upon the experience of the original registration states in 1910 may be used, and all elements of uncertainty as to bias will be removed. Furthermore, by the use of the premium tables one can make intelligent examination of the alluring proposals made to him for the purchase of insurance, whether by theoretically grasping commercial institutions or by theoretically eleemosynary foundations.

Finally, it may be pointed out that this volume makes a first rate text-book for the systematic study of the basic elements of actuarial science. The reviewer is using it in this way at the present time, in a course in life table construction, with great satisfaction. It may be purchased from the Superintendent of Documents at a cost of $1.25 per copy, cloth bound, a price which is only a small fraction of what any commercial publisher would have to charge for a book so expensive to manufacture.

Raymond Pearl

SPECIAL ARTICLES

X-RAY CRYSTALLOMETRY: X-RAY WAVE LENGTHS, SPACE-LATTICE DIMENSIONS AND ATOMIC MASSES

The fundamental equation in X-ray spectrometry and crystallometry is

$$\lambda = 2d \sin \theta$$

wherein d is the perpendicular distance between adjacent planes in the crystal which reflect in the first order at a glancing angle of incidence θ, X-rays of wave-length λ. Since only θ in this equation is capable of direct measurement the absolute magnitudes of λ and d can only be determined if some other relation between them can be found, or if either can be determined independently.

The method first used was to obtain a value of d from the density of the crystal, the number of molecules in its unit of structure, and the mass of a single molecule. The first of the last-named quantities can be measured directly, the second is an integer the choice of which can be guided with sufficient accuracy from the X-ray data, and values for the third have been obtained by a variety of methods, perhaps best by the determination of electrochemical equivalents and electronic charge. No other relation between λ and d than that given above is at present known to exist, *i. e.,* no other quantity than θ is known to depend upon these two variables only, so that the first suggested method of getting their absolute magnitudes is not feasible.

An independent method of getting d is to employ the quantum relation between wave-length of X-rays and volts required to give electrons equivalent energy. In using this method we must take care to leave out of account those values of h which themselves depend upon X-ray wave-lengths.

Using the first method we select the following data:

Number of molecules per mol, $N = 6.0594 \times 10^{23}$		(1, 5)
Density of calcite	2.7116 gm/cm³	(2, 5)
Interaxial angle for calcite	101°-55′	(3, 5)
Molecular weight $CaCO_3$	100.07	(4)

The volume of the unit rhombohedron is $1.09626\ d^3$ and it contains one half of a molecule[6] so that the grating constant $d = 3.02855 \times 10^{-8}$ cm. The ratio of the grating constant of calcite, d_{CaCO_3} to that of rocksalt, d_{NaCl}, has been determined by Uhler and Cooksey[7] and by Siegbahn[8], their respective values being $\frac{3.0307}{2.814} = 1.07701$, and $\frac{3.02904}{2.81400} = 1.076417$ ($\log^{-1} 0.0319806$), the latter of which is the more accurately determined and will be taken as the true ratio. This requires that d_{NaCl} be changed to 2.81355×10^{-8} cm. The values given by Duane[9] for these two constants are 3.028×10^{-8} and 2.814×10^{-8}, the ratio of which, 1.07605, is probably a little low. To correct Duane's wave-lengths to the new basis we must multiply those based on 3.028×10^{-8} for d_{CaCO_3} by $\frac{3.02855}{3.02800} = 1.00018$, and those based on 2.814×10^{-8} for d_{NaCl} by $\frac{2.81355}{2.81400} = 0.99984$.

It should be noted further that Siegbahn[10] has more recently obtained a value for $\frac{\lambda}{d} = \sin\theta$ for the $K\alpha_1$ line of copper which does not agree with that which he obtained at the time the above-mentioned ratio was obtained. His new value for λ is 1537.302×10^{-11} for $d_{CaCO_3} = 3.02904 \times 10^{-8}$ as compared with the previous value 1537.36×10^{-11} for $d_{CaCO_3} = 3.028 \times 10^{-8}$. Referred to the same basis (the new value of $d_{CaCO_3} = 3.02855 \times 10^{-8}$) this means a change from 1537.64×10^{-11} to 1537.056×10^{-11}, a decrease of 0.038 per cent. Since this correction amounts to more than the difference involved in changing 3.028×10^{-8} to 3.02855×10^{-8} and 2.814×10^{-8} to 2.81355×10^{-8}, and since Compton's value for the density of rock-salt has been criticized as probably too low[11] it seems premature on the basis of the above evidence to decide in favor of either of the two constants used by Duane.[12].

A recent note by Davey[13] bases a similar analysis upon a value of $N = 6.0642 \times 10^{23}$ and upon 2.173 gm/cm³ as the density of rock-salt, thus getting a spacing for the (100) planes in this crystal of only 2.810×10^{-8} cm. Adoption of this value would require extensive correction of all reported wave-lengths without any considerable advantage, and observers agree that rock-salt is a less suitable standard than calcite, on account of the greater probability of inclusions leading to abnormally high densities. The density corresponding to the value here chosen for d_{NaCl}, 2.8135×10^{-8},

[1] R. T. Birge, *Phys. Rev.*, (2), 14, 365 (1919).

[2] A. H. Compton, *Phys. Rev.* (2), 7, 646-685 (1916).

[3] P. Groth, *Chemische Kristallographie*, 2, 204 (1908).

[4] "International Atomic Weights," (1921).

[5] H. S. Uhler, *Phys. Rev.* (2), 12, 39-46 (1918).

[6] This is not a true unit of structure, which, however, is of no importance for these calculations; *cf.* R. W. G. Wyckoff, *Amer. Jour. Sci.*, 50, 317-360 (November, 1920).

[7] H. S. Uhler, C. D. Cooksey, *Phys. Rev.*, (2), 10, 645-652 (1917).

[8] M. Siegbahn, *Phil. Mag.*, (6), 37, 601-612, (1919).

[9] W. Duane, *Nat. Res. Counc. Bull.*, 1, 383-408 (November, 1920).

[10] M. Siegbahn, *Comptes Rendus*, 173, 1350-1352 (December 19, 1921).

[11] R. Ledoux-Lebard, A. Dauvillier, *Comptes Rendus*, 169, 965-967 (November 24, 1919); H. S. Uhler, *loc. cit.*[5].

[12] *Loc. cit.*[9]; *cf.* M. Siegbahn, *Jahrb. d. Rad. u. Elektr.*, 18, 240-292 (1921).

[13] W. P. Davey, SCIENCE, 54, 497-498 (November 18, 1921).

and to $N = 6.0594 \times 10^{23}$, is 2.166 gm/cm³ or only a little lower than the lowest value quoted by Davey.[14]

The value $N = 6.0594 \times 10^{23}$ is equivalent to a factor 1.65033×10^{-24} ($\log^{-1} \overline{24}.2175704$ for converting atomic or molecular weights to grams.

The second method, depending upon the value of h, requires in addition a determination of the potential applied to an X-ray tube. The work of Blake and Duane[15] may be considered as a determination of d in terms of h. The values of h collected by Birge[16] vary somewhat among themselves but 6.560×10^{-27} seems a reasonable mean value of the results not depending upon X-ray wave-lengths, and this gives $d_{CaCO_3} = 3.0303 \times 10^{-8}$ or 0.058 per cent. higher than the value given above. This is within the range permitted by the probable error in the value of h just taken.

The following constants are therefore recommended to be used until other values are agreed upon, to the accuracy indicated by the logarithms.

Grating space of calcite:

3.028×10^{-8} cm. ($\log^{-1} \overline{8}.48116$)

Number of molecules per mol:

6.0594×10^{23} ($\log^{-1} 23.78243$)

Molybdeuum K-radiation wave-lengths:

α_1 0.70783×10^{-8} cm. ($\log^{-1} \overline{9}.84993$)

α_2 0.71212×10^{-8} cm. ($\log^{-1} \overline{9}.85255$)

L. W. MCKEEHAN

RESEARCH LABORATORIES OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, AND THE WESTERN ELECTRIC COMPANY, INCORPORATED,

SEPTEMBER 20, 1922

PERIPHERAL MIGRATION OF A CENTRIOLE DERIVATIVE IN THE SPERMATOGENESIS OF ŒCANTHUS

IN 1920 Mr. Chas. S. Driver began at Columbia University a study of the male germ cells of a common tree-cricket, *Œcanthus nigricornis* Walker, an Orthopteron insect of the family *Gryllidæ*. His preliminary study convinced him that, during the changes undergone by the spermatid as it begins to lengthen into the mature sperm, the entire distal centrole migrates posteriorly along the axial thread, eventually forming a terminal "plug" for the caudal sheath at its distal extremity. While a peripheral migration of part of the central apparatus in the spermatids of invertebrates was not hitherto entirely unknown, previous accounts are few in number and somewhat conflicting in substance. A reexamination of this phenomenon was, therefore, of considerable interest. The untimely death of Mr. Driver left his work incomplete and his material was delivered to me for further study. Driver deserves much credit for the excellence of the preparations, which are remarkably well fixed and stained. The method of Benda was used for fixation, and the sections were stained according to the alizarin-crystal violet technique. My observations were made at a magnification of 1,100 to 1,650 diameters, somewhat higher than that used by Driver in his survey of the material.

After a careful study I have reached a different conclusion in regard to the migrating "centriole" from those of Driver and earlier observers. Although there is in the spermatids of Œcanthus a peripheral migration of a body which appears much like a centriole and stains in a similar manner, I am able to demonstrate that the migrating body is not an entire centriole, but only a portion or derivative of the distal centriole.

In early spermatids of Œcanthus the central apparatus appears as a bar which lies perpendicularly to the nuclear membrane. The axial thread has already appeared at this early stage. The bar constricts in the center, dividing into a proximal and a distal centriole. Almost immediately a small portion of the latter, encircling the axial thread, is budded off and begins a migration along the thread. As it moves distally it increases rapidly in size, and eventually becomes as large as both proximal and distal centrioles combined. It reaches a permanent position at the distal extremity of the caudal (mitochondrial) sheath. The remainder of the distal centriole continues to lie

[14] *Loc. cit.*,[13] assuming the value attributed to Retgers is 2.167 and not 1.167 as printed.

[15] F. C. Blake, W. Duane, *Phys. Rev.*, (2), 10, 624-637 (December, 1917).

[16] *Loc. cit.*[1]

in close proximity to the proximal one at the nuclear wall; and in cells too heavily stained with crystal violet they appear as a single body, a fact which may account for Driver's view that only the proximal centriole remains near the nucleus. A full account of the circumstances connected with the origin and migration of the distal centriole derivative will be incorporated in a later paper.

Accounts of a distal migration of a centriole or its derivatives in the spermatogenesis of invertebrates are, as already indicated, rare. Only among insects have such cases been recorded. Perhaps the clearest and most convincing statement is that of Otte ('07)[1] for *Locusta viridissima*. Some of his figures, notably No. 87 and No. 92, bear a strong superficial resemblance to certain cells to be found in the Œcanthus preparations. Otte, like most of the other observers of similar phenomena, considers the migrating body to be an entire distal centriole. My observations upon the origin of the migrating body in *Œcanthus* caused me to become skeptical of similar reports in other cases; and through the kindness of Dr. O. L. Mohr of the University of Kristiania, who has sent me testes of *Locusta viridissima* fixed in Benda's solution, I was enabled to make a re-examinaion of the spermatids of this insect. A preliminary survey of the material, while not entirely conclusive, indicates that the centrioles of the "neck-region" of young spermatids are two in number prior to, and throughout, the period in which the centriole-like body performs its migration to the posterior pole of the cell. This body, therefore, appears to be a centriole derivative and not the distal centriole itself.

The discovery in *Œcanthus* of a centriole derivative which migrates along the axial thread to a position remote from the nucleus is of interest because it presents certain transitional features between two previously known and common types of spermatid metamorphosis. The first of these types has been reported by numerous observers upon the spermatogenesis of various invertebrates, including most of the insects. In the early spermatids of these animals two centrioles lie together in the neck-region of the young spermatid. One of these, the distal centriole or blepharoplast, spins out an axial thread. The two centrioles remain practically unchanged in the same region throughout the metamorphosis of the spermatid, and no peripheral migration of centriole derivatives occurs. The second type is characteristic of certain vertebrates, notably the mammals, and has been described by various authors for man, rat, guinea-pig, *Phalangista*, etc. In the spermatids of these forms two centrioles also remain in the neck-region, but the distal, after spinning out the axial thread, cuts off a ring-shaped body which encircles the thread and migrates distally, at least as far as the terminus of the middle-piece. There is no well-defined middle-piece in the insect sperm, and, as already stated, the migrating body, closely analogous to that of the mammal sperm, passes to the posterior margin of the caudal sheath.

This study also has a bearing upon certain phases of the problem of fertilization, notably the origin of the first cleavage spindle. Many observers hold that the first cleavage centers arise from, or in the immediate neighborhood of, the neck-region of the sperm as it enters the egg. It is possible that the proximal and distal centrioles maintain their individuality and form each a pole of the spindle, but this must remain a matter of conjecture. It is noteworthy, however, that in practically every animal that has been critically studied,[2] portions of both proximal and distal centrioles pass into the neck-region of the mature sperm. In this respect Œcanthus falls directly into line with the vast majority, and probably also *Locusta*.

H. H. Johnson

Columbia University,
New York City

[1] Otte, Heinrich: "Samenreifung und Samenbildung bei Locusta viridissima," *Zool. Jahrb.*, Bd. 24, Heft 3, S. 431-521, 1907.

[2] Apparently an exception obtains in certain Mollusca; *vide* Gatenby ('18): "The Cytoplasmic Inclusions of the Germ-Cells. Part III—The Spermatogenesis of Some Other Pulmonates." *Quart. Jour. Mic. Sci.*, N. S., Vol. 63, No. 250, pp. 197-258.

SCIENCE SERVICE NEWS BULLETIN

The news bulletins prepared by Science Service will hereafter be printed as a supplement to SCIENCE. As most scientific men know, Science Service is a corporation not for profit whose capital has been provided by Mr. E. W. Scripps. The American Association for the Advancement of Science, The National Academy of Sciences and the National Research Council nominate a majority of the members and trustees.

The objects of Science Service are to supply current and interesting scientific information to as large a part of the general public as can be reached. The bulletins are not addressed primarily to men of science and might not be in place in the regular pages of SCIENCE. They will, however, prove to be of interest, partly because every one is at most an amateur in the sciences that are outside his own field, and partly because it is one of the objects of science to maintain its relations with the general public on which it must depend for recruits and for support.

It is hoped that the publication of Science Service Bulletins will prove to be interesting and profitable to scientific men and will lead to their cooperation in maintaining high scientific and literary standards in the popularization of science. It should be understood that while the editor of SCIENCE is responsible for the publication of the bulletins, responsibility for the contents rests with the editor of Science Service, Dr. E. E. Slosson, and the editor of the bulletin, Mr. Watson Davis, and in the last resort with the American Association for the Advancement of Science, the National Academy of Sciences and the National Research Council.

MEASURES FEEBLE HEAT STARS SEND TO EARTH

BY measuring a hundred millionth degree of temperature and a trillionth of an ampere of electric current, Dr. C. G. Abbot, of the Smithsonian Institution, has determined for the first time the heat spectrum of starlight with great accuracy.

Working with the 100-inch telescope at Mt. Wilson Observatory this fall, Dr. Abbot measured the heat at different parts of the spectrum of ten stars and the sun. The rays were dispersed by a spectroscope in a band similar to the rainbow.

The bright star Capella, which is very similar to our own sun in its spectrum, was found to furnish the equivalent of one horse power to an area on the earth approximately equal to the state of Minnesota. But this prominent star is feeble compared with our sun, which is equal to a hundred billion Capellas and sends down on twenty square feet heat equal to a horse power. On the whole earth Capella's heat equals 500 horse power, and as all the stars together equal 500 Capellas this would amount to 250,000 horse power over the whole earth from the stars alone.

Dr. Abbot explained that his work on the heat of stars, accomplished with the cooperation of L. B. Aldrich of his staff, is an outgrowth of the principal work of the Astrophysical Observatory, which is the investigation of the sun.

"This work was begun about 1890 by Dr. S. P. Langley whose great pioneer work in measuring the sun's heat, its distribution in the spectrum, and the losses and modifications which it encounters in passing through the earth's atmosphere, were classic," said Dr. Abbot.

"It might be supposed that the investigation of a heat source whose in-put on the earth's surface amounts to the equivalent of a horse power per couple of square yards would require only simple and insensitive apparatus, but such is not the case. The complexity of the solar beam, made up of rays of greatly differing wave length which are all differently transmitted by the earth's atmosphere, requires the employment of the spectroscope to separate the rays, and for the recognition of their heat the use of highly sensitive thermometric apparatus.

"The most satisfactory heat instrument for these purposes is the bolometer, invented by Langley about 1880. Two hair-like wires of platinum are placed side by side, the one hidden from the rays by means of a metallic diaphragm, the other exposed in the spectrum. The heat absorbed by the exposed thread, if it be as little as the millionth of a degree, suffices to disturb a sensitive electrical balance, and by a beautiful device introduced by Langley in the earliest years at the Astrophysical Observatory these indications are automatically recorded from one end of the spectrum to the other. The record takes the shape of a curve which mounts to different heights with reference to its base line, and these heights are proportional to the heat in the various rays of the spectrum. The absorption bands due to the chemical elements in the sun, and those due to some of the elements and compounds of gaseous nature in the earth's atmosphere, are indicated as depressions in this sinuous curve. In this way the effects of the earth's atmosphere upon the sun rays may be determined and allowed for, so that the intensity and quality of the rays as they would be outside the atmosphere, on the moon, for instance, where there is none, can be computed. When this is done, the intensity of the sun's heat freed from atmospheric influences is found to be variable."

The form of distribution of the solar spectrum gives an indication of the temperature of the sun. Just as the blacksmith's iron as he heats it becomes faintly glowing, then a brighter red, then yellowish, then white hot, so the spectra of the sun and other stars depend for the arrangement of the intensities of the different colors upon the temperatures which prevail in these sources of light. The measurements of the Smithsonian Institution indicate a temperature for the sun approximating 6,000 degrees C.

NO SCIENTIFIC BASIS FOR PREDICTING CALIFORNIA QUAKE

The fact that the earthquake zone in California is analogous geologically to the devastated region in Chile has raised some apprehension here as to the probability of a quake or tidal wave in California.

Since the disaster of 1906, considerable scientific research on the causes of the crust movements on the west coast has been conducted which may eventually lead to definite earthquake predictions.

But Dr. H. O. Wood, in charge of investigations for the Carnegie Institution of Washington, when seen at the Mount Wilson Observatory, said:

"There is no scientific basis for any estimate of probability of an earthquake in California following upon the recent shock in Chile. No indications of any impending shock have been noted here. Sometimes several great earthquakes have occurred in places far distant from one another within a relatively short time interval so as to suggest causal group occurrence but more commonly there is no such apparent grouping in the occurrence of great shocks."

About 150 miles off the coast of California, there is a sharp break in the ocean bottom that is as steep as the east slope of the Sierra Nevadas, according to Dr. William E. Ritter, director of the Scripps Institution for Biological Research, who located it by extensive soundings when he was on the oceanographic expedition of the *Albatross* in 1904. It has been suggested that this is a plane of weakness that might give rise to an earthquake at sea. Such a crustal slip would probably create a serious tidal wave such as that which swept the Chilean coast in the wake of the recent shocks.

But investigations into the history and folklore of the country are reassuring. They indicate that no tidal wave ever swept the California coast, according to Dr. Ritter. There is not even a tradition of sudden encroachment of the sea upon the land.

HOW CHILEAN QUAKE HAPPENED

How Chile's death-dealing earthquake, which shattered cities and engulfed their helpless inhabitants with tremendous tidal waves, originated at sea off the coast of that country, is explained by Dr. W. J. Humphreys, meteorological physicist of the U. S. Weather Bureau, from the seismographic records made by the earth's tremors at this point. For four hours the pen of the highly sensitive instrument drew the picture of the movements in the earth, which wrought such havoc among the Chilean towns in a few minutes.

Earthquakes, Dr. Humphreys said, are produced by a slipping or breaking of the crust of the earth as a result of strains. These strains may be caused by the shrinking of the interior of the earth through temperature changes, changes in loads due to rapid erosion taking material from one place to another in the course of a few hundred years, or from the tendency of higher land to flow out to sea.

From what is known of the present quake, it seems to have been caused by higher land moving out to sea. The actual break in the crust occurred at some distance from shore, and this sudden change in the ocean floor at that point produced a tidal wave. As there were several such waves, there must have been several faults or breaks in the earth's crust at the sea bottom which created the different huge billows in the incompressible water. It is probable that this crack extended for a hundred miles or more and that the wave created was detected in the Philippines or other distant Pacific points.

Breaks, such as caused the shocks and waves

in Chile, have left their mark on the physical geography of our own country. For instance there is a break in the earth's crust which can be seen at Great Falls, Va., near Washington. It has been traced from near Boston, Mass., through Pennsylvania and New York to the James River in southern Virginia. The Hudson River valley was created in the distant past by a similar slipping in the earth's crust.

An earthquake may occur anywhere on the earth's surface and no place is immune, yet they are most likely to happen at the present time in the newly formed geological regions such as are found along the western coast of South America, our own western coast, up to Alaska and down the other side of the Pacific by way of Japan, the Philippines, Java, and other islands in the South Pacific.

Because an earthquake occurs in one place is no indication that it will be followed by another in some other quakey regions. They do not run in series, unless the changes made in the load at one point may be so great as to cause additional strain at another place sufficient to cause a break. There are sometimes more shivers in the vicinity of an original break caused by further settling of the tremendous masses of rocks.

PARAFFIN AND POISON PROTECT WOOD FROM TEREDO

Discovery has been made of a way to seal poison in wood which promises complete protection for railroad ties, wharf piling, mining and ship timbers against the ravages of land and water creatures like the teredo. Dr. Paul Bartsch, curator of mollusks of the Smithsonian Institution at Washington, has found that by forcing hot paraffin containing copper or arsenic salts into timbers under pressure the wood can be preserved from damage by shipworms and other destructive forms of life. The method of application is the same as that now used in treating timber with creosote.

Heretofore it has been found hard to keep preservatives in the wood. Gradually the poisons leached out, and left the timber unproteced. By the use of paraffin, which is resistant to water, acids and alkalis, Dr. Bartsch claims this leaching can be overcome and the wood protected more effectively and with less expense than by present preservatives.

The Forest Products Laboratory reports that the hot paraffin solutions have a great penetrative power and blocks treated by the new method with iodides of copper and arsenic sealed in have been found by officers at the Key West Naval Station to be unaffected by ship worms after three months exposure in infested waters where the untreated wood to which they were attached was promptly attacked.

Dr. Bartsch now has a less expensive highly poisonous copper salt and is working to obtain a cheaper arsenic preparation, which he believes will eventually displace present timber preservatives. When the Panama Canal was built the greenheart wood was used in the lock gates on account of it being largely resistant to marine borers. Some difficulty was experienced in getting men to handle the wood, as on some it has an effect similar to that of our poison oak. Recently it has been found that even this toxic timber is attacked by the mollusks, which chisel out their homes inside it with impunity. They use the tooth-like edges of their shells.

A colony burrowing through the wood weakens the timber and often results in heavy piling being completely cut in two. Untreated wood shows the holes which the mollusk makes in three months and some creosoted timber after two years in the water has been found to be infested. Copper solutions of one in 2,000,000 have been found deadly, and Dr. Bartsch claims that when the tender tentacles of marine forms come in contact with his preparation they will curl up like the victim of a wood alcohol party. When the shipworm swallows impregnated sawdust his boring days will be promptly over.

Any number of poisons can probably be effectively kept in the wood by mixing them in the paraffin. So resistant is paraffin to the effect of acids that bottles are made of it to hold hydrofluoric acid, which eats through glass. Heat alone would melt it out, but for railroad ties a paraffin too hard to be affected by the sun's heat would be used.

ALUMINUM SULPHATE MAKES RARE FLOWERS AND FRUIT THRIVE

Magnificent orchids and rhododendrons and gigantic blueberries can be grown in ordinary soil to which aluminum sulphate is added, Dr. Frederick V. Coville, chief botanist of the U. S. Department of Agriculture, has discovered. Such rare plants will not flourish in untreated soil that is alkaline.

The farmer applies lime to make his soil alkaline and capable of raising bumper yields of the common crops, but the nurseryman can now reverse the process and apply aluminum sulphate to make the soil acid and capable of raising blue-

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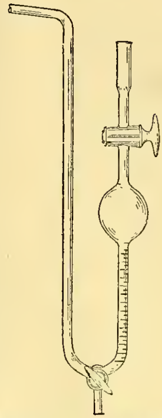

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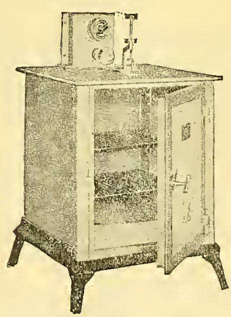

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berries, orchids and rhododendrons, if Dr. Coville's experiments are applied on a large scale with continued success.

This treatment gives promise of making easy the cultivation of all plants requiring an acid soil. Orchids, azaleas, kalmias and other difficult plants, Dr. Coville believes, will be made to thrive in common soils by this means. The discovery is expected to prove of especial value to nurserymen in saving them from the necessity of using peaty lands to raise these flowers.

Rhododendrons grow with great luxuriance in sand mixed with peat, with rotting wood, or with half rotted leaves, but they die in ordinary garden soil, because its reaction is neutral or alkaline. Partially rotted leaves are the chief source of soil acidity. And the rhododendron must have an acid soil. The alum or aluminum sulphate when first applied has an acid effect and this acidity is continued owing to the fact that the lime in the soil, which would tend to make it neutral, is replaced in the soil by aluminum and the released lime is leached away in the form of calcium sulphate.

The growth of the rhododendrons has been stimulated very greatly in this way. In one experiment, Dr. Coville placed three plants in the same sort of soil. One was untreated, another was treated with Epsom salts and one with aluminum sulphate. The untreated one failed to flourish. The Epsom salts treatment caused an increase in diameter of 30 per cent., while the increase due to the aluminum sulphate treatment was 250 per cent.

Most American crops are natives of alkaline or neutral soils, and for that reason the most prominent problem has been to prevent soil acidity by the addition of lime. This is the first time that an artificial means of converting an alkaline soil to acidity has been worked out.

COLD WINTER COMING IS BEST WEATHER BET

THE coming winter will probably be a cold one, despite the heralded reports from Norway telling of warm weather in the Arctics.

Major E. H. Bowie, forecaster of the U. S. Weather Bureau, says that daily observations received by radio from Spitzbergen, Iceland, and Wrangel Island, as well as from the Amundsen Polar Expedition north of Alaska indicate temperature conditions contrary to those reported as prevailing in the eastern Arctic by Consul Ifft at Bergen, Norway.

The abnormally warm weather said to have been found in the eastern Arctic is not confirmed by the records received from stations in other sections of the Circle. Recently there was a big snow storm on Spitzbergen, and from Wrangel Island, beyond Bering Straits, reports of exceedingly low temperatures have been made since August.

About the coming winter, Major Bowie says that although meteorologists do not make definite long distance weather forecasts, the chances are that the approaching winter will be cold. The last two winters have been abnormally warm, and according to the law of probability it is unlikely that this winter will follow suit.

Whatever effect may have been produced by the possible greater speed of the equatorial currents carrying warm waters higher in the Arctic, as claimed from Norway, this is not likely to modify the winter in the Northern Hemisphere in general. U. S. Hydrographic officials here say they have received no reports tending to confirm this greater warmth of ocean current water and no unusual ice or water conditions have been found this season.

ITEMS

TAXICABS in Havana use gasoline in preference to the much cheaper alcohol, because congested traffic conditions require quick starting ability.

MANY a rich Chinese merchant of to-day is waked up by an American alarm clock, talks over an American telephone, and rides in an American motor-car.

THE size and height of rooms in native houses in Japan are more standardized than the room-dimensions in the houses of any other country.

LONG continued exercise of white rats increases the weight of the heart, kidneys and liver, on an average of about twenty per cent.

NOBODY on earth has ever seen the other side of the moon, as that satellite always keeps the same face toward us.

IN 1921 the people of the United States spent ten dollars a person for candy, nine dollars for education, fifty cents for chewing-gum, and twenty-nine cents for health.

RHAZES, Persian physician of the tenth century, picked out the site for a hospital in Bagdad by hanging pieces of meat in different parts of the city in order to find the place least favorable to putrefaction.

NEARLY all the varieties of coffee plant in the western hemisphere are said to have sprung from one plant imported by the French at the island of Martinique in 1717.

chemical reducing properties. It seems to have no effect upon rubber in the dilution used; at least, I have never had to replace my rubber hose connections. There are no objections to glucose at all that I have found and its inexpensiveness and the freedom from the annoyance of constantly having to replace a volatile solvent such as alcohol are unquestioned advantages.''

FUMIGATING GAS WAVES ITS OWN RED LANTERN

A NEW fumigating gas which saves human lives by giving warning of its presence has been developed by the U. S. Public Health Service in cooperation with the Chemical Warfare Service of the War Department, it is announced by a board appointed to investigate ship fumigation. It will be used in ridding ships, cars and houses of rats, bedbugs, lice and other insects.

Hydrocyanic acid gas, the fumigant now used, has occasionally cost human lives because of lack of odor, although by killing disease-carrying vermin it has prevented serious epidemics from sweeping over the country.

The weeping is done by the potential victim, not by his relatives, when the new gas is used, the expert explained. Cyanogen chloride, a very active tear gas and a by-product of war work, is mixed with the hydrocyanic acid gas to form the new combination for fumigating use. The new poison is easily detected as doses too weak to deliver a knockout produce severe weeping. It is harmless to foods, tobacco, fabrics, leather, and has no corrosive action on metals that may be on board. The gas does its work quickly and then dissipates rapidly. It costs but little more than the fumigants which are more dangerous to handle.

Hydrocyanic acid gas and sulphur dioxide are the gases which have been used largely in ship fumigation, the board's report explained. Sulphur dioxide, although it gives warning of its presence in time to allow the escape of any person within the quarters where it is used, is costly, harmful to clothing and foodstuffs, and requires from 5 to 12 hours exposure. Hydrocyanic acid gas is cheaper and more poisonous than the sulphur dioxide and does not affect food, clothing, or other articles. But it is odorless and non-irritating and leads to fatalities due to failure to detect its presence in time.

COMBINED DYES KILL BACTERIA

''DYE bacteria and they die'' is one way of expressing a discovery that Professor John W. Churchman, of Yale University, and surgeon-in-chief of the New Haven Hospital, has reported to the National Academy of Sciences.

''Different kinds of aniline dyes have high bactericidal power,'' Dr. Churchman said. ''By mixing two kinds of dyes of opposite selective power a mixture results that readily kills all bacteria. The two dyes may be used together in a mixture of this kind, and the strength of one fortifies the weakness of the other. This establishes a new principle in dye therapeutics.''

In 1912 Dr. Churchman discovered that the dye, called gentian violet, kills certain kinds of bacteria even when it is as weak as one part in a million. This fact was applied in treating many kinds of infections.

Now Dr. Churchman has announced the finding of another aniline dye, acid fuchsin, which kills the bacteria which the gentian violet spares and spares those which the gentian violet kills. The mixture of the two dyes, which has a royal purple color, spares none of the bacteria.

''Contrary to what is usually held, dyes may be effective against bacteria even though they do not stain them,'' he said. ''Bacteria may also be stained by dyes without injury.''

He has shown, moreover, that the mechanism by which dyes ''kill'' bacteria depends not on their ability really to kill them, but to paralyze their reproductive capacity.

ITEMS

AN American, William Wheelwright, introduced the telegraphic system into Chili, and organized the first steamship service between the west coast of South America and Europe.

MANY rice crops of the South to-day are directly descended from a pocketful of rice smuggled out of Italy by Thomas Jefferson.

THOMAS JEFFERSON, author of the Declaration of Independence, and third president of the United States, was also an astronomer, physicist, engineer, anatomist, geologist, zoologist, botanist and paleontologist.

LEONARDO DA VINCI, famous painter of the woman with the million-dollar smile, was the best physiologist of his time and made anatomical drawing of human bodies which he dissected with his own hands.

THE United States imported 43,365,763 bunches of bananas in 1921, but this fruit was once sold in this country as a tropical curiosity at ten cents apiece with each individual banana wrapped in tin foil.

SCIENCE SERVICE NEWS BULLETIN

Science Service, Washington, D. C.[1]

HELIUM HUNTING IN THE MILKY WAY

By Isabel M. Lewis,
U. S. Naval Observatory

Helium, our wonderful non-inflammable balloon gas, does more than lift airships without danger from explosion. Much is being learned of the size, structure and form of the universe by a study of the stars containing incandescent helium.

Stars of the helium type give light which when broken up by the spectroscope shows prominently the bright yellow lines of helium, indicating that this gas is present conspicuously in their atmosphere. They are excessively hot and massive and bluish-white in color, and they occur in abundance—often as double, triple or multiple stars enmeshed in nebulosity—in the constellation of Orion. Hence their name of Orion stars.

It was found some time ago that comparatively near us in space, that is, so near to our solar system that light traveling 186,000 miles per second would only take a few hundred years to reach it, there exists a local cluster or group of these helium stars in the constellation of Orion. In fact, our sun is a star in the Milky Way and within this extensive group. It is about fifty light years to the north of the central plane of that great galaxy.

Enormous dark tracts of nebulosity in that thickly star-strewn space, located in the constellations of Centaurus and Scorpio and shutting off light from stars beyond, lie between 650,000 and 975,000 light years from the solar system. This is about the greatest distance that has been found for any type of celestial object and shows how enormous is the extent of the Milky Way along its greatest axis.

Because all the helium stars in the Orion group are well within the range of vision of the naked eye or at most no fainter than stars of the seventh magnitude which lie just beyond the naked-eye vision, it was assumed that there were few, if any, fainter helium stars lying beyond this group.

Recent investigations made at the Harvard College Observatory and based upon data furnished by the new Henry Draper Catalogue, however, reveal that there are many faint helium stars beyond and independent of this local group. These fainter stars are confined closely to the vicinity of the Milky Way, lying within a belt only ten degrees wide on either side of it. Some of these stars must be at distances of thousands of light-years from the earth. It has been found also that the distribution of helium stars is not uniform along the Milky Way. In some regions they are grouped more densely than in others and the southern sky is particularly rich in stars of this class.

Just as the Columbuses and Magellans by means of their ships made voyages into the unknown regions of our earth and brought back new knowledge of the size and shape of the world on which we live, so these explorers of the skies with their spectroscopes seeking out the helium stars are adding to our knowledge of the star-lit universe of which our planet is a part.

NEW MUSEUM INTERPRETS AMERICAN ABORIGINAL LIFE

New light from all directions breaks in upon the life of the aborigines of the Western World through the study of the vast collections of the Museum of the American Indian, Heye Foundation, New York, which was opened free to the general public November 15.

This is the only museum in the world devoted exclusively to the preservation of the records of the races which were living in the Western World when Columbus reached these shores, and contain 1,800,000 specimens. The great problems to which it is dedicated include the unveiling of the mystery of the origin of the so-called Red Men themselves. It is within the range of possibility, in the opinion of George G. Heye, the founder of the museum, that this goal will be reached.

The building of the Museum of the American Indian is situated in Broadway at 155th street, close to the museums of the Hispanic Society and of the American Numismatic Society and the quarters of the American Geographical Society. The rearing of the whole important group was due primarily to the zeal of Archer M. Huntington, who gave the site for the Museum of the American Indian and as one of its trustees gave liberally to its building fund.

[1] For a statement concerning Science Service and the reasons for printing its news bulletins in this place, see the issue of Science for November 24.

The specimens are shown on three of the four floors and at the top of the building is a commodious work room given to the cleaning and preparation of the collections for display. Although this museum is devoted to delving into the past, it is conducted in accordance with the principles of modern business efficiency. The installations are in the latest types of cases. Already the storage vaults in the basement are filled, and many of the bulky specimens which can not be shown at present, are housed in another building which is almost as large as the museum itself.

There is a novel system of installation, introduced for the first time in the United States, through which the public can see what is not in open view without asking for it. Under many cases, there are drawers which the visitors may pull out and view objects under their glass tops. The students and the research investigators also have access to the collections in storage, all of which have been systematically catalogued by the director himself. There is not a bit of bone or a potsherd in the whole institution which can not be instantly found for purposes of comparison and research.

If some one should come in with a fanciful theory that the Australian bushmen and the American Indians had some relationships because both used boomerangs, he would see that such a comparison did not hold good very far. The Indian rabbit stick is not a boomerang, although it looks a little like that famous weapon, because it really does not come back. Fact can thus be quickly separated from fancy by bringing the objects themselves quickly to the study of the investigator.

"The trustees of the Museum," said Mr. Heye, "wish to make it clear that the objects which are assembled here are of great practical value, aside from the historical and archeological interest attaching to them. This is realized, for instance, by many manufacturers of textiles who have been making use of ideas gained from our collections. They have been sending their designers here even before the museum was officially opened and they inform us that they have found the inspiration of many new designs that were adapted from what was seen here. We think also that the textile industry will find data to guide it in dyeing operations, as many of the objects here, centuries old, were dyed with vegetable colors which to all appearances are as fresh as they were when first applied. We believe also that, although modern machinery has outdistanced the Indian craftsmen in speed, the industries of the twentieth century will find many hints in the synoptic exhibitions of basketry, ceramics and carving which we have installed. In every way the desire to serve the public is uppermost."

The board of the museum consists of Harmon W. Hendricks, James B. Ford, F. Kingsbury Curtiss, Archer M. Huntington, Minor C. Keith, Clarence B. Moore, F. K. Seward, and Samuel Riker, Jr.; Mr. Heye, also a trustee, is chairman.

AIRPLANE CAMERA SURVEYS MISSISSIPPI DELTA

For the first time the great delta of the Father of Waters, the Mississippi, has been surveyed with true accuracy, is announced by the U. S. Coast and Geodetic Survey. From the air, by using cameras, that great fan-shaped marshy region stretching 600 miles into the Gulf of Mexico was charted, and important shifts of land and water were discovered.

Formerly it was necessary to survey it from boats, using tall signals and special ladders and tripods, on account of the prevalence of marshes and tall vegetation. Much of it is inaccessible on foot. For these reasons the topography of this area has always been largely a matter of guesswork on the part of surveyors and engineers. A seaplane, camera and men were furnished for the survey by the navy, and pictures were taken of the delta from a height of 8,000 feet. Over a thousand photographs were subsequently formed into a mosaic or composite picture.

Many totally unknown lakes and ponds were discovered by the aviators. Old stream-beds and changes due to over-flowing banks could be traced. New sub-deltas were found that had formed since the last survey. Some places existing on the last chart have either ceased to exist or have altered completely in form.

The most important of these changes is in the vicinity of the South Pass, the main entrance to the river. Former surveys showed the west bank of this pass as a marshy area extending out into the gulf for a distance of over four miles. Now, according to this recent photographic mapping, it is merely a narrow strip, so narrow that it is giving the engineers considerable concern as a new "crevasse" may break through at any time, completely altering the mouth of the river.

Owing to the many forces constantly at work on the delta, changing the contour of the coast line, producing entirely new areas and completely wiping out others, it has been necessary to survey it frequently. With aerial photography, this can be accomplished in much less time and with more accuracy than by the old methods. As it is

a region of practically no difference in height such as would cause errors in scale, it is admirably suited to this method of surveying.

VACCINE THROAT SPRAY FOR PNEUMONIA

It may soon be possible to spray your throat and so become immune to pneumonia infection. Dr. Russell L. Cecil and Gustav I. Steffen of the Hygienic Laboratory of the U. S. Public Health Service, working at Bellevue Hospital in New York City, have completed experiments on monkeys that suggest that considerable immunity against virulent pneumonia can be obtained by the mere spraying of the throat with pneumococcus vaccine.

Monkeys can be completely protected against pneumonia by injections of the vaccine under the skin, and recent tests prove that injecting the vaccine directly into the trachea or windpipe, leading from larynx to lungs, is just as completely effective. Although throat spraying did not produce complete immunity in the case of monkeys, the bacteriologists believe that it may prove effective when used on a human being. They found that monkeys when having their throats sprayed closed the opening into the windpipe and the vaccine did not get a fair chance to act. The human trachea could easily be reached by the spray and immunity produced.

Protection against pneumonia produced by spraying or injection of vaccine into the windpipe probably extends only as far as the cells that would be first attached by the microbes producing pneumonia, as tests indicate that a protective substance is not formed in the blood as in the case of smallpox or similar immunization. Further tests to amplify the experimental data and perfect the methods are to be undertaken in order that practical use of protection against pneumonia can be achieved at the earliest possible time and the greatest possible safety.

During the war, Dr. Cecil and collaborators tested the prophylactic value of pneumococcus vaccine on recruits in the U. S. Army and found that the cases of pneumonia were few in the organizations that were treated with vaccine injections under the skin. There were some severe reactions at the time of the inoculations, however, and further research was thought advisable before active immunization against pneumonia would be practical in civil life. For this reason experiments leading to the spraying method were undertaken.

The vaccine used consists of a salt solution suspension of killed pneumococci, the microbes that produce pneumonia. As many as 120,000,000,000 pneumococci are used in a single vaccination experiment.

In 1920 pneumonia was responsible for 137.3 deaths out of every 100,000 people in the United States, and in fatality it was outranked by only tuberculosis and organic heart disease. In 1918, when influenza deaths mounted to the high total of 300.8 per 100,000, frequent pneumonia as an after effect caused a pneumonia death rate in that year of 286.2.

Through the use of pneumococcus vaccine and further experimentation, it is probable that these high rates will be greatly reduced when the vaccination against pneumonia is practiced widely. Eventually it may even be possible to control this respiratory disease as completely as smallpox, public health experts believe.

GLUCOSE RECOMMENDED AS AUTO RADIATOR ANTI-FREEZE CHEMICAL

Glucose is recommended as a preventive of automobile radiator freezing by Dr. Charles H. LaWall, Department of Theoretical Pharmacy, Philadelphia College of Pharmacy and Science. "For four winters past I have successfully employed commercial glucose with unquestioned efficacy and with no detrimental results whatever," explained Dr. LaWall.

He believes that glucose is superior to anti-freezing mixtures containing denatured or wood alcohol, glycerine, or some chemical salt such as calcium chloride. The ordinary confectioners' white glucose is preferred, although on one occasion he used the glucose sold for table use.

The amount necessary is between 15 and 20 per cent. or about a pint and a half of glucose to a gallon of water. The glucose may be mixed with enough warm water to completely dissolve it and then added to the remainder of the water in the radiator. No further addition or attention is necessary except to replace the water lost by evaporation. When warm weather arrives the radiator should be emptied, rinsed out and filled up with plain water.

"In addition to using the mixture practically for four years with satisfactory results I also performed some experiments to determine the congealing point of such a mixture," said Dr. LaWall. "I found that it begins to get slushy at about 10 degrees above zero Fahrenheit, but that it does not actually freeze and harden even at 6 degrees below zero Fahrenheit."

"Glucose does not corrode nor affect metals; in fact, it prevents such action by virtue of its

SCIENCE NEWS

LIFE ORIGINATED WHERE TIDES EBB AND FLOW

Science Service

In a shallow brackish water, warmed by the sun to temperatures such as occur in tidepools of to-day, the forerunners of living things as we knew them must have originated, Dr. D. T. MacDougal, director of the department of botanical research of the Carnegie Institution of Washington, told the Royal Canadian Institute in describing what the scientist knows of the beginnings of life.

''The first form of life on this globe must have been minute masses of primordial jellies,'' said Dr. MacDougal. ''The beginnings of life could not have been in the monotonus immensity of the seas, which are really a uniformly salt solution with but minute variations. Where the sea met the land, however, many new combinations were possible. There was no soil on the land, for this is a product of plants and animals. The landscape was of bare rocks, sand and water. Rapid alternations of sunshine and clouds with abundant rains would have characterized such a time, and volcanoes may have belched out earth encircling volumes of ashes and gases, some of which would come down with the rains. Hydrocarbons, ammonia, hydrogen phosphide and other necessary compounds might thus have been brought together accidentally but frequently with the result that there may have been formed countless masses of matter which might have become the basis of changes upon which life might be developed.

''In any case the compounds formed, which might have been jellies, did not fall into the way of beginning life as we know it until it became the seat of changes by which organic compounds were formed. For this to have happened, the colloidal or jelly condition must be assumed. This formation of additional masses of jelly and retaining them would go on until a certain size was reached, when fission or division would ensue as a drop of water too large divides into two smaller ones. This would have been the beginnings of growth and reproduction which are to-day the fundamental phases of biology.''

The basis of all life from moss to men is protoplasm, a jelly-like substance, said Dr. MacDougal. The way in which this delicate jelly acts is universal, but its make-up is infinitely complex, although all protoplasm is made up of four general classes of substances, albumins, gums or mucilages, lipoids or fatty substances, and soaps.

''Somewhere in the ever more complex web of life the sun-traps or screens of coloring matter, which absorb and use the energy of certain rays of light in running the protoplasmic mill of plant life were made,'' said Dr. MacDougal. ''These may have been of various colors, absorbing different patterns of the spectrum. The type of screen which has survived is that of leaf-green or chlorophyll. The chlorophyll of the plant cell absorbs radiations of certain wavelengths and the derived energy is ultimately used in the formation of sugars, and other chemical combinations. Transformations quickly follow, which result in nitrogenous substances. These products of the leaf mill are absolutely fundamental to the existence of the living world.

''The formation of coal beds was the final result of this photosynthesis of bygone ages, and when the accumulated remains of millions of years of the activity of vegetation is used the race will face the sternest necessity which it has yet encountered. We may discover other coal deposits, find new subterranean lakes of oil, get gasoline from shales, make use of corn cobs and seaweed, convert the power of our streams and harness the tides, but these are but petty economies deferring the day when, all of these proving inadequate, the major activities of the race, civilization in its present movement, and indeed the actual existence of man, will depend upon direct use of the energy of sunlight.''

CIVILIZATION MUST FAIL UNLESS SOLAR ENERGY IS UTILIZED

Science Service

Our great civilization is ''a most squandrous and profligate one and is using the principal of its legacy in numberless new ways,'' Dr. H. A. Spoehr will declare in the forthcoming issue of the *Journal of Industrial and Engineering Chemistry*. Dr. Spoehr has been working for many years at Carmel, California, in the Coastal Laboratory of the Carnegie Institution of Washington, on the question of how plants are able to make use of the energy of the sun's rays, and he has come to the conclusion that the solution of this problem is the task of the twentieth century and demands the cooperative effort of scientists in all fields.

"The destiny of civilization is guided by and reflects the amount of available energy," Dr. Spoehr will say. "When coal and oil are exhausted the daily ration of solar energy will represent almost the entire means of livelihood; our mushroom civilization must pass like the historic empires of the past and we may expect the reappearance in the world once more of galley slaves and serfs."

There is as yet no adequate substitute known for the fossil fuel that we have been using so lavishly during the last half century. A year's consumption of coal at the present rate represents the accumulation of hundreds of years. The date of depletion of the petroleum supply of the United States is clearly in sight. Water power would be insufficient, even if we could use every drop that fell in the country for running machinery. Alcohol seems the most promising substitute for mineral oils as a motor fuel and this can be made in any quantity by the fermentation of various kinds of vegetable matter. But this in any case requires the setting aside of large areas of land for the purpose. If, for instance, corn were to be used for the manufacture of fuel alcohol it would require more than four states the size of Ohio to grow the corn necessary to produce the seven and a half billion gallons of alcohol that would be needed to replace the five billion gallons of gasoline now consumed annually. But we can not afford to reduce our food to furnish our fuel.

Nature's method of utilizing solar energy by means of the green leaf is, as Dr. Spoehr will point out, "exceedingly inefficient and wasteful." But "it is the duty of the scientist to learn the precise manner in which this is accomplished. He need not be timid about competing with nature. He has many cases to his credit of surpassing the processes of nature both in efficiency and reliability. The most promising outlook for success in this field would be offered through an organization by which information from the various allied fields can be collected and focussed on the chemical and energy changes taking place in the process of photosynthesis."

PEAT MAY SERVE AS LOCAL EMERGENCY FUEL

Science Service

Facing a cold winter with many consumers none too certain of their coal supply, the country has had its attention called to the fuel resources of the country as never before. People who have thought of peat as a product of the bogs of Ireland and a poor substitute for wood and coal are beginning to learn that this excellent fuel lies in rich deposits in New England and the lake states, the very regions expected to be hardest hit by the present coal shortage.

About 20,000,000 tons of peat are used in Europe every year, but in the United States there are deposits estimated to contain 14,000,000,000 tons, an amount sufficient to supply Europe's present annual rate of use of this material for 700 years, it has been estimated by geological experts.

A large part of this peat is well adapted to power production or for use at the bog for the generation of electricity. The enormous deposits in New England could be used by the lime and textile industries cheaper than coal, experts believe, while those private consumers living near the peat fields could be economically supplied with peat for open grate fires, fall and spring furnace fuel, kindling and auxiliary fuel for use with coal during the severe winter months, and cooking range fuel.

Peat represents the arrested decay of vegetable matter. When plant remains fall upon drained soil they are promptly attacked by bacteria and soon disappear, but when the plant falls into water the change is different from decay when exposed to air. The acids formed slow up the decay by destroying the bacteria.

Peat is produced by this arresting of the decomposition of roots, trunks of trees, twigs, shrubs, mosses and other vegetation saturated or covered with water. It contains a large proportion of the carbon of the original plant material. It is almost always a surface deposit, formed under conditions favorable to luxuriant growth of plants and their incomplete decay.

Most coals were once peats, but it does not follow that the peats will necessarily become coal in course of time. When the peat is formed, carbonization is largely stopped, unless it starts again and the peat bed is buried beneath muds, sandstones, limestones, or other deposits of sediment and subjected to heat and pressure, coal will not be created. A twelve or fourteen inch seam of coal is equivalent to a good peat bog twenty feet deep. The largest peat deposit in this country is in Minnesota and covers nearly 4,000 square miles or about 2,500,000 acres.

This fuel has a higher heat value than wood, is more easily ignited than coal, requires less

draught. Peat burns freely when dry, and makes a hot fire. It is lower in heat value per pound than coal but it gives out proportionately more heat, due to its relatively higher oxygen content.

There is no soot from a peat fire, but if not handled properly a light smoke carrying the odor of burning leaves may get into the room. Peat makes fine kindling for a hard coal fire and is especially good to wake up such a fire quickly without shaking down the furnace. If a few blocks of peat are thrown on top of the fire and the draughts opened, surprising results are obtained.

Too much of this fuel should not be put on at a time. Peat is about twice as bulky as coal and can not be transported long distances at a price that is economical, but it does offer a good emergency substitute for coal and is especially useful as a supplementary fuel for use with coal.

OYSTER CHANGES SEX THREE TIMES A YEAR

Science Service

THE remarkable and long disputed changes in the sex of the edible oyster are settled by researches of Dr. J. H. Orton, of the British Marine Biological Association at Plymouth, and Dr. R. Sparck, of the Danish Biological Station at Limfjord. Working independently, both these naturalists announced that these bivalves may be male, then female, then male again all within one year. The rate of change, Dr. Sparck believes, depends largely upon the temperature of the water.

The oyster either never has possessed, or more probably has discarded, all the trappings of sex. There is a single genital gland and a single duct. At one time male cells are produced and discharged into the sea-water in clouds. At another time egg cells are produced and are fertilized by male cells drawn in from the surrounding water.

There is no difference in the external appearance of the oyster in its male and female phases, although if the shells be opened, microscopical examination of the sexual gland shows the difference between mobile sperm cells and the large inactive egg cells. When it is sexually mature for the first time the oyster is male. Next, after a varying period, it becomes a female, and very soon after the discharge of the embryos it again begins to liberate male cells. One oyster has been known to change three times in a single season.

Dr. Sparck, however, thinks that the duration of the male stage depends on the temperature. The colder it is the longer the male stage lasts. The oysters in Southern Europe have been found to begin breeding at an earlier age than those of Northern Europe. Oysters in the northern waters can produce young only every third or fourth year, and therefore only three or four times in their whole life.

USEFUL POWDERS FROM WASTE LIQUIDS

A. C. S. News Service

THE atomizer has gone into business for itself and is making big dividends out of wastes. Such evil-looking liquids as the greasy waters from fish oil plants, waste sulfite liquors from paper mills, and the waters in which raw-wool has been washed, yield wealth when forced through the atomizer.

Walter H. Dickerson, a member of the New York Section of the American Chemical Society, gives a description of the recently invented machinery which reduces materials from a liquid to a dry powder condition. The process is described, briefly, as one of "reducing the material to be dried to a finely divided state by spraying or atomizing; exposing the spray to heated air or gas and quickly effecting the evaporation of the moisture contents."

Mr. Dickerson believes that some day the Chicago River may be run through such a machine, to the greater beauty of the stream itself and to good economic advantage. "Indeed, this would be entirely possible and advantageous," said he, "if the waste heat that escapes up the flues of manufacturing plants in the industrial district of Chicago near the river could be utilized for drying operations."

In paper manufacture, chemists have found, only about fifty per cent. of the wood used in making pulp goes into the paper. The remaining portion of the wood passes off in the waste waters from the plant. Analyses showed that these waste waters contained high proportions of lignin—the adhesive material in wood. This is not required in paper but is very useful for the making of binders—cores for use in making molds used in foundries, and in making coal briquettes. The spray drying process makes the recovery of the lignin a profitable operation.

The waste waters from fish oil plants yield materials good for fertilizer and for poultry food. Waste waters from wool cleansing plants give grease, nitrogen and potash. Other industrial uses of the process include a new method of making starch, in that it can be reduced to the form of fine powder, through the atomizer and

drier, cheaper and faster than by old methods of drying.

Wastes from the sugar mills of Cuba and Louisiana are being made into stock foods and the pineapple juices which heretofore were allowed to run into the ocean from the canning plants in Hawaii, are now being preserved and converted into fine sugars. In the manufacture of powdered milk one of the difficulties encountered has been that of temperature control. The product often has a burnt or ''caramel'' taste. By the spray drying process this has been eliminated.

MAKING THE DESERT SAFER

U. S. Geological Survey

To those who have never been on a desert the word ''desert'' conveys the impression of a barren waste incapable of supporting life, a perilous stretch of waterless, lifeless land that separates areas of fertile land on either side of it. The word ''desert,'' however, may have diverse meanings, for some deserts are much more inhospitable than others. Travel through any wide area of desert is nevertheless fraught with danger, for in such areas springs, wells and water-holes are few and far between, and our American deserts have, year after year, taken their toll of human life. The recent work of the United States Geological Survey in mapping certain desert areas in the southwest and in erecting at suitable places signposts giving directions and distances to springs and waterholes is therefore of special interest. In 1917 the Geological Survey, under authority contained in an act of Congress making a small special appropriation, erected signposts in the most dangerous parts of our southwestern deserts, giving directions and distances from watering place to watering place. The results of this life-saving work of the Geological Survey are being published in a series of guidebooks.

One of these guidebooks, the third of the series, by C. P. Ross, has just been published. It describes desert watering places in the lower Gila region, Arizona, including approximately the triangular area between Phoenix, Yuma and Parker. It contains three large maps of the region, shaded to indicate the relief and showing the location of the roads, the wells, springs and other watering places, and the signposts erected by the Geological Survey. The maps are the most complete and accurate yet published for this region. The relief shading brings out strongly the larger features of the topography and makes the maps readily understandable, even by those who have no technical training.

The paper contains detailed logs of the roads in the region, including not only those of the principal automobile routes but those of branch roads that lead to remote parts of the desert, which are seldom visited and little known. These logs show in heavy type the points at which water can be obtained. There is also a list of watering places, with brief information as to their location and availability.

The introductory part of the guidebook contains detailed information regarding difficulties encountered in traveling through the desert and suggestions for surmounting them. Any one who intends to travel in this region should consult one of these guidebooks. Copies of this publication, which is numbered Water-Supply Paper 490-C, and entitled ''Routes to desert watering places in the lower Gila region, Arizona,'' have been sent to the post offices, the chambers of commerce, and the principal hotels and garages in the region and can be consulted at many of these places.''

SCIENCE ITEMS

Science Service

Denial of a rumor spreading through this country that the International Research Council, the world organization of science, took action at its Brussels meeting last July excluding Germans and Austrians from its meetings and those of the international affiliated unions for twelve years has been made by Dr. Vernon Kellogg, permanent secretary of the National Research Council, which represents the international organization in America. ''No such action was proposed or taken,'' said Dr. Kellogg. ''No German or Austrian organizations have as yet been admitted to the International Research Council, but their admission is probably a matter of the near future.''

Scots realize that the ladies will have their furs and that the trappers can not keep up with the demand. Silver fox raising which was started in Ross-shire two years ago has proved a success and the new industry will be extended. The Highlanders may seem personally partial to bare knees, but their well-known racial thrift convinces them that the fashion for furs should be catered to. The Scottish Board of Agriculture is encouraging the fox breeding.

In order to prevent the spread of the bubonic and other plagues carried by rat-fleas, 330,000 rats have been captured and examined at Sydney.

SCIENCE NEWS

DR. LANGMUIR ON ELECTRON EMISSION

Recent discoveries in electron emission and current-control were described in a series of three lectures by Dr. Irving Langmuir at Carnegie Institute of Technology, Pittsburgh, on November 27, 28 and 29. Dr. Langmuir's auditors during the series were scientists, engineers, industrial executives and students of Carnegie Tech, and his world-wide reputation as a research physicist with the General Electric Laboratories at Schenectady attracted capacity audiences. Synopses of Dr. Langmuir's three lectures follow:

ELECTRON EMISSION FROM HEATED METALS

When metals are heated in high vacuum, electron, or atoms of negative electricity, evaporate from their surface. If there is another electrode in the evacuated space which is given a positive charge the electrons drift over to this electrode (anode) so that a current flows between the two electrodes. Dushman has recently derived an equation which should supersede the well-known Richardson equation, giving the relation between the electron current and the temperature of the cathode. The advantage of this new equation is that there is only one constant which we need to know for each different cathode material, instead of two constants which were necessary for the Richardson equation.

The electron emission from a large number of different materials has recently been measured. The thoriated tungsten cathode gives a current at a temperature of 1,500° absolute, which is about 130,000 times greater than that from ordinary tungsten. Measurements have also been made of cathode materials that have even much greater emissions.

In order to get all the current that a cathode is capable of giving, it is necessary to apply to the anode a high enough voltage to overcome what is known as the space charge effect. By putting in gases positive ions are formed in the space between the electrodes, and these neutralize the negative space charge and allow the current from the cathode to pass across the space with much lower anode voltages. In other words, the effect of gases is to increase the current-carrying capacity of the two. Such an effect is used in the Tungar rectifier. Care must be taken what gas is used for the purpose, for many gases have the effect of poisoning the cathode, and cutting down its emission to a small value.

If very high voltages are used on the anode, so as to produce intense electric fields, it is possible to pull electrons out of the cathode. In fact, it is possible to pull electrons even out of cold cathodes, that is, cathodes at ordinary temperatures. The currents obtained this way from the cathode come from very minute areas, but in these areas the current density amounts to more than one hundred million amperes per square inch.

ELECTRON EMISSION FROM THORIATED FILAMENTS

The thoriated tungsten filament is a tungsten filament containing one or two per cent. of thorium, usually in the form of oxide. When such a filament is heated, to about 3,500° Centigrade, a little of the thorium oxide is changed into metallic thorium. In the meantime, however, any thorium on the surface of the filament evaporates off, leaving only pure tungsten. If the filament temperature is then lowered to about 1,800°, the thorium gradually wanders or diffuses through the filament, and when it reaches the surface, if the vacuum is very perfect, remains there and gradually forms a layer of thorium atoms which never exceeds a single atom in thickness. The thickness of this film is therefore about 1/100,000,000 of an inch, and yet this film increases the electron emission of the filament more than one hundred thousand fold.

Of course this useful film is very sensitive and needs some protection to keep it in good condition. Very slight traces of water vapor or other gases would oxidize this film and destroy it. This can be avoided by putting in the bulb some substance that will combine with the water before this has a chance to attack the thorium film. Such a substance is metallic magnesium. Furthermore, it is necessary to avoid heating the filament to too high a temperature for otherwise the film might evaporate off. It is therefore best to operate such filament within a rather narrow range of temperature close to 1,700° C., where the ratio of evaporation is very small, and where the temperature is high enough for the thorium gradually to diffuse to the surface and continually repair any damage done by the effect of slight traces of residual gases.

The thoriated tungsten filament opens up many new fields of scientific investigation. By measuring the electron currents, it is possible to determine accurately exactly how much thorium is present on the surface. An amount of thorium corresponding to only 1/1000 of the surface covered with a layer one atom deep is easily measurable in this way. It is possible to knock off a thorium film by bombarding it with positive ions, moving at high velocities, and in this way the true nature of this bombardment can be determined.

METHODS OF CONTROLLING ELECTRON CURRENTS IN HIGH VACUUM

Most of the applications of high vacuum tubes have depended upon the control of electron currents, as, for example, by the grid in the three electrode tube. The action of the grid is due to the charge on the grid modifying the space charge effect. This is the action that is employed in practically all tubes used to-day for radio transmission and receiving. There are many other methods, however, of controlling electron currents. A very important method is that used in the magneton, where there are only two electrodes in the evacuated space and the control is obtained by means of a magnetic field generated by an external coil of wire. A still simpler form of magneton suitable particularly to very large power tubes, consists of a very large filament in the axis of a cylindical anode with very large straight filaments. The magnetic field produced by the current through the filament is enough to prevent electrons flowing between cathode and anode. By heating the filament with alternating current, the current periodically falls to low value and at these times current can flow to the anode. This gives a pulsating or oscillating current, which can be used for radio transmission. A 1,000 kilowatt tube of this kind is in process of development; preliminary tests have been in every way satisfactory.

Another form of tube by which electron currents can be controlled is the Dynatron. This depends upon subjecting one of the three electrodes in the tube to electron bombardment in such a way as to cause electrons to be splashed out of it, just as water can be splashed out of a cup by attempting to fill it too rapidly from a faucet. A tube of this kind acts like a real negative resistance, and can be used for producing electrical oscillations with considerable efficiency.

One of the most important applications of electron discharges from hot cathodes is in the Coolidge X-ray tube which is now almost universally used as a source of X-rays. These tubes were first made about 1913 and are gradually being improved in many respects. The latest type of tube, suitable for use by dentists, is a small tube weighing only a few ounces, and only about three inches long. Because of the special features of this tube, the entire X-ray outfit, including the transformer, lead screen, regulating apparatus, etc., weighs only a few pounds and takes up a space of only a small fraction of a cubic foot. One very great advantage of this new form of tube, besides its convenience, is its absolute safety, even in the hands of inexperienced operators, for there are no high voltages in any part of the apparatus which is accessible.

EYE HOLDS SECRET OF TRAFFIC SAFETY

Science Service

A "LOOK-ONE-WAY" traffic system as a preventive of many of the frightful automobile accidents of America's deadly streets has been suggested by Dr. Raymond Dodge, authority on visual psychology and head of the psychological section of the National Research Council. Traffic signs, signals and routes should be determined according to a thoroughgoing study of what the human eye can see easiest.

"In the present regulaton of traffic, both driver and pedestrian never cover less than forty-five degrees of visual angle and may be required to look over an angle of over two hundred degrees. Such a range of vision is humanly impossible without moving the head from side to side. This always involves an interruption in the view of the part of the street from which trouble may come. One of the greatest dangers in crossing the street comes from vehicles that suddenly emerge from a side street.

"As a matter of safety there are grave doubts as to whether the present regulations that limit pedestrians to a narrow street crossing at exact intersections of streets is the best practicable solution. It may be more convenient for drivers, but the exact intersection of streets is most dangerous for pedestrians. Behind waiting cars is safer than in front of them. Twenty feet from a cross street would diminish the probability of being surprised by turning cars.

"Use of all parallel streets as one-way streets would be a great advantage. There is a slight but real difference between the sides of the street for pedestrians. It can be demonstrated that the left-hand sidewalk is safer. When the pedestrian is on the left sidewalk about to cross a street he has to watch only automobiles on his left and to the right of him, while a walker stepping off the right hand sidewalk across a street has to be alert

to possible danger on his left, to his left rear, and to his right. It is well known that the left hand side of the street should be used by pedestrians when there is no sidewalk.''

There is a very real and important problem with respect to the ideal construction of a traffic sign. How many words would be read in the available time? What would be the minimum size of letters? What should be the structure, place, color and content of signs? He contends that there is already a body of practical experience and scientific information available which would only need to be adapted to highway use and experimentally justified.

For instance, he said, it has been thoroughly demonstrated that adults do not read familiar words letter by letter but by familiar letter groups. Yet, here in Washington, we have signs reading ''Slo.'' Dr. Dodge said that when he first saw that strange sign it took him many times the effort and time to understand and interpret it that would have been sufficient for ''Slow.''

''The nature and time of hand and arm signals by automobile drivers should be also regulated. They are sometimes short, and sometimes long, sometimes early and sometimes late. The continuous indication of a driver's intentions beginning at least five seconds before a movement is executed and continuing until a movement is completed would be a great advantage.''

Traffic policemen should wear white sashes and trolley posts should be painted in alternate bands of white and black to increase their optical usefulness.

PREDICTS WINTER WEATHER BY SUMMER-TIME TEMPERATURES

Science Service

FORECASTING the rainfall for the coming winter and spring from the past summer's ocean temperatures, Dr. Geo. F. McEwen has predicted that the Southern California coastal region will receive about one half inch less than its average rainfall during the season 1922-23. He suggested the possibility of applying the same system to predictions over more extensive areas. Dr. McEwen is neither a goose-bone prophet nor a crystal gazer, but the oceanographer connected with the Scripps Institution for Biological Research. He bases his system of forecasts on carefully worked out observations during the last six years.

These observations show that when the ocean temperature averages colder than usual the rainfall is heavier than usual and when the summer seas are warmer than the average the subsequent rainfall is smaller than the average rainfall. A fall of one degree in temperature corresponds on the average to an increase of about two inches in the rainfall.

Rainfall in the Southern California coastal region depends mainly upon the flow of the moisture-laden air from the Pacific and is proportional to the amount of the air transferred.

This in turn depends on the formation of a belt of high air pressure over the continent, he explains. In summer the barometric pressure is greater over the oean than the land for two reasons. The wind velocity over the smooth water surface averages two or three times as great as that over the relatively uneven land and in summer the air flows from the land. But as the season advances to winter, air flows over the land from the water and carries a great mass of air from the Pacific Ocean to the North American continent.

Enough pressure measurements over the North Pacific on which to base predictions being unavailable, Dr. McEwen used the known relation between pressures and surface ocean temperatures. The velocity of the winds which move clock wise over the Pacific depends on the air pressure and the upwelling of cold bottom water along the coast and therefore the rate of cooling of the surface water is proportional to the wind velocity. The lower the ocean temperature at or near the surface during the late summer and autumn, he declares, the greater must be the intensity of the ocean belt of high air pressure and accordingly the greater will be the expected seasonal rainfall over the coastal region of Southern California.

When asked which days would be the rainy ones, Dr. Ewen explained that long range forecasting is only done at the sacrifice of details and for daily information he advised waiting for the regular government forecast issued twenty-four to forty-eight hours in advance.

Another example of successful long range forecasting is the prediction of the monsoon rainfall of India, months in advance, by means of observations on atmospheric pressure distributions over vast areas of land and water.

ECLIPSE EXPEDITIONS IN AUSTRALIA

By Isabel M. Lewis, U. S. Naval Observatory
Science Service

NEVER have eclipse expeditions been favored with fairer skies than spread over the entire continent of Australia on the eventful day of the total solar eclipse of last September. From

Wallal on Ninety-Mile Beach in northwestern Australia to Goondiwindi and Stanthorpe in Queensland all forms of eclipse observations were made by a host of astronomers from many lands.

Shadow-bands, fleeting lunar shadow, a never-to-be-forgotten pearly coronal light, four, enormous, equatorial streamers, petal-formed and arched, a million and more miles in length, five brilliant planets and a star of first magnitude, Spica, near the sun, eclipse paraphernalia of all kinds and shapes manipulated by leading astronomers from many lands, even a governor in attendance, were features of this eclipse. And what more was to be desired to make a perfect success of a perfect eclipse day?

The most important feature of the eclipse from the astronomical point of view was the successful exposure of many photographic plates with astrographic telescopes at all points of observation in Australia. These plates, it is hoped, may reveal the slight displacements of the star-images from their normal positions known as the Einstein effect, due to the bending of light rays by the sun's gravitational field, which is a vital test of the Einstein theory.

At Wallal, where observations were made by Canadian astronomers, by an expedition from the Lick Observatory under Director W. W. Campbell, and by observers from New Zealand and various observatories in Australia, particular attention was given to this problem. Owing to the great clouds of dust that arose after totality was over it was impossible to develop the plates at Wallal and they were shipped to Broome, where they were developed later. The sailing of their ship made it necessary for the American astronomers to embark for home before these plates were developed. It is only recently that these developed plates arrived in the United States and the scientific world is now awaiting with the liveliest interest the announcement of the results of the measurements of these plates which it is hoped will be forthcoming before many days have passed.

Astronomers from observatories in eastern Australia who made observations at Goondiwindi and Stanthorpe, though enthusiastic about the eclipse as a scenic feature, deplore the fact that the "seeing," as astronomers call that state of the atmosphere that is such a vital factor in determining the value of observations, was particularly bad. As a result they are pessimistic as to the value of the measurements of the star-images that will be made on plates taken at these places. The eclipse occurred at these points in the late afternoon so the altitude of the sun was much lower than at Wallal where the eclipse occurred about 1:30 P.M. The effects of atmospheric refraction and other atmospheric disturbances were consequently more pronounced in eastern Australia than at Wallal. It is generally felt that the most valuable results will be the ones obtained from plates taken at Wallal, though Director Dodwell, of the Government Observatory at Adelaide, is said to have made some excellent observations at Cordillo Downs in central Australia.

Instruments were transported to this point from the railroad terminus by camel train, an arduous undertaking which took six weeks time. It is reported to have been attended with complete success, though no results of the reductions of plates in Australia are yet available.

SCIENCE ITEMS

Science Service

A FARM which raises diamond-back terrapin for the market by thousands has been conducted for many years near Savannah, Georgia.

ELEVATOR screenings, which grain elevators have been paying to get rid of, have been successfully used to fatten sheep in Canada.

FORTY THOUSAND separate and distinct species of locusts, the historic pests which annually cost the world about $100,000,000 have been identified and collected by American scientists.

THE reddish color of Mars is supposed to be due to great stretches of desert on that planet.

THE ZR-1, the airship now being built for the U. S. Navy, will be 680 feet long, 78 feet in diameter, and have twenty gas bags with a total capacity of 2,155,200 cubic feet.

BY making synthetic thymol, a drug that is used extensively as an antiseptic and a specific against the hookworm disease, Department of Agriculture chemists have again vanquished Nature at her own game. Thymol is now imported from India, where it is found in the seed of one of the plants growing there. The chemists have found that artificial thymol identical with the natural product can be made from cymene, a waste product in the paper industry. Thymol is now sold for $4.50 a pound, but it is estimated that the synthetic product can be made for about $2.50 a pound. As there are 2,000,000 gallons of cymene wasted annually in this country and Canada, chemists expect that this country will soon be able to produce all the thymol consumed here.

SCIENCE NEWS

ALL STARS PROBABLY HAVE SAME COMPOSITION

Science Service

CONTRARY to what has formerly been supposed, hot stars and cool stars probably are very nearly the same in chemical composition, Dr. Henry Norris Russell, director of the Princeton University Observatory and research associate of the Mount Wilson Observatory, declared in an address before the Carnegie Institution of Washington here tonight.

"Recent physical research has told us so much about the properties of atoms that we have come to a new understanding of what we observe in the stars," said Dr. Russell. "Our knowledge of the composition of the stars depends upon the lines which we observe in their spectrum and which show the presence of many of the familiar chemical elements.

"The atmosphere of the cooler stars are full of the vapors of metals, while in the hottest stars the metals seem almost to disappear and to be replaced by gases such as nitrogen and helium. It has been supposed that this means that the stars differ in chemical composition, or that atoms of one kind are changed into those of another kind at such high temperatures; but in the laboratory we can subject atoms to far more violent treatment than they receive in the atmosphere of the stars without the least sign of their changing into atoms of other sorts. We can, however, knock one or two electrons off the atoms, and each time an electron is removed the spectrum of the light given by the atom changes entirely. After two or three such changes there are practically no lines left in the accessible part of the spectrum, though there may be strong radiations of ultra violet light or X-rays."

Dr. Russell said that in the hotter stars the atoms of the metals are in this condition and though still present, do not reveal themselves to the spectroscope. On the other hand, he said, gases like helium are so hard to set shining that it is only in the hotter stars that we can tell that they are there. The most abundant elements, such as hydrogen, show their presence when less abundant ones would disappear.

"This theory of ionization makes it probable that all the stars are very similar in actual composition—the observed differences arising from differences in the state in which the atoms find themselves in their atmospheres," he concluded. "On these principles it is already possible to reach conclusions about the temperature and pressures in the atmospheres of the stars. The pressures seem almost always to be very low and the gas so rarified that we would almost call it a vacuum in the laboratory. The temperature in the hottest stars probably reaches 25,000 degrees."

Deep in the interior of the stars the temperatures are enormously higher and are probably millions of degrees, Dr. Russell estimated. Here it is possible that once in a while atoms of one element do become changed into atoms of another kind. There is reason to believe, he said, that if hydrogen atoms are changed into others an enormous amount of heat would be set free, which would suffice to keep the stars shining for billions of years.

TRACES OF CHEMICALS DO GOOD AND HARM

Science Service

NEGLIGIBLE traces or impurities may mar or make a chemical process or a product, Jerome Alexander, consulting engineer of New York, told the American Institute of Chemical Engineers at its annual meeting.

The Germans scrapped their own poison gas plant when they learned how the British made their "mustard gas" or diethyldichlorsulfide during the war by analyzing it and determining its impurities, he explained in labeling such traces telltales.

"Among the traces that help are vitamines," he said. "Also the value of traces of salts in water, for brewing, baking and other operations, is beginning to be appreciated, and we hear now of these being specially added. While 0.216 per cent. of arsenic reduces the conductivity of copper 39 per cent., pure copper rolls much less readily than that containing arsenic, and yields tubes that corrode ten times more rapidly. A little lead in brass makes it machine easily and prevents chattering. The reputation of Swedish iron is due to the manganese impurities it contains. A little copper inhibits the corrosion of steel. Small quantities of barium harden lead and make it ring like a bell. In many alloys small quantities of aluminum deoxidize the melt and prevent atmospheric corrosion of the casting. In the electrodeposition of metals small quantities of 'addition compounds' which are in many cases protective colloids, give a desirable cathodic deposit. Auer von Welsbach found the great effect produced by ceria in the thoria mantle, the optimum value being about 1 per cent. Thus in a certain flame a pure thoria mantle gives 7 candle power, whereas the standard mantle with 1 per cent. ceria gives 88 candle power. With ¼ per cent. ceria the luminosity sinks to 56 candle power, while with 5 per cent. ceria it is only 44 candle power. Goodyear had no trouble in vulcanizing his rubber because of the various nitrogenous impurities present in the crude product of his day. With the advent of modern pure plantation rubber, it has become necessary to add various accelerators. Old patents show that celluloid dissolved in the "wood spirits" of that day, which contained ketones in considerable quantity, but refined wood alcohol is not a solvent for it. Traces of lead tetra-ethyl will take the 'gasoline knock' out of an internal combustion engine, even 0.06 per cent. being effective."

But other traces hinder rather than help, Mr. Alexander said. Iron was described as powerful in small amounts. A manufacturer of brewing sugar came to see how his new product was working in a brewery and found the brew-master running an inky black liquid into the sewer, he related. Being a chemist, he immediately wired his analytical department that their product was full of iron, and in reply received a telegram saying that the batch complained of had only 0.002 per cent. of iron. But that was enough to make plenty of ink with the hop tannins.

"In making dry batteries, traces of iron in the pyrolusite or of copper in the ammonium chloride are highly objectionable," he said, giving further examples. "One part of sulfur per million in cocoanut oil is said to create trouble in the soap making process. In lead burning traces of arsenic in the hydrogen used to make it impossible to secure a good joint. Attempts to make a good nickel steel were for years frustrated by impurities present in the commercial nickel of the day."

PLAGUE RATS MENACE HAWAII; BUT POISON CAKES COMBAT THEM

Science Service

LIVES and fortunes are the stake in a tremendous war against field rats now being conducted by the territorial board of health and the sugar plantations of the Hawaiian Islands. The results of this war are likely to be of assistance throughout the world in campaigns against the rat, one of the worst enemies of mankind.

It is stated by those who have studied the problem at the experiment station of the Hawaiian Sugar Planters' Association that the common field rat destroys sugar cane on these islands valued at $100,000 each year, and probably the damage is in excess of this sum.

Worse than this huge tax on the industry, however, is the ever present danger of bubonic plague from infected rats. Twelve deaths among Japanese and Filipino plantation laborers occurred within the past few months on the Hamakua coast, island of Hawaii.

A new and successful method for wholesale killing of rats has just been discovered. Poison rat-cakes are being manufactured by the millions at Honokaa plantation and are spread broadcast through more than ten thousand acres of cane fields and waste areas, resulting in the death of so many rats that where the board of health previously trapped over two thousand rats a month, it now catches only about fifty.

The poison used is barium carbonate, deadly to rats and field mice, but only slightly poisonous to human beings, livestock and poultry. The poison is mixed with flour dough and made into small round cakes less than an inch in diameter and about one fourth inch thick.

A new and very important feature, for which patents have been applied, is the coating of paraffine over the cakes to protect them from dampness and moulding, thus insuring their effectiveness for many months. A very small nibble at one of these poison cakes will kill a mouse, while a piece as large as a small pea will kill a rat. Honokaa Sugar Company is manufacturing these rat-cakes chiefly for its own use, but it is also selling some at nominal cost for trial use on other plantations.

A man on horseback, dropping a rat-cake about every ten feet, can cover an area of 35 acres in one day, at a total cost of sixteen cents per acre. This done two or three times a year is sufficient to control thoroughly this very serious pest.

Other poisons have been tried at Honokaa. The best of these is strychnine wheat placed in small bamboo tubes and wrapped with paraffine paper. The usual methods of poisoning are intended for use on a small scale and no effective system has been evolved previously which is cheap enough to use over large areas and impervious to the weather.

Many efforts were made along other lines before

poisoning was decided upon as the one effective plan. The U. S. army stationed in the islands had offered assistance in the way of poison gas experiments, as it realized the seriousuess of the plague situation.

C. E. Pemberton, assistant entomologist at the sugar planters' experiment station, was assigned to investigate this possible means of control, but he reported:

"The use of gas in any form for combatting rats in the cane fields is wholly impracticable. Rat burrows, deep, extensive and permanent, are common, but extremely difficult to find until the cane has been cut and the trash burned. By then the rats have left the burrows. A minute search in any field, before harvesting, would reveal most of the rat burrows present, but the time required for such work would be far too great to warrant such a procedure."

Trapping was also experimented with and found unsuitable for use over so large an area.

The board of health is leaving the experimental work to the sugar planters, aud is using its energies in cleaning up rat infested places in the labor camps. The people of Hamakua are giving the board every assistance in ridding the district of the menace. Camps are being cleaned up, rubbish is being burned and intensive trapping is conducted around houses and barns. All stray dogs and cats have been killed as it has been found that they also are capable of carrying the plague.

MESOTHORIUM

U. S. Bureau of Mines

THE chemistry of mesothorium, the radio-active element found in monazite sand and other thorium minerals, which is used as a substitute for radium in the manufacture of certain luminous paints and for medicinal purposes, is discussed in Technical Paper 265,byHerman Schlundt, just issued by the United States Bureau of Mines.

Among the thirty-odd radio-active elements, mesothorium, the first product of thorium, ranks next to radium in importance, states the author. Like radium, its disintegration products emit the three types of radiation that are characteristic of radio-active substances and that are known as alpha, beta and gamma rays. Mesothorium decays at least 250 times faster than radium, and hence in the pure state its activity, weight for weight, would greatly exceed that of radium. Although itself rayless, its first product, which is rapidly formed after mesothorium has been separated, gives a powerful beta and gamma radiation; the alpha radiatiou of freshly prepared radium attains a maximum within a month, whereas that of mesothorium increases comparatively slowly, and reaches its highest point during the fifth year after separation. Mesothorium preparations therefore must be "aged" before their full alpha-ray effect is realized in luminous products.

During the first years of separation, notwithstanding the comparatively rapid decay of mesothorium, its preparations maintain a higher gamma-ray activity than an equivalent quantity of radium. Mesothorium may thus serve as a substitute for radium, both in luminous compounds of radium and for therapeutic purposes.

Uranium ores, especially carnotite, are worked primarily for the extraction of radium—uranium, vanadium, etc., being secondary products. Mesothorium, on the other hand, is obtained as a secondary product or a by-product in the manufacture of thorium for the gas-mantle industry, its output being governed by the demand for thorium nitrate.

For a good many years the production of mesothorium in Germauy, and to some extent in other countries in Europe, has kept pace with the productiou of radium. The Germans early recognized the value of mesothorium as a substitute for radium, not only for luminous paint but also for medical purposes. Only during the last two or three years, however, has production taken place in this country. Two companies have been recovering mesothorium as a by-product in the extraction of thorium. The Bureau of Mines has had a cooperative agreement with one of these companies. Very little has been published concerning the recovery of mesothorium. Methods of measurement have been uncertain and somewhat difficult, and Dr. Schlund's paper is intended as a contribution to the chemistry of this useful and interesting element.

Experiments of the Bureau of Mines in determining the ratio of mesothorium to thorium by direct comparison of gamma activity with radium are described in this paper.

WOULD REQUIRE PEDESTRIANS TO SIGNAL AUTO TRAFFIC

Science Service

SIGNALS by pedestrians to show automobile drivers their street crossing intentions were proposed here to-day by Dr. Raymond Dodge, chairman of the psychology section of the National Research Council, as a means of making city traffic more safe.

"It is often quite impossible for a driver to determine when a pedestrian is going to start across the street, when he is going to retreat, or what direction he is going to take," Dr. Dodge said, and suggested that it would be a great help to drivers if pedestrians were required to indicate their intentions in some such way as the chauffeur is required to do in making turns.

"A simple scheme for the most desirable starting time and duration of signals can be worked out by any psychologist who knows the limitations of attention and reaction-time and will familiarize himself with the traffic situation.

"It is possible that there also ought to be tests for pedestrians as well as drivers, with distinguishing marks for incompetents. It would be some help if the driver could know that the man trying to cross the street was partially paralyzed, partially blind or deaf, had a wooden leg, or some other disability which made it difficult to take care of what he had left. As it is now, youth and old age are the only clearly marked incompetents.

Much has already been done to diminish the sources of confusion, such as the introduction of traffic signals and the establishment of zones or islands of safety where pedestrians can take their problems in smaller doses. But, if I am correctly informed, a systematic analysis of confusion of pedestrians or drivers has yet to be made. Such a study would involve the practical limits of attention and the facts of human variability. The sudden appearance of an unheralded vehicle coming around the corner, the convergence of vehicles on a pedestrian and even the blatant automobile horns themselves are worth considering as sources of confusion.

"Advantages would be derived from one-way traffic. Confusion would be diminished by uniformity of traffic rules, and signals, by better lighting of cars, and a better system of street lighting. Most street lighting involves decrease of the visual acuity by glare. Pedestrians should also have training in time and space estimation.

In addition to the possible services of psychology in the regulation of the highway, there is undoubtedly need for the services of expert educationalists," Dr. Dodge said. "The pedestrian must be trained as well as the driver of motor vehicles and the proper place for that training is in the school. It seems reasonable to suppose that one of the most important school functions in fitting the child for his environment is the ability to take care of himself on the highway. This task can be undertaken only when the regulations of the highways have reached a point where it is uniform in all the states and uniformity should only be aimed at when we are sure that from the standpoint of space and time as well as from the standpoint of the human mind the proposed regulations have been thoroughly scrutinized and revised."

"Newspaper and movie campaigns by cartoons, advice and stories," Dr. Dodge added, "should be continuous and not limited to one week in the year."

SCIENCE ITEMS

Science Service

Scientists, government officials, fruit growers and nurserymen met in Washington on November 20 to discuss means of checking the latest Japanese invasion to gain a foothold in this country. The camphor scale, a newly discovered crop insect pest, is spreading rapidly among camphor, satsuma orange, olive, privet, Japanese persimmon, fig, plum and pecan trees in Louisiana and Alabama. Drastic measures to prevent the spread into other states were suggested as the experts gathered. The insect has been traced to an importation of satsuma orange trees direct from Japan just before the plant quarantine barriers were put up in 1911-12. This scale has been classed as a menace with the Japanese beetle, the European corn-borer and the pink boll worm, which gained a footing about the same time. A federal quarantine on the two states invaded to protect the other citrus-growing regions of the country from attack by prohibiting the movement of nursery stock and other articles likely to carry the pest is being considered.

One dollar from each of the Knights of Pythias, $1,000,000 in all, has been donated by the Supreme Lodge of that order for benefit work among the lepers of Culion Island and to carry on the search for an absolute cure for that dread disease. Part of this fund will be used in the erection of a fully equipped experimental laboratory.

Pasteur, great French bacteriologist, whose centennial is to be celebrated in December, spent five years studying the diseases of the silkworm for the Department of Agriculture of France.

More than seventy per cent. of the world's production of crude rubber is consumed by American rubber manufacturers.

Algerian sheep are comparatively immune to anthrax, while all other sheep seem extremely susceptible to it.

SCIENCE NEWS

THE PSYCHOLOGY OF AUTO DRIVERS

Science Service

NATION-WIDE standardized mental tests for auto drivers to determine the kind of machine each individual shall be permitted to run is the plan for cutting down our alarming motor-car accident toll urged by Dr. Raymond Dodge, professor of psychology in Wesleyan University, and this year chairman of the division of psychology of the National Research Council.

"All persons are not equally suited to driving a car," he said. "One man in an emergency gets and acts on an idea quickly, another slowly. The time that elapses after a danger is seen until the driver can start the movement that is required to avoid it is an important factor in safety. Slow and uncertain or wavering actions are undoubtedly the occasion of many accidents. This slowness is in part due to lack of practice and training and in part due to the natural tendencies of the individual. Both of these factors can be made matters of test."

"The natural speed with which a person acts, his 'reaction time' can be easily measured and the relative ability of chauffeurs in this respect could be determined," Dr. Dodge explained. "The time that it takes for a signal to reach the eye, be transmitted to the brain, and for the brain to send its order down through the nerves of the arm seems instantaneous, but it can be measured by the reaction time test used in our psychological laboratories every day. A person is seated at a table with his finger on a telegraph key. As soon as he sees a given signal he presses the key. When the signal flashes, the electric current also starts a pointer marking off the fractions of a second upon a dial. When the key is pressed the current is broken and the hand on the dial stops moving. This gives a record of the time it took the person to get and act upon the idea."

"Tests for driving ability," he continued, "should be varied according to the sort of tasks which the drivers are called upon to perform. Tests for drivers of light, pleasure vehicles might be very different from tests for drivers of fast ambulances and fire appliances, and they in turn might be quite different from tests for drivers of heavy motor trucks. High powered fast machines obviously should not be entrusted to poor or relatively untrained chauffeurs. A specific form of test for various types of machines is good common sense and good science.

"In addition to tests for mechanical expertness, knowledge of traffic regulations and automobile limitations should also be required."

Jailing reckless drivers and requiring speeders to view accident victims in the morgue are haphazard methods. Licenses to drive should not be issued to persons with such tendencies to motor manslaughter. It is perfectly possible that the psychologists will be able to work out tests to determine the moral tendencies and regard for common interests of applicants for driver's licenses.

"Careful analysis and expert thoroughgoing experimental investigation of these and other problems involving the mental processes of those who use the highways should be made," Dr. Dodge emphasized. "When there has been a systematic exploration of the human factor in traffic, tests can be standardized.

"It is notorious that tests for drivers in one community are entirely different from tests in other communities. Licenses from different localities are quite incomparable in value. It is obvious that the same ability to drive is not required on a country road as in the city, but if the farmer is to drive into town, he must be able to handle his machine under city traffic conditions or else not be allowed to come in. Standard tests would help remedy this situation.

"Even now we should have a national blacklist for chauffeurs so that those who have forfeited their licenses on account of bad driving in one state can not go over into another state and continue their homicidal practices."

CHRISTMAS TREES OLD IN LEGEND AND EVOLUTION

Science Service

CHRISTMAS trees, as a family, are of the oldest of our trees to-day. For reasons connected with their antiquity, experts of the U. S. Forest Service say that these evergreens have become so popular for Yule-tide decorations that between four and five million trees are consumed in this country every year, while plantations which raise Christmas trees as a farm crop are springing up to help supply the future demand.

These conifers or cone-bearing trees that hold the bright gifts and cheerful tinsel of this religious festival and winter holiday were the earliest of trees, and their direct ancestors were the first flowering plants on earth. They probably originated during a period of rigorous climate and their thin needle-leaves present less surface to cold and exposure than the broad-leaved trees which represent a later stage in plant evolution.

And these needles are probably responsible for the use of the conifers as Christmas trees. They present only a small surface to the effect of evaporation and so enable the tree to retain its moisture and keep green. This greenness added a touch of life to the dullness of winter and made the evergreens popular as decorations. Legends and custom did the rest.

There are many kinds of these evergreens, but the principal ones used for Christmas trees in various parts of the United States are the pines, spruces, firs and cedars. If you do not know what kind of a tree it is that bears your gifts, you can easily tell by looking at the needles on the branches. In the pines, the needles grow in bunches of from one to five needles to the bunch. If the individual needles in these bunches are pressed together they form a complete cylinder. Some kinds of pine have two needles to the bunch, but these two are each half cylinders, while in those having three needle bunches the three needles form a cylinder, and so on.

If the tree is a fir, the needles grow out from the two sides of the stem, while in the spruce the needles grow out in all diretions around the stems. In the cedar, the needles are like little twigs pressed compactly together in a sort of shingle-like formation.

Joy-killers frequently arise and bewail the cutting of these trees for Christmas use as wasteful. But aside from the joy they bring the kiddies, U. S. Forest Service officials believe that properly done the cutting of Christmas trees can really be made a Christmas gift to the forests themselves.

In Maine and the Adirondacks, the principal localities that supply Christmas trees, there are frequently as many as 50,000 to 100,000 seedlings to the acre. Few of these can reach maturity. It is essential for the production of tall, clean timber that there should be at the beginning many trees to the acre, but unless these are thinned out, the poorer trees may hamper the development of the better ones.

Man, by interfering in the struggle and thinning out of all lagging trees, can hasten the growth of the remaining trees. In many localities, this work depends on the possibility of finding a market for the small trees to pay for the cost of the thinning, and the Christmas market solves the problem.

In Michigan, however, the state agricultural station several years ago started raising Christmas trees as a farm crop. They have just issued information telling how this can be done commercially and encouraging farmers to plant for this purpose.

WAITING FOR TREE PLANTERS

New York State College of Forestry

Every home owner in New York State is paying heavy freight on the lumber of which his house is made. Every lessee of an apartment or dwelling is paying in rent large amounts for freight on the lumber used in the construction of the building in which he lives, according to the New York State College of Forestry at Syracuse University. The people of the Empire State—relative figures apply to all the eastern states—are taxed for freight approximately $22 a thousand on yellow pine, $27 on Douglas fir, $12 on North Carolina pine, $12 on white pine, and $20 on imported hardwoods. The freight rate on Douglas fir which comes from the Pacific Coast is more than the lumber costs at the mill.

Thirty-five million dollars are taken from the pockets of the citizens of New York every year for freight on imported lumber. In addition to this freight bill of $35,000,000 on lumber must be added the cost of shipping 55 per cent. of our pulpwood into the state from Canada and other points. The transportation costs are bound to grow as the depletion of the nearest lumber and wood supply continues and the demand increases.

Much of the lumber consumed in the east is shipped from the south. It is estimated that in the course of ten to fifteen years the southern field will be exhausted insofar as outside consumption is concerned. Then Oregon, Washington and California will have a practical monopoly of the lumber business which will bring about materially increased freight charges to eastern consumers.

Measures should be taken to overcome this condition as far as it is now possible. A large portion of the lumber and other wood products used in New York could and should be grown within the state, and forests should be planted wherever land is suitable for that purpose. More than

4,000,000 acres of idle land in New York and about 85,000,000 acres in the United States (a tract about as large as New York, Pennsylvania, Rhode Island, Connecticut and New Jersey) are waiting for tree planters.

THE SPEED OF STARS

Science Service

Two hundred miles a second is the speed at which some stars are racing through space, Dr. Walter S. Adams, acting director of the Mount Wilson Observatory, declared in a lecture at the Carnegie Institution of Washington.

The rapidity with which the stars move depends upon their stage of development, their true or intrinsic brightness and probably their mass. The giant stars are moving more slowly than the dwarf stars and the increase of velocity with decreasing mass is a regular one. But these individual stars, he pointed out, are not moving at random. They move in great streams and the speedway of the heavens is in the plane of the Milky Way.

"None of the rapidly moving stars are going in the same direction as our sun," he said. "The speed of the sun is about twelve miles a second when referred to the slowly moving stars and over one hundred miles a second with reference to the exceptionally speedy stars.

"From a knowledge of the spectrum of stars we have been able in the past to learn both their chemical constitution and order of evolution as regards temperature and physical state, and their motions toward or away from the earth in miles a second. In recent years we have been able to add a third use to which the spectrum may be put, and we can now determine the true or intrinsic brightness of a star directly. This quantity combined with a knowledge of its brightness as it appears to us enables us to determine its distance in a very simple manner."

The method has nearly tripled the number of stars for which we know the distances, Dr. Adams said, and a knowledge of the distances has made it possible to determine the true motions of these stars in space.

FLYING CHEAP TRAVEL

Science Service

If airplanes could get enough business, passengers could be carried much more quickly at little greater cost than by railroad, Archibald Black, aeronautical engineer of Garden City, N. Y., told the American Society of Mechanical Engineers while discussing the proper design for commercial flying machines. "For example, the distance from New York to Chicago by the Pennsylvania Railroad is 908 miles, or a flying distance of from 750 to 800 miles," he said. "Were it possible to load the airplane fully each trip, the operating cost would be 6.5 cents per passenger mile or $48.75 to $52 per passenger. This compares with the railroad rate of $51.30, including fare, excess fare and Pullman. Allowing for the trip to and from the fields, as well as an intermediate stop, the time by air would average about nine hours as against twenty hours by the Pennsylvania Railroad's 'Broadway Limited.' The only reason why airplanes can not carry passengers at such rates to-day is that it costs too much to get the business."

Moderate size machines only, he emphasized, could be efficiently operated at this low cost and the requirement of ability to fly on one of two engines is utterly impractical for commercial airplanes because of the prohibitive cost. The commercial plane should be designed for jumps lasting not over four hours, while high speed is undesirable and high climbing ability unnecessary and impractical for the commercial craft.

A MARVELLOUS ARCHEOLOGICAL DISCOVERY

London Times

The earth holds in her recesses the rich memories of our race, and sometimes, as though the effort of the reflective and inquiring mind of modern man had suddenly flashed forth in a revealing intuition, a discovery comes that lights up the obscurity of the distant past. One such discovery we are privileged to record to-day. Our Cairo correspondent tells us how, after sixteen years of patient toil and research, Lord Carnarvon and that distinguished excavator, Mr. Howard Carter, have been rewarded by a marvelous find in the Valley of the Kings near Thebes. All the mysteries of this famous valley had been disclosed, so it was thought, long since. Mr. Carter, with the pertinacity of the gifted archeologist who scents discoveries from afar, dug on persistently until at last, in the royal necropolis of the Theban empire, he came across some tempting signs below the tomb of Rameses VI. Lord Carnarvon went out from England, and he and Mr. Carter together opened the sealed doors of a hitherto unnoticed chamber. When opened this chamber revealed an amazing spectacle. There were gilt couches, inlaid with ivory and precious stones; innumerable boxes, inlaid and painted with entrancing hunting scenes; a wonderful throne; a chair encrusted with precious stones and

adorned with royal portraits; bituminized statues of a king, chariots, maces, a footstool, alabaster vases, and quantities of trussed duck and haunches of venison, left, according to the ancient custom, as provision for the great dead. Beyond the first chamber lay another chamber crowded with a confusion of gold beds, boxes and alabaster vases, and beyond this, again, lies another chamber which may prove to be the actual tomb of the king whose funeral relics lie in bewildering profusion in the first two rooms. The name of the king who thus emerges in splendor from the dim past into the murky light of our troubled day is Tutankhamen, of the Eighteenth Dynasty, who reigned in Tel-el Amarna and Thebes over three thousand years ago. Little was known of him except that he claimed to be a son of the famous Amenhotep III, and that he married the daughter of that strange Pharaoh Akhenaten, who revolutionized the Egyptian religion by instituting in the worship of the rays of the sun a kind of monotheism, and at the same time promoted a remarkable artistic revival. Of Tutankhamen the chief fact hitherto attested is that in his reign the traditional religion, with its worship of Amen as the principal deity, once more claimed its own. He was, so to speak, the patron of a counter-reformation. Now, thanks to this remarkable discovery, we may perhaps learn more of the circumstances of this strange ebb and flow of religious emotion in the days when mankind was still young. And though the world is old now and restless still, with the craving for power and for a knowledge of great mysteries, even now when the eastern lands are trembling between war and peace and a Europe undreamed of by the Pharaohs is wrestling with problems that would have been stranger to them than all their weird panoply is to us, that figure of the ancient king who thus suddenly steps out from oblivion has a permanent significance. On his footstool are figures symbolizing his lordship over Syria, and the peoples of Ethiopia owned his sway. Around him are the confused tokens of a reversion from a groping after new spiritual ideas to the comfortable forms of an ancient ritual.

PRELIMINARY TRANS-ATLANTIC RADIO AMATEUR TESTS SUCCESSFUL

Science Service

MESSAGES broadcasted by amateur radio stations in preliminary trans-Atlantic tests just completed were received across the water in England, reports from that country say.

For ten days on predetermined schedules, amateur radio enthusiasts in all parts of Canada and the United States competed in order to qualify for a special place in the final trans-Atlantic tests that will be held between December 12 and 31. To qualify they had to be heard by a station at least 1,200 air miles away. Indications are that many will compete in the final tests.

The way in which the amateurs in the different radio districts kept within their allotted times was gratifying, according to officials of the American Radio Relay League who are managing the tests.

At least 20,000 radio amateurs are competing in these tests, it is estimated.

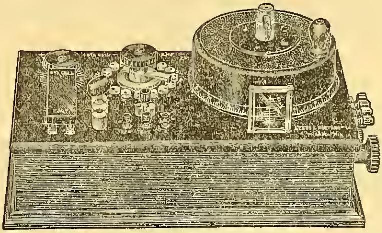
ITEMS

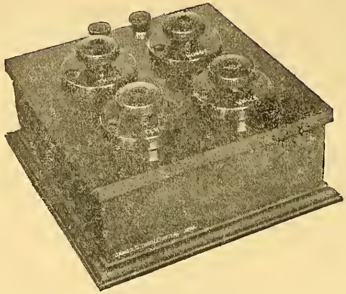
Science Service

WORDS from a language which flourished centuries before Columbus are being used for names of varieties of the fruit, avocado or "alligator-pear," which is relatively new to this country. The U. S. Department of Agriculture has introduced Mayan names along with this salad-making fruit that its experts have brought from Guatemala, where centuries ago an ancient civilization flourished. Some folks seeing certain kinds of "alligator pears" taged "Itzamna," "Lamat," "Hunapuh," "Kayab," "Mayapan" and others equally strange, may have thought that the government has enlisted the services of the namer of Pullman cars. It has just been explained by the department that these names are taken from the Maya who built up in what are now the wilds of Guatemala great cities and a powerful agricultural civilization hundreds of years before Columbus ever left the old world. The avocado called "Itzama" is named after the chief Mayan god, the creator of mankind and the father of all the other gods. Such names as "Lamat" and "Hunapuh" designated days in the wonderful calendar of these ancient people who had invented a system of chronology more accurate than the time systems of the Europeans of their time. "Mayapan," the name given to another variety of this salad fruit, was one of the important cities of this people. It means "place where there are Mayas."

THE *Santa Maria*, a commercial flying boat of the Aeromarine Company of New York, has flown 45,000 miles.

AIRPLANES are carrying mail in Morocco over a route formerly covered only by means of camels and donkeys.





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In the Resistance Boxes each dial controls 9 *coils* of like value—which plan eliminates "kicks" in a telephone receiver or galvanometer when the switch is being rotated.

The Wheatstone Bridge includes four sets of coils, 9 x (1+10+100+1000 ohms), and the bridge coils have a dial control which multiplies by .001, .01, 0.1, 1, 10, 100 or 1000 —thus simplifying construction and operation as compared with two separate "arms."

Write for illustrated descriptive Bulletin S-1000.

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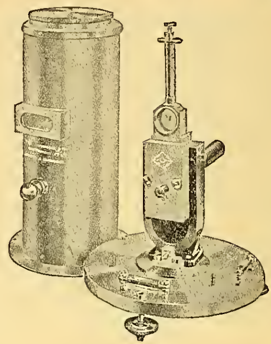

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